

Disordered eating attitudes and behaviours among female patients
undergoing fertility treatment:
Implications for preconception care

Iolanda Rodino
BSc (Hons) MPsych (Clinical)



This thesis is presented for the degree of Doctor of Philosophy of
The University of Western Australia
School of Human Sciences, School of Psychological Science
2019

DEDICATION

This thesis is dedicated to the memory of my parents

Angela and Antonio Rodino

“Family is important”

THESIS DECLARATION

I, Iolanda Rodino, certify that:

This thesis has been substantially accomplished during enrolment in the degree.

This thesis does not contain material which has been submitted for the award of any other degree or diploma in my name, in any university or other tertiary institution.

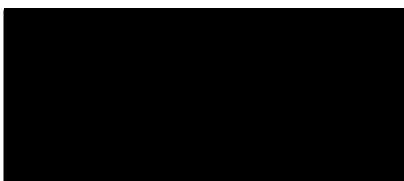
No part of this work will, in the future, be used in a submission in my name, for any other degree or diploma in any university or other tertiary institution without the prior approval of The University of Western Australia and where applicable, any partner institution responsible for the joint-award of this degree.

This thesis does not contain any material previously published or written by another person, except where due reference has been made in the text and, where relevant, in the Declaration that follows.

The work(s) are not in any way a violation or infringement of any copyright, trademark, patent, or other rights whatsoever of any person.

The research involving human data reported in this thesis was assessed and approved by The University of Western Australia Human Research Ethics Committee (Approvals RA/4/1/4642; RA/4/6552) and by the Human Research Ethics Committee of Joondalup Health Campus and Hollywood Private Hospital, respectively responsible for managing ethics applications for the participating fertility clinics (Approvals: JH1111; HPH334).

This thesis contains published work and/or work prepared for publication, some of which has been co-authored.



Iolanda Rodino

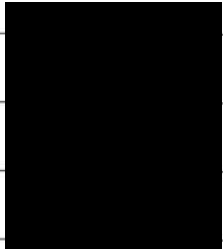
3rd August 2018

AUTHORSHIP DECLARATION: CO-AUTHORED PUBLICATIONS

This thesis contains published work which has been co-authored with the Candidate's co-supervisors, Dr Katherine Sanders, Dr Susan Byrne and Dr Gilles Gignac. The Candidate played a significant role in all aspects of the studies reported within this thesis. This included the conceptualization of each study, research design and development, participant recruitment, data entry, data analysis and the preparation and revision of thesis chapters and published manuscripts. The first draft of all publications listed in this thesis was written by the Candidate with revisions made in accordance with suggestions from her supervisors. The bibliographical details of the peer-reviewed published articles and where they appear in the thesis are outlined below.


Study One (Chapter 4)

Rodino, I.S., Byrne, S. & Sanders, K.A. 2016. Disordered eating attitudes and exercise in women undergoing fertility treatment. *Australian and New Zealand Journal of Obstetrics and Gynaecology*, 56, 82-87.

Author	Contribution	Initials
Ms Iolanda Rodino	80 %	
Dr Susan Byrne	5 %	
Dr Katherine Sanders	15 %	


Study Two (Chapter 5)

Rodino, I.S., Byrne, S. & Sanders, K.A. 2016. Obesity and psychological wellbeing in patients undergoing fertility treatment. *Reproductive Biomedicine Online*, 32, 104-112.

Author	Contribution	Initials
Ms Iolanda Rodino	80 %	
Dr Susan Byrne	5 %	
Dr Katherine Sanders	15 %	

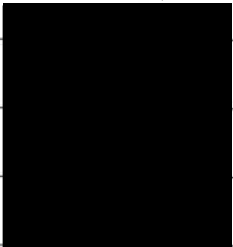
Study Three (Chapter 6)

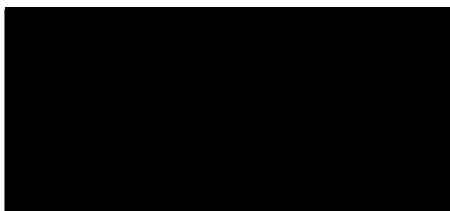
Rodino, I.S., Gignac, G.E., & Sanders, K.A. 2018. Stress has a direct and indirect effect on eating pathology in infertile women: Avoidant coping style as a mediator. *Reproductive Biomedicine and Society Online*, 5, 110-118.

Author	Contribution	Initials
Ms Iolanda Rodino	80 %	
Dr Gilles Gignac	10 %	
Dr Katherine Sanders	10 %	

Study Four (Chapter 7)

Rodino, I.S., Byrne, S.M., & Sanders, K.A. 2017. Eating disorders in the context of preconception care: Fertility specialists' knowledge, attitudes, and clinical practices. *Fertility and Sterility*, 107, 494-501.

Author	Contribution	Initials
Ms Iolanda Rodino	80 %	
Dr Susan Byrne	5 %	
Dr Katherine Sanders	15 %	



Iolanda Rodino, PhD Candidate

3rd August 2018

Declaration for thesis containing published work

I, Dr Katherine Sanders certify that the student statements regarding their contribution to each of the works listed above are correct.

All authors acknowledge the contribution of each paper for this thesis and approve this work for submission of the degree of Doctor of Philosophy.

Signed:  Date: 31/07/2018

Dr Katherine Sanders, Principal Co-Ordinating Supervisor,
School of Health Sciences

Signed:  Date: 31/07/2018

Dr Susan Byrne, Co-Supervisor,
School of Psychological Science

Signed:  Date: 31/07/2018

Dr Gilles Giguac, Co-Supervisor,
School of Psychological Science

REGIONAL SCIENTIFIC CONFERENCE ORAL PRESENTATIONS

Rodino IS, Byrne S, Sanders KA. Disordered eating attitudes and behaviours in women undergoing fertility treatment. Oral presentation, Fertility Society of Australia Annual Scientific Meeting, Sydney, September 2013.

Rodino IS, Byrne S, Sanders KA. Obesity has limited psychological impact in women undergoing fertility treatment. Oral presentation, ASPIRE – The 5th Congress of the Asia Pacific Initiative on Reproduction in conjunction with the Fertility Society of Australia Annual Scientific Meeting, Brisbane, April 2014.

Rodino IS, Byrne S, Sanders KA. Fertility specialists' knowledge about eating disorders. Oral presentation, Fertility Society of Australia Annual Scientific Meeting, Perth, September 2016.

Rodino IS. Eating disorders and Infertility. Invited Psychosocial Speaker, Fertility Society Australia Annual Scientific Meeting, Adelaide, October 2017.

ABSTRACT

Research Background and Aims

Infertility is commonly defined as the inability to conceive following 12 months of regular unprotected intercourse. Contributors to infertility are multifactorial although clinical and research focus has increasingly been on lifestyle factors that are modifiable, particularly weight status. Weight status, as gauged by body mass index (BMI), can be directly influenced by disordered eating attitudes and weight control behaviours and thus in the context of infertility, is important to explore.

Currently there is no shortage of empirical literature investigating the topics of prevalence, psychological correlates and predictive risk factors for eating pathology as they occur in relation to the general community or university populations. However, there is a paucity of research that explicitly considers each of these issues in the context of an infertile population. This thesis contains four inter-related studies conceptualized to address each of these limited research areas.

Study One of this thesis aimed to investigate the presence of disordered eating attitudes and weight control behaviours in a large Australian sample of women attending a fertility clinic. *Study Two* aimed to determine whether commonly reported psychological correlates associated with eating pathology varied according to participant weight status (normal, overweight or obese) and to identify predictors of obesity-specific distress in infertile women. An evaluation of mood according to infertility diagnosis (polycystic ovary syndrome [PCOS] versus non-PCOS) was further evaluated. Next, as stress precipitates negative lifestyle behaviours and a diagnosis of infertility is widely known to be stressful, *Study Three* aimed to examine the relationship between levels of perceived stress, avoidant coping style and disordered eating attitudes and behaviours in infertile women. Finally, with a focus on mental health literacy, *Study Four* aimed to investigate fertility doctor knowledge and clinical practices with respect to eating pathology.

Methodology

Using cross-sectional designs, two independent projects were conducted to achieve the aforementioned aims. Project One from which *Studies One, Two* and *Three* were operationalised, involved participant recruitment from three fertility clinics located in the metropolitan region of Perth,

Western Australia. Participants anonymously completed a battery of questionnaires, self-reporting on anthropometric indices and psychometrically validated psychological measures. This recruitment strategy resulted in an overall sample of 429 infertile participants. From this cohort, *Study One* utilised the data of relevant questionnaire responses from 385 participants for analyses, *Study Two* utilised the specific questionnaires of 403 participants, and *Study Three* utilised questionnaire responses from 416 participants.

Project Two, from which *Study Four* was derived, consisted of an online survey gauging Australian and New Zealand fertility specialists' ($n = 80$) diagnostic knowledge, attitudes and clinical practices regarding eating disorders. Views on doctor training needs were also assessed.

Synopsis of Central Findings

In contrast to previous studies that report rates of eating disorders in women attending a fertility clinic as exceeding community prevalence rates, *Study One* showed the frequency of an eating disorder in the study sample (6.8%) was comparable to the Australian population rate (7.7%). Consistent with prior studies most women (77%) who had experienced a history of an eating disorder did not disclose this information to their fertility doctor. Profile analysis further revealed that although women with ovulatory disorders did not differ from women with PCOS ($p = .855$), they exhibited significantly higher levels of disordered eating attitudes when compared to women with other types of infertility; male factor ($p = .046$), unexplained infertility ($p = .047$) and heterogeneous causations infertility group ($p = .017$). Moreover, women with any form of ovulatory disorder including PCOS, had a higher risk of engagement in compulsive, driven exercise compared to other infertile counterparts (OR 6.98, CI = 1.39, 34.90, $p = .018$), but did not differ on quantity of exercise endorsed ($p = .625$).

In *Study Two*, independent of infertility diagnosis, between group comparisons demonstrated that obese infertile women differed from normal and overweight counterparts on psychological symptoms of body shape concerns, low self-esteem and binge eating (all $p < .001$), a triad of psychological symptoms associated with eating pathology. Within group analyses showed that for obese women, psychological predictors for body shape concerns were higher perfectionism ($p < .001$) and a trend towards lower self-esteem ($p = .051$). Relatedly, higher self-esteem was predicted by

higher levels of positive affect ($p < .001$), lower levels of negative affect ($p < .001$) and reduced concerns about body image ($p < .009$). *Study Two* further revealed that contrary to other studies on PCOS, infertile women with PCOS did not differ from non-PCOS women on a broad array of psychological variables (depression, stress, infertility specific distress, perfectionism, negative affect and self-esteem) when the confound BMI was controlled (all $p > .05$). Higher levels of anxiety ($p = .002$) and body shape concerns ($p = .002$) in women with PCOS, however, were observed.

Using structural equation modelling, *Study Three* revealed that perceived stress had a direct effect on maladaptive eating behaviours ($\beta = .21$; $p = 0.005$) as did avoidant coping style ($\beta = .21$; $p = 0.019$). A partial mediation effect was observed ($\beta = .14$; $p = 0.018$) affirming that for women undergoing fertility treatment, avoidant coping style partially mediated the relationship between their level of perceived stress and eating pathology.

Study Four showed that fertility doctors had gaps in their diagnostic knowledge relating to anorexia nervosa, bulimia nervosa and binge eating disorder on diagnostic criteria relating to body mass index, menstrual aberrations and weight control behaviours. Knowledge differences did not vary according to doctor gender ($p = .14$) or level of fertility specialist clinical experience ($p = .98$). Whilst 83.7% of doctors reported it important to screen for eating disorders, only 35% of doctors reported routinely doing so when carrying out patient preconception assessments. Most doctors (96.2%) reported a need for further education, training and clinical guidelines on this topic.

Conclusions

Eating disorders and infertility are important areas of public health concerns in women of child bearing years. Whilst the reported prevalence rate of eating pathology in this study's sample of infertile women was comparable to community lifetime rates, non-disclosure of history of eating pathology remains a concern. Infertile women with forms of ovulatory disorders, PCOS and obesity do present with psychological vulnerability relating to eating pathology. Collectively the results highlight the important clinical considerations of integrating routine screening and adjunct mental health services for eating pathology in preconception care. Finally, having implications not only for outcomes relating to infertility, but longitudinally with respect to pregnancy and birth outcomes, the

findings of this thesis support the need for increased professional training for fertility health care providers in this area of clinical concern.

ACKNOWLEDGEMENTS

First, I extend my gratitude to my principal supervisor *Dr Kathy Sanders* for her pivotal role in all aspects of this thesis. Thank you for your scholarly guidance on the area of human fertility, your encouragement to develop my research ideas and for astute feedback on thesis and manuscript drafts. I also thank you for being instrumental to introducing me to the field of infertility research.

A sincere thank you is expressed to my co-supervisors, *Dr Susan Byrne and Dr Gilles Gignac*. *Dr Byrne* provided expert knowledge on information relating to eating disorders in the formative stages of this research. *Dr Gignac's* statistical expertise was paramount in *Study Three* and his critical review of this thesis, guidance and timely encouragement were much appreciated.

I am indebted to the *study participants* (clinic patients and Australian and New Zealand fertility specialists). Without your participation, this thesis could not have been completed.

To the nurses at *Concept Fertility Centre, Hollywood Fertility Centre* and *Fertility North* who assisted with patient recruitment for Project One, thank you for your enthusiasm.

Gratitude is expressed to *Professor Roger Hart* and *Ms Kim O'Dea* for their assistance with the recruitment of fertility specialists who participated in Project Two.

To *Dr Peter Burton*, thank you for your encouragement, support and confidence in my aspirations as a researcher.

To *Dr Joanne Edmondston*, thank you for proof reading a draft of this thesis and for your guidance on the administrative processes associated with thesis submission.

This research was supported by an *Australian Government Research Training Program Scholarship* (Australian Postgraduate Award).

To my sisters *Rose* and *Mary*, your support and heartfelt words of encouragement were invaluable.

Lastly, and most importantly, I acknowledge and thank my husband *Doug Robb* and our children, *Consuela, Emerson, Petrie* and *Mason*. The magnitude of a PhD endeavour can only fully be appreciated by those who have accommodated the extensive study demands associated with the PhD process. The completion of this thesis has been a family effort and without their love, patience and confidence in me to complete this thesis, accomplishing this goal would not have been possible.

TABLE OF CONTENTS

THESIS DECLARATION	iii
AUTHORSHIP DECLARATION: CO-AUTHORED PUBLICATIONS.....	iv
REGIONAL SCIENTIFIC CONFERENCE ORAL PRESENTATIONS	vii
ABSTRACT	viii
ACKNOWLEDGEMENTS	xii
TABLE OF CONTENTS	xiii
LIST OF TABLES	xix
LIST OF FIGURES.....	xx
LIST OF ABBREVIATIONS	xxi
CHAPTER 1.....	1
INTRODUCTION.....	1
1.1 FOREWORD	2
1.2 General Introduction.....	3
1.2.1 The Impact of Infertility	3
1.2.2 Definitions of Infertility	3
1.2.3 Prevalence of Infertility.....	4
1.2.4 Common Causes of Infertility	5
1.2.5 Medical Interventions for Infertility.....	6
1.3 Importance of Lifestyle Factors and Preconception Care	8
1.3.1 Human Ovulatory Cycle.....	9
1.3.2 Effects of Body Mass Index (BMI) on Reproductive Functioning	10
1.3.3 Neuroendocrine Mechanisms Underlying Weight Regulation and Reproduction	12

1.3.4	Evolutionary Perspectives on the Role of Energy Balance in Female Reproductive Functioning.....	14
1.4	Eating Disorders and Reproductive Health.....	17
1.4.1	Diagnostic Categories Associated with Eating Disorders.....	18
1.4.2	Types of Eating Disorders influencing Menstrual Functioning.....	19
1.4.3	Prevalence of Eating Disorders.....	21
CHAPTER 2.....		23
LITERATURE REVIEW.....		23
2.1	FOREWORD.....	24
2.2	Prevalence of Eating Disorders in Women Undergoing Fertility Treatment.....	25
2.3	Psychological Correlates Impacting on Infertility and Eating Pathology.....	32
2.3.1	Psychological Correlates Associated with Eating Pathology.....	33
2.3.2	Elevated BMI, Physical and Mental Health.....	34
2.3.3	Obesity, PCOS and Mental Health.....	35
2.4	Understanding the Manifestations of the Stress Response and Coping Style.....	39
2.4.1	Transactional Model of Stress and Coping.....	41
2.4.2	Infertility, Perceived Stress and Avoidant Coping Style.....	42
2.4.3	Perceived Stress, Eating Pathology and Avoidant Coping Style.....	45
2.4.4	Integrated Perspective: Perceived Stress, Coping Style, Eating Pathology and Infertile Women.....	48
2.5	Challenges for Fertility Specialist Providers (Mental Health Literacy).....	49
2.6	Significance and Original Contributions of Thesis.....	52
2.6.1	Study Objectives.....	54

2.6.2 Thesis Organization and Structure	55
CHAPTER 3.....	56
MATERIALS AND METHODS	56
3.1 FOREWORD	57
3.2 Project One (<i>Studies One to Three</i>).....	58
3.2.1 Participants	58
3.2.2 Measures.....	59
3.2.2.1 Demographics Questionnaire	59
3.2.2.2 Eating Disorder Examination – Questionnaire (EDE- Q - Fairburn & Beglin, 2008).....	60
3.2.2.3 International Physical Activity Questionnaire (IPAQ – Craig et al., 2003)	61
3.2.2.4 Rosenberg Self-Esteem Scale (RSES - Rosenberg, 1965)	63
3.2.2.5 Depression, Anxiety and Stress Scale (DASS-21 – Lovibond & Lovibond, 1995).....	63
3.2.2.6 Positive and Negative Affect Schedule (PANAS; Watson, Clark & Tellegen, 1988)	64
3.2.2.7 Fertility Problem Inventory (FPI – Newton, Sherrard & Glavac, 1999).....	65
3.2.2.8 Clinical Perfectionism Questionnaire (CPQ - Fairburn, Cooper & Shafran, 2003b).	66
3.2.2.9 The Brief Coping with Problems Experienced (Brief COPE - Carver, 1997).....	66
3.2.2.10 Perceived Stress Scale (PSS - Cohen, Kamarck & Mermelstein, 1983)	67
3.2.3 Procedure - Project One (<i>Studies One to Three</i>)	68
3.3 Project Two (<i>Study Four</i>).....	69
3.3.1 Participants	69
3.3.2 Online Doctor Survey.....	69
3.3.3 Procedure.....	70
3.4 Data Management and Analyses (<i>Studies One to Four</i>)	70
CHAPTER 4 - STUDY ONE.....	73
Disordered Eating Attitudes and Exercise in Women Undergoing Fertility Treatment.....	73
4.1 FOREWORD	74

CHAPTER 5 - STUDY TWO	81
Obesity and Psychological Wellbeing in Patients Undergoing Fertility Treatment.....	81
5.1 FOREWORD	82
CHAPTER 6 - STUDY THREE	92
Stress has a Direct and Indirect Effect on Eating Pathology in Infertile Women: Avoidant Coping Style as a Mediator	92
6.1 FOREWORD	93
CHAPTER 7 - STUDY FOUR	103
Eating Disorders in the Context of Preconception Care: Fertility Specialists' Knowledge, Attitudes, and Clinical Practices	103
7.1 FOREWORD	104
CHAPTER 8.....	113
GENERAL DISCUSSION.....	113
8.1 FOREWORD	114
8.2 STUDY ONE: Disordered Eating Attitudes and Exercise in Women Undergoing Fertility Treatment	115
8.2.1 Eating Disorders Prevalence and Disclosure Issues	115
8.2.2 Presence of Obligatory Exercise in Women with Ovulatory Disorders	117
8.3 STUDY TWO: Obesity and Psychological Wellbeing in Patients Undergoing Fertility Treatment	119
8.3.1 Psychological Wellbeing in Obese Infertile Women	119
8.3.2 Psychological Risk Factors for Obese Infertile Women	122
8.3.3 Psychological Health in Women with PCOS	123

8.4	STUDY THREE: Stress has a Direct and Indirect Effect on Eating Pathology in Infertile Women: Avoidant Coping Style as a Mediator.....	124
8.5	STUDY FOUR: Eating Disorders in the Context of Preconception Care: Fertility Specialists' Knowledge, Attitudes, and Clinical Practices	128
8.6	Clinical Implications and Recommendations for Preconception Care.....	131
8.6.1	Sound Knowledge Base and Training	131
8.6.2	Routine Screening	132
8.6.3	Clinical Interpretations of BMI	132
8.6.4	Patient Psycho-Education about Diet and Exercise.....	133
8.6.5	Stress Management and Evidenced Based Interventions	134
8.6.6	Collaboration and Referral to Specialist Multi-Disciplinary Eating Disorder Programmes.....	135
8.7	Strengths and Limitations.....	135
8.8	Directions for Future Research.....	137
8.9	Concluding Remarks	139
	REFERENCES.....	141
	APPENDIX A – Project One	179
	COVER PAGE.....	180
	Participant Information Sheet.....	181
	SURVEY A - Demographics.....	183
	SURVEY B – EDE-Q	187
	SURVEY C - IPAQ.....	190
	SURVEY D - RSES	192
	SURVEY E – DASS-21	193

SURVEY F - PANAS	195
SURVEY G - FPI	196
SURVEY H - CPQ	199
SURVEY I – Brief COPE	200
SURVEY J - PSS	202
Psychosocial Factors and Fertility: Debriefing Sheet	204
APPENDIX B – Human Research Ethics Approvals.....	205
APPENDIX C – Project Two.....	211
Participant Information Sheet.....	211
Fertility Specialist Online Survey	213
APPENDIX D: The SCOFF questionnaire	218

LIST OF TABLES

Chapter 3

Table 1	An overview of final sample sizes, measures, diagnostic groups and statistical analyses for <i>Studies One to Four</i>72
---------	--

Chapter 4

Table 1	Comparison of demographic characteristics by infertility category77
---------	---

Chapter 5

Table 1	Sociodemographic and treatment characteristics of the participants (total $n = 403$)...86
Table 2	Mean scores and standard deviations on psychological test variables according to body mass index category and polycystic ovary syndrome status (total $n = 403$).....87
Table 3	Psychological variables associated with shape concern and self-esteem in obese women adjusting for polycystic ovary syndrome status ($n = 73$).....88

Chapter 6

Table 1	Pearson product moment correlations, means and standard deviations ($n = 416$)98
---------	--

Chapter 7

Table 1	Demographic characteristics of respondents (total $n = 80$)107
Table 2	Fertility specialists' knowledge of diagnostic criteria for eating disorder categories ($n = 80$)108
Table 3	Fertility specialists' attitudes to clinical practice regarding eating disorders ($n = 80$)109

LIST OF FIGURES

Chapter 1

Figure 1	The partitioning of food (i.e. metabolic fuels) according to cellular priority.....	14
Figure 2	The positive energy balance paradox whereby in modern-day societies of chronic overfeeding and low physical activity, women with genetic vulnerability (e.g. PCOS) experience pathophysiological consequences of hyperandrogenism, insulin resistance and menstrual disturbance.....	16
Figure 3	Key physiological changes following increases in level of cortisol and links between nutrition and reproduction.	40

Chapter 3

Figure 1	Sample calculation of Total METS.....	62
----------	---------------------------------------	----

Chapter 4

Figure 1	Estimated marginal mean score for each Eating Disorder Examination Questionnaire subscale stratified by infertility category.....	78
----------	---	----

Chapter 6

Figure 1	Schematic representation of proposed model relationships between perceived stress, mediator avoidant coping style and eating pathology (disordered eating attitudes and behaviours)	97
Figure 2a	Base model establishing the standardized total effect between perceived stress and eating pathology ($n = 416$)	99
Figure 2b	Demonstrating path relationships between perceived stress and eating pathology once avoidant coping style has been included as an intermediary variable	99

Chapter 7

Figure 1	Percentage of fertility specialists indicating use of specific clinical practice strategies, availability of clinical guidelines, and training needs relating to eating disorders ($n=80$)	109
----------	--	-----

LIST OF ABBREVIATIONS

ACTH	adrenocorticotrophic hormone
AMOS	analysis of moment structures
AN	anorexia nervosa
ANOVA	analysis of variance
APA	American Psychiatric Association
ARFID	avoidant restrictive food intake disorder
ART	assisted reproductive technology
BED	binge eating disorder
BITE	Bulimia Investigation Test, Edinburgh
BMI	body mass index
BN	bulimia nervosa
CI	confidence interval
COPE	Coping with Problems Experienced
CPQ	Clinical Perfectionism Questionnaire
CREI	Certificate of Reproductive Endocrinology and Infertility
CRH	corticotropin releasing hormone
DASS-21	Depression, Anxiety and Stress Scale-21 items
DEB	disordered eating behaviours
DOHaD	developmental origins of health and disease
DSM-III-R	Diagnostic and Statistical Manual of Mental Disorders – Revised, 3 rd edition
DSM-IV-TR	Diagnostic and Statistical Manual of Mental Disorders – Text Revision, 4 th edition
DSM-5	Diagnostic and Statistical Manual of Mental Disorders – 5 th edition
EAT	Eating Attitudes Test
EDE	Eating Disorder Examination
EDE-Q	Eating Disorder Examination-Questionnaire
EDI	Eating Disorder Inventory
EDNOS	eating disorder not otherwise specified

FHA	functional hypothalamic amenorrhea
FPI	Fertility Problem Inventory
FSA	Fertility Society of Australia
FSH	follicle stimulating hormone
GHQ	General Health Questionnaire
GnRH	gonadotropin releasing hormone
HPA	hypothalamic-pituitary-adrenal
HPO	hypothalamic-pituitary-ovarian
HREC	Human Research Ethics Committee
ICD-10	International Statistical Classification of Diseases – 10 th edition
ICSI	intracytoplasmic sperm injection
IBW	ideal body weight
IPAQ	International Physical Activity Questionnaire
IUI	intrauterine insemination
IVF	in vitro fertilization
LBW	low birth weight
LH	luteinizing hormone
LHT	life history theory
LSD	least significant differences
MANOVA	multivariate analysis of variance
MAR	medically assisted reproduction
MET	metabolic equivalent of task
MHL	mental health literacy
NA	negative affect
NICE	National Institute for Health and Clinical Excellence (UK)
OI	ovulation induction
OR	odds ratio
OSFED	other specified feeding and eating disorder

PA	positive affect
PANAS	Positive and Negative Affect Schedule
PCO	polycystic ovary
PCOS	polycystic ovary syndrome
PSS	Perceived Stress Scale
QOL ED	quality of life relating to eating disorder
RANZCOG	Royal Australian and New Zealand College of Obstetricians and Gynaecologists
RANZCP	Royal Australian and New Zealand College of Psychiatrists
RSES	Rosenberg Self Esteem Scale
SCID	Structured Clinical Interview for DSM-IV Axis I Disorders
SCOFF	sick, control, one stone, fat, food – reflecting elements of a 5-item questionnaire
SD	standard deviation
SE	standard error
SEM	structural equation modelling
SPSS	Statistical package for social sciences
TI	timed intercourse
UFED	unspecified feeding and eating disorder
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 FOREWORD

Impaired fertility stems from a heterogeneous group of underlying factors including modifiable lifestyle factors. The primary goal of preconception care, that is, health care before conception occurs, is to identify and optimize those physical and psychosocial factors that may affect a woman's capacity to conceive and to gestate a pregnancy successfully to term. Disordered eating attitudes and weight control behaviours are factors within preconception care that are understudied in the field of infertility and represent the focus of investigation for this thesis.

Chapter 1 provides a general overview of the relationship between female infertility and eating pathology, as broadly viewed from the frameworks of preconception care and evolutionary perspectives of reproduction. It commences with a discussion of infertility including definitions, prevalence, contributing factors to infertility and medical interventions used for the treatment of infertility. The chapter proceeds with a discussion of the interconnection between body mass index (BMI) and reproductive health and concludes with a discussion of diagnostic categories of eating disorders as they potentially relate to BMI and female reproductive health.

1.2 General Introduction

1.2.1 The Impact of Infertility

For many women in childbearing years, having children is both a natural and uncomplicated process with the desire to procreate linked to cultural identity, personal aspirations and cultural norms (Pedro & Andipatin, 2014; Inhorn & Patrizio, 2015). Studies have shown that the desire to have children is strong not only for women but also men, with the majority of individuals contemplating having children viewing it to be a major life goal (Lampic et al., 2006; Peterson et al., 2009; Greil et al., 2010; Hammarberg et al., 2017). Consequently, when delays to conception occur and family creation necessitates the use of assisted reproductive technology (ART), the struggle to conceive can be associated with widespread emotional, relationship and social challenges (Cousineau & Domar, 2007; Verhaak et al., 2007; Schmidt, 2009; Greil et al., 2010; Schweiger et al., 2018).

Research indicates that infertile couples are at greater risk of poorer psychological wellbeing, poorer quality of life and lower marital and sexual satisfaction than fertile couples and that for some individuals, mental health concerns do not always improve post fertility treatment. This occurs particularly in cases where there remains involuntary childlessness (Daniluk, 2001; Kowalcek et al., 2001; Cousineau & Domar, 2007). Other studies highlight cultural complexities suggesting that infertility poses challenges to a person's perception of self-worth, having a profound influence on sociocultural standing (Zegers-Hochschild et al., 2009; Inhorn & Patrizio, 2015). Collectively then, given the wide-ranging repercussions, it is unsurprising that the inability to conceive and the failure of reproductive efforts impacts both men and women, influencing psychological and health-related quality of life (Lykeridou et al., 2009; Schmidt, 2009; Chachamovich et al., 2010; Schweiger et al., 2018; Zurlo et al., 2018).

1.2.2 Definitions of Infertility

Diverse nomenclature is used within the clinical and research literature to define infertility. Clinically, infertility is most frequently defined as the failure to achieve a pregnancy after 12 or more months of regular unprotected intercourse (Zegers-Hochschild et al., 2017). The term subfertility

refers to any form of reduced fertility or variance in delayed time to conception beyond a 12-month time frame. In the clinical literature, fecundity is often used synonymously with the term fertility and is operationally defined as the probability of pregnancy within any one menstrual cycle (Evers, 2002; Habbema et al., 2004; Gnoth et al., 2005). Other researchers favour definitions of infertility that incorporate the notion of “live-birth” (Larsen, 2005), a definition that is most likely to be of central importance to those patients who endeavour to conceive.

1.2.3 Prevalence of Infertility

Epidemiological data show that infertility represents a significant public health concern (Lemoine & Ravitsky, 2013). Boivin et al. (2007) in a systematic review of 16 population surveys reported a 12-month point prevalence rate for infertility for women aged 20 to 44 years ranging from 3.5% to 16.7% (median of 9%), with a lifetime prevalence ranging between 6.6% to 26.4%. These figures, however, are representative of industrialized nations and may be quite different to those of developing countries where rates of infertility are high (Mascarenhas et al., 2012; Pedro & Andipan, 2014; Inhorn & Patrizio, 2015). For instance, in a systematic analysis of 277 health surveys, Mascarenhas et al. (2012) reported infertility prevalence to be highest in South Asia, Sub-Saharan Africa, North Africa, Central and Eastern Europe and Central Asia, with figures ranging up to 30%, where access to reproductive health medical resources are limited. Ultimately, however, the true prevalence of infertility in countries is difficult to determine owing to differences in definitions of infertility endorsed, individual and cultural reporting practices and presence or absence of registers.

The National Perinatal Epidemiological Statistical Unit, a unit of the Australian Institute of Health and Welfare, maintains a registry recording the details of all ART treatment cycles and pregnancy outcomes for licenced fertility clinics located in Australia and New Zealand. The most recent data reveals that approximately one in six Australian couples experience difficulties with infertility (Harris et al., 2016). In 2014 there were 73,598 ART treatment cycles reported from Australian and New Zealand clinics (67,707 and 5,891 cycles, respectively), representing a 2.4% increase in Australia and 9.6% increase in New Zealand since 2013 (Harris et al., 2016). Thus, the

prevalence of infertility is a matter of growing public health concern with consideration of the factors influencing fertility status warranting exploration.

1.2.4 Common Causes of Infertility

The pathophysiological determinants of infertility stem from a heterogeneous group of underlying factors and can include male, female or a combination of male and female factors. Male factor infertility can be influenced by genetic/chromosomal and lifestyle factors affecting sperm production (e.g. inadequate sperm production, sperm motility, sperm defects) or may be due to abnormalities of the sperm transport system (e.g. blocked/absent vas deferens) (Krausz, 2011; Katz et al., 2017). Common factors impairing female reproductive potential include endocrine disorders influencing ovarian function, anatomical abnormalities affecting transport of gametes or implantation of the embryo (e.g. tubal disease, uterine abnormalities, endometriosis), chromosomal abnormalities and immune system disorders (Adamson & Baker, 2003; Speroff & Fritz, 2005; Unuane et al., 2011). The term combined factor infertility is used in those diagnostic situations where both male and female factors contribute to a couple's infertility. Cases where the cause of infertility is unknown are referred to as unexplained infertility, that is, a full infertility evaluation of the couple having failed to yield a definitive cause of their inability to conceive (Evers, 2002; Adamson & Baker, 2003; Speroff & Fritz, 2005). According to Harris et al. (2016), of ART treatment cycles initiated within Australia and New Zealand, 30.8% of patients were reported to experience female only infertility factors, 19.7% male only infertility factors, 12.5% combined male-female factors and 22.3% unexplained infertility. A further 14.7% of women did not have a primary cause stipulated for their infertility.

Women with ovulatory disorders represent the most common category of female factor infertility (Adamson & Baker, 2003; ESHRE Capri Workshop Group, 2012). Ovulatory disorders can be categorized as either anovulatory (absent ovulation) or oligo-ovulations (infrequent ovulation) (Adamson & Baker, 2003; ESHRE Capri Workshop Group, 2012). Polycystic ovary syndrome (PCOS) affecting anywhere between 5-15% of women worldwide is the most common form of ovulatory disorder diagnosed in women embarking on fertility treatment (Adamson & Baker, 2003; Azziz, 2016). Other diagnoses relating to ovarian dysfunction include functional hypothalamic

amenorrhea, hyperprolactinemia and diminished ovarian reserve due to premature ovarian failure or advanced maternal age (Barbieri, 2002; Adamson & Baker, 2003; Speroff & Fritz, 2005).

Contributory non-modifiable factors to ovulatory disorders include genetic pre-dispositions, immune problems and current maternal age. Modifiable determinants of ovulatory disorders involve neuroendocrine disturbances emanating from lifestyle factors such as smoking (Dechanet et al., 2011), excessive physical activity (De Souza & Williams, 2004; Loucks, 2007b; Hakimi & Cameron, 2017), extremes of weight status (i.e. body mass index), stress and eating pathology (Abraham, 2003; Loucks & Thuma, 2003; Berga & Loucks, 2006; Abraham et al., 2007; Homan et al., 2007; Loucks, 2007a; Berga, 2008; Lynch et al., 2014; Kimmel et al., 2016).

1.2.5 Medical Interventions for Infertility

As outlined in the glossary on ART terminology and fertility care (Zegers-Hochschild et al. 2017), fertility treatments can include a broad array of medical interventions ranging from surgical corrections to interventions inclusive of a treatment regime involving hormone administration, monitoring of blood hormone levels, surgical intervention for gamete retrieval and laboratory techniques. Assisted Reproductive Technology (ART) is restricted to those, “*interventions that include the in vitro handling of both human oocytes and sperm or of embryos for the purpose of reproduction*” (Zegers-Hochschild et al., 2017, p. 397). ART interventions although not restricted to, primarily include in vitro fertilization (IVF) and/or intracytoplasmic sperm injection (ICSI) techniques, with ICSI being used predominantly to overcome male factor infertility.

Broadly, ART techniques necessitate a treatment plan requiring the administration of supraphysiological doses of hormones to stimulate a woman’s ovaries to develop multiple follicles in which the oocytes (eggs) develop. This is accompanied by blood hormone and ultrasound monitoring to gauge the progress of follicle maturation. Upon ultrasound confirmation of follicle maturation surgical techniques are used to retrieve the eggs followed by laboratory procedures to combine eggs and sperm. This intervention facilitates the creation of an embryo. With laboratory evidence of successful fertilization and adequate embryo development noted by cell division, an embryo is selected for subsequent transfer into the woman’s uterus for implantation. A pregnancy test is

undertaken approximately two weeks later to determine confirmation of a pregnancy (Speroff & Fritz, 2005).

Minimal fertility treatment strategies not subsumed under the rubric of ART but included under the broader term MAR (medically assisted reproduction) consist of hormone tracking and timed intercourse (TI), ovulation induction (OI) (i.e. an intervention requiring lower doses of drug regime and blood serum hormone tracking) and intrauterine insemination (IUI) (Speroff & Fritz, 2005; Zegers-Hochschild et al., 2017). The IUI procedure involves semen having undergone a laboratory preparation to isolate sperm which is then loaded into a catheter. To facilitate fertilization the catheter is placed directly into the uterus via the cervix. The goal of IUI is to increase the number and probability of sperm reaching the Fallopian tubes where fertilization takes place. Multiple unsuccessful treatment outcomes using low level techniques pre-empts the use of IVF and ICSI.

In clinical presentations where treatment imperatives owing to advanced maternal age are not of primary concern, non-medical fertility treatment interventions such as advice about sexual relations, psychoeducation about stress, and modification of maladaptive lifestyle habits, form an adjunct to medical intervention and focus within infertility research (Homan et al., 2007; Anderson et al., 2010a, 2010b; Rooney & Domar, 2014). Despite this, the frequency of non-medical interventions as a first line of clinical care within preconception care, although acknowledged as important, remains unknown within a fertility clinic context. This may be owing to restricted preconception care practices such as: (1) limited knowledge and/or use of screening tools to identify risk factors or absence of accepted clinical guidelines about what preconception advice should be routinely offered to individuals presenting for medically assisted reproduction, (2) limited training and guidance on how preconception care information is disseminated in a personalized and non-judgmental manner, and (3) absence or use of established referral pathways for holistic health care. These inter-related components are essential for the delivery of sound preconception care (Cefalo & Moos, 1995; Anderson et al., 2010b).

1.3 Importance of Lifestyle Factors and Preconception Care

Exposure to, or endorsement of, maladaptive lifestyle factors contribute substantially to chronic illnesses, reproductive dysfunction and mortality (Eggert et al., 2004; Homan et al., 2007; Lassi et al., 2014; Liao et al 2018). Specifically, in the preconception period, women can be exposed to various environmental, physiological, behavioural and psychological factors which may adversely affect their ability to conceive and/or to carry a pregnancy successfully to term (Posner et al., 2006; Mumford et al., 2014). Therefore, screening for and intervening with clinical management of lifestyle risk factors in the preconception period (e.g. nutrition, exercise, smoking, alcohol use and body mass index [BMI]), represents an opportunity to optimize fertility treatment options and outcomes (Anderson et al., 2010b). Moreover, for some infertile patients, optimization of preconception lifestyle factors can circumvent the need for the physically, emotionally and financially costlier ART treatments (Abraham et al., 1990; Kersten et al., 2015).

Ovulatory function is one aspect of reproduction that is impaired by adverse modifiable lifestyle factors (Homan et al., 2007; Anderson et al., 2010a; Rooney & Domar, 2014). In particular, the effects of preconception dietary intake, disruptions to energy balance and BMI on ovulatory function, have been extensively investigated (Couzinet et al., 1999; Loucks & Thuma, 2003; Schneider, 2004; Wade & Jones, 2004; ESHRE Capri Workshop Group, 2006; Chavarro et al., 2007; Colombo et al., 2009; Anderson et al., 2010a; Evans & Anderson, 2012). Despite this, there is a paucity of research examining the association between ovulatory dysfunction and the disordered eating attitudes and behaviours that may precipitate changes to dietary intake, energy balance and BMI. Fairburn and Beglin (1994) describe disordered eating as a multifaceted construct that consists of both disordered cognitions leading to concerns about eating, weight and body shape and engagement in maladaptive weight control behaviours. It is these issues of disordered eating attitudes and weight control behaviours in women undergoing fertility treatment that are the central foci of investigation in this thesis.

Prior to discussing the role of disordered eating attitudes and weight control behaviours as they specifically pertain to infertility, as background information to this thesis, an overview of the physiological mechanisms of the female ovulatory cycle will be outlined followed by a discussion of

BMI as a proximate index of weight and nutritional status. Then the energetic regulation of ovulatory functioning will be described in the context of evolutionary perspectives of reproduction. Placing information about energy deficits, BMI and eating pathology within an evolutionary framework provides a theoretical perspective for understanding how female reproductive functioning is physiologically responsive to the ecological context of food availability (i.e. shortages and excesses) and has relevance for design of interventions for fertility optimization.

1.3.1 Human Ovulatory Cycle

The human ovulatory cycle consists of two phases: the follicular phase and the luteal phase. On average the female reproductive cycle (combined follicular and luteal phases) lasts approximately 28 days (Johnson & Everitt, 2000; Speroff & Fritz, 2005). The overarching hormonal control of the cycle is orchestrated by the hypothalamus via the hypothalamic-pituitary-ovarian (HPO) axis. As an integrator of central and peripheral cues about energy balance, the hypothalamus has the capacity to respond to deficits and excesses of nutritional cues through suppression or activation of reproductive hormones (Gordon, 2010; Evans & Anderson, 2012; Comminos et al., 2014). This is specifically achieved through variations in levels of the hypothalamic gonadotropin-releasing hormone (GnRH) with appropriate functioning of the HPO axis being regulated by the frequency and amplitude of the GnRH pulses.

The GnRH neurons, located in the brain, regulate both the synthesis and secretion of follicle stimulating hormone (FSH) and luteinizing hormone (LH) by the anterior pituitary. In response to pulsatile secretions of FSH and LH, the ovaries synthesize oestrogen. Oestrogen can be used as an index of follicular maturity with rising levels of oestrogen from the dominant follicle pre-empting the surge of LH from the anterior pituitary. The LH surge ruptures the follicle, releasing the oocyte. The erupted follicle becomes the corpus luteum and acts as a temporary endocrine gland secreting oestrogen and progesterone. Progesterone causes changes in the uterine lining making it more suitable to support implantation of any fertilized ovum and ensuing pregnancy (Johnson & Everitt, 2000; Speroff & Fritz, 2005).

Irregularities in the length of the follicular and luteal phases and/or absence of ovulation can indicate degrees of suppression of ovarian function. This is typically indexed by low levels of the hormone oestrogen in the follicular stage and low progesterone in the luteal phase (i.e. luteal phase defect) (Johnson & Everitt, 2000; Loucks & Thuma, 2003; Speroff & Fritz, 2005). Several lines of evidence indicate that disturbances of energy availability created through deficiencies in eating behaviours, excessive exercise and low BMI can have an oestrogen lowering effect. Therefore, relevant to infertility, clinical observations of lowered pulsatile secretion of LH and FSH can emerge in situations of energy balance deficits warranting investigation. This is particularly so, in those clinical situations where a woman presents with a low BMI and where food availability, genetic and health issues are not limiting factors (Pirke et al., 1989; Johnson & Everitt, 2000; Marcus et al., 2001; De Souza, 2003; Loucks & Thuma, 2003; De Souza & Williams, 2004; Wade & Jones, 2004; Speroff & Fritz, 2005; Williams et al., 2010; Andrews et al., 2015).

1.3.2 Effects of Body Mass Index (BMI) on Reproductive Functioning

The BMI is the most commonly used measure to gauge weight status and is determined from an individual's weight (kilograms) divided by their height squared [$\text{BMI} = \text{kg}/\text{m}^2$] (World Health Organization [WHO], 2000). Medically, BMI is also used to characterize disease risks with higher levels of BMI associated with greater risks of disease and mortality (WHO, 2009; Dagfinn et al., 2016; Global BMI Collaboration, 2016). Normal weight status has been defined as a BMI ranging from $18.5\text{kg}/\text{m}^2$ to $24.9\text{kg}/\text{m}^2$ and is considered by medical professionals to be the optimal weight range that women should attain prior to attempting conception (WHO, 2000; Royal Australian and New Zealand College of Obstetricians and Gynaecologists, Guideline C-Obs-49, 2013; <http://www.ranzcog.edu.au/college-statements-guidelines.html>). An individual is classified as being underweight if their BMI is less than $18.5\text{kg}/\text{m}^2$, overweight if the BMI ranges from 25 to 29.9 and obese if their BMI equals or exceeds the value of 30 (WHO, 2000).

Both underweight and overweight status can influence the capacity to reproduce successfully in natural conception and medically assisted treatment cycles (ESHRE Capri Workshop Group, 2006; Pinborg et al., 2011; Broughton & Moley, 2017). Low BMI stemming from under-nutrition or

excessive exercise is associated with inadequate ovarian follicular development, anovulation and menstrual cycle disturbances (Green et al., 1988; Berga et al. 1997; De Souza & Williams, 2004; Loucks & Thuma, 2003; Schneider, 2004; ESHRE Capri Workshop Group, 2006). Relatedly, obesity impairs natural fertility (Giviziez et al., 2016) with fecundity estimated to deteriorate for increasing BMI values above 29 kg/m² (Fedorcsak et al., 2004; Practice Committee of the American Society of Reproduction, 2015). Grodstein et al. (1994) found in an exploratory study of 597 women with ovulatory disorders, overweight and obese women (BMI \geq 27) had three times the relative risk of primary ovulatory infertility [OR = 3.1, 95% CI: 2.2-4.4] when compared with women of normal body weight.

Collectively both underweight and obese BMI status can also have detrimental effects on IVF treatment outcomes. Research has shown there is an increased incidence of cancelled fertility treatment cycles, poorer drug response rates, lower fertilization rates, reduction in embryo quality and overall poorer pregnancy rates and longer time to achieve pregnancy, in underweight and obese patients (Norman & Clark, 1998; Pasquali et al., 2003; ESHRE Capri Workshop Group, 2006; Gesink Law et al., 2007; Maheshwari et al., 2007; Norman et al., 2008; Landres et al. 2010; Pinborg et al., 2011; Broughton & Moley, 2017).

In addition, maternal pre-pregnancy weight has been associated with diverse negative maternal-fetal outcomes including a higher risk of pre-term birth for underweight women and a doubling of risk for the development of pre-eclampsia and gestational diabetes for those women who are overweight (Linne, 2004; Dean et al., 2014). Clearly from both preconception and maternal-fetal perspectives, factors influencing BMI are important to assess.

Yet despite its convenience in both clinical and research settings, there are limitations associated with the use of BMI as a reproductive health indicator. Research demonstrates, that overt BMI per se, does not always accurately reflect the weight status required for healthy reproductive functioning. This is because BMI fails to inform about weight composition (i.e. critical ratio of muscle to fat mass), fat distribution (android versus gynaecoid) and energy balance needs required for ovulation (Frisch & McCarthur, 1974; Bronson & Manning, 1991; Loucks, 2003; Loucks, 2004; Loucks, 2007a; Maheshwari, 2010; Legro, 2016). Moreover, BMI does not reflect the disordered

eating behaviours that some women endorse to actively suppress their BMI to maintain a desired body weight and shape. That is, despite the appearance of a “normal/healthy” BMI, a woman who utilizes disordered eating behaviours to maintain normal weight status can disrupt her metabolic cues and energetic signals required for the pulsatile secretion of hormones relevant to reproductive functioning (Loucks, 2003; Loucks & Thuma, 2003; Wade & Jones, 2004; Evans & Anderson, 2012). Variations in body weight through dieting can impair episodic LH secretion thereby suppressing ovarian function and influence fertility via an association with an increased prevalence of luteal phase defects (Pirke et al., 1989; Andrews et al., 2015). Consequently, in an otherwise ‘healthy’ appearing woman, cyclical ovarian activity can become impaired independently of BMI status primarily owing to short-term fluctuations in energy balance (Pirke et al., 1989; Schweiger et al., 1989; Loucks & Thuma, 2003; Wade & Jones, 2004; Abraham et al., 2007; Evans & Anderson, 2012).

1.3.3 Neuroendocrine Mechanisms Underlying Weight Regulation and Reproduction

Energy balance is defined as the difference between the amount of energy consumed in food by a person in relation to the quantity of energy expended by that person through metabolic and physical activity (e.g. exercise) (Loucks & Thuma, 2003; Wade & Jones, 2004; Loucks, 2007a). Other indicators of the adequacy of an individual’s BMI and state of energy balance are operationally reflected in the metabolically relevant neuroendocrine mechanisms underlying weight regulation. The inter-connection between energy balance and optimal functioning of the HPO-axis is regulated by neuroendocrine hormones related to the gut and adipose tissue (Caprio et al., 2001; Moschos et al., 2002; Schneider, 2004; Evans & Anderson, 2012; Comninou et al., 2014). Specifically, feedback about current energy status and fat mass is relayed from peripheral senses to central systems via three main metabolic hormones: insulin, ghrelin and leptin. These hormones serve an integrative role in the regulation of food intake and ovulatory function, ensuring enough energy is acquired (Evans & Anderson, 2012; Comninou et al., 2014; Cui et al., 2017).

Insulin is produced in the pancreas and plays a role in metabolizing carbohydrates and fats, in regulating level of glucose in the blood and has been implicated in the control of satiety (Taniguchi et al., 2006). Insulin also plays a role in reproduction by cueing information about energy balance,

glucose availability and energy storage. Both low and excessive levels of circulating insulin are associated with anovulation (Sliwowska et al., 2014; Loh et al., 2017). Ghrelin is one of the key gut signals associated with appetite. Ghrelin acts as a potent meal-initiation signal and rises sharply in states of hunger and negative energy balance (Klok et al., 2007). Therefore, in situations of low energy balance, elevated levels of ghrelin are observed resulting in suppression of GnRH pulsatility and gonadotropin release (Scheid & De Souza, 2010). Leptin is an adipocyte-derived hormone that has been implicated in the regulation of food intake and energy homeostasis (Mantzoros et al., 2000; Monteleone et al., 2000; Chan & Mantzoros, 2005; Rosenbaum & Leibel, 2014). The concentration of leptin in the blood is a biomarker of energy balance with low leptin levels signalling subnormal BMI and/or negative energy balance, including states of acute fasting (Wade & Jones, 2004; Chan & Mantzoros, 2005; Evans & Anderson, 2012; Rosenbaum & Leibel, 2014).

Insulin and leptin resistance/insensitivity are evidenced in those situations whereby the body receptors are unable to accurately respond to elevated plasma levels of insulin and leptin resulting in the body miscuing energy status (Moschos et al., 2002; Shimizu et al., 2007). This may be in part due to a transport problem of insulin and leptin across the brain-blood barrier (Schwartz et al., 1996; Schneider & Warren, 2006; Shimizu et al., 2007). Similarly, ghrelin resistance has been implicated in disruption to neuroendocrine control of energy homeostasis and linked to development of obesity (Cui et al., 2017). Therefore, neuroendocrine abnormalities can influence appetite and weight regulation.

Relevant to infertility, women diagnosed with PCOS and women with binge eating disorders are characterized by abnormalities in neuroendocrine hormones associated with increased appetite (e.g. dysregulated ghrelin) (Mantzoros et al., 1997; Monteleone et al., 2000; Geliebter et al., 2004; Moran et al., 2004). Furthermore, insulin and leptin levels are diminished in women who have functional hypothalamic amenorrhea, women who excessively exercise, women who have low BMI, or in women who maintain a diet composition low in fat (Mantzoros, 2000; Andrico et al., 2002; Moschos et al., 2002; Meczekalski et al., 2014). Such presentations can also occur in women who are restrained eaters or individuals with eating disorders such as anorexia nervosa (Monteleone et al., 2000; Heberbrand et al., 2007; Singhal et al., 2014). Collectively, the above findings suggest that

neuroendocrine dysregulation can be found in women with forms of impaired ovulatory functioning and relatedly, in the profile of women with features of eating pathology.

1.3.4 Evolutionary Perspectives on the Role of Energy Balance in Female Reproductive Functioning

The importance of BMI, energy availability and metabolic stability to reproductive capacity is embedded conceptually within life history theory (LHT), a branch of evolutionary ecology (Parker & Smith, 1990; Voland, 1998; Lawson, 2011). This theory provides an explanatory model for investigating factors that modulate female reproductive efforts to adapt to the environmental context of energy availability and to maximize an individual's potential for survival (Vitzthum, 2009). LHT contends that nutritional energy is allocated to three main functions of life; these being growth, life maintenance and reproduction (Figure 1).

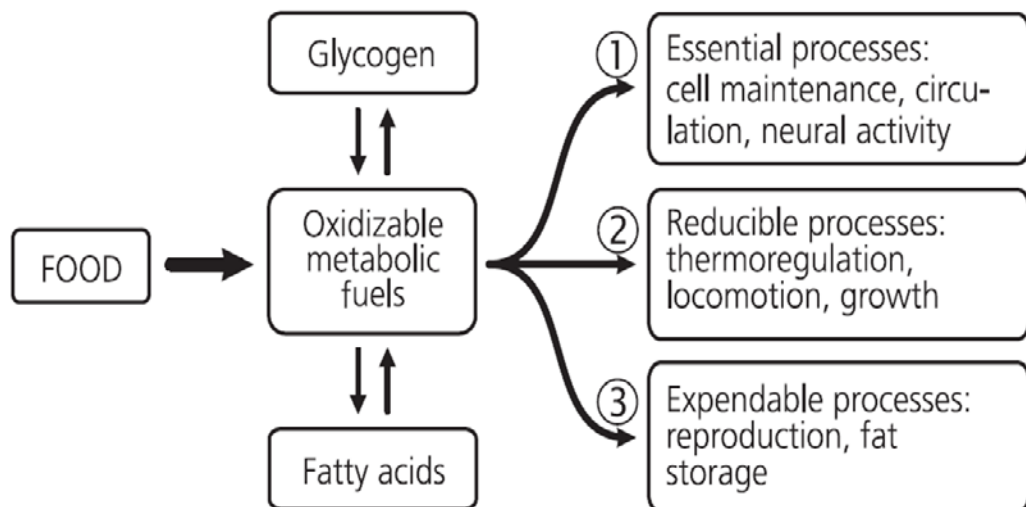


Figure 1: The partitioning of food (i.e. metabolic fuels) according to cellular priority. 1: Some processes are essential for survival and cannot be compromised. 2: Others can be reduced to achieve energy savings. For example, thermoregulation and locomotion are relevant targets of energy allocation across the lifespan however energy allocation to growth is unnecessary in individuals who have completed their growth. 3: Reproduction and fat storage can be maladaptive when calories are scarce and therefore have a low priority in times of energy deficits. (Wade & Jones, 2004, p. R1278).

Accordingly, female reproduction is particularly energetically costly (Wade & Jones, 2004) and, therefore, is tightly monitored and regulated through an energy-sensing network operated by the hypothalamus. In times of limited available energy (either self-imposed owing to eating pathology, endorsement of excessive exercise or involuntarily as during times of famine) available energy is prioritized and allocated into essential organs and life-sustaining metabolic processes (basic cellular functions, thermoregulation), at the cost of reproduction (Wade et al., 1996; Wade & Jones, 2004; Schneider, 2004). Consequently, reproduction is directly related to a woman's optimal body weight range (BMI) and current energy availability (Loucks & Thuma, 2003; Schneider, 2004; Wade & Jones, 2004; Loucks, 2007; Evans & Anderson, 2012). It is well-established that a negative energy balance (energy deficit) induced by under-nutrition and/or excessive exercise, if accompanied by progressive weight loss, is associated with inadequate ovarian follicular development, anovulation, hypo-oestrogen and menstrual cycle disturbance (Pirke et al., 1989; Berga et al. 1997; Loucks & Thuma, 2003; De Souza & Williams, 2004; Schneider, 2004).

Paradoxically, positive energy balance due to self-imposed over-eating, binge eating pathology and/or protracted sedentary behaviours leading to obesity, has also been linked with negative reproductive and physical health trade-offs (Schneider, 2004; Unluturk et al., 2016). In evolutionary terms, this can be partially explained by the Thrifty Gene Hypothesis (Neel, 1962). A key tenet of this hypothesis is that some humans have been genetically programmed to consume excess food and to store fat. This is to ensure sufficiency of calories for the purposes of survival against environmental vicissitudes (i.e. times of famine) and/or energetically costly childbirth.

Whilst advantageous in ancestral times, or in hunter-gather and subsistence economies typically characterized by episodic famine/feast cycles, the propensity for genetically primed fat-storage poses a disadvantage in western societies characterized by continuous dietary abundance. This is due to the physical and reproductive health related problems associated with obesity. This includes symptoms of metabolic instability (e.g. insulin resistance, leptin insensitivity, hyperandrogenism) and infertility (i.e. dysregulated pulsatile gonadotropin secretions reducing folliculogenesis resulting in ovulatory disorders) (Pasquali et al., 2003; Balen, 2004; Jain et al., 2007; Homburg, 2009; Unluturk et al., 2016; Delitala et al., 2017).

One infertility category illustrating the challenges of evolutionary priming is PCOS (Franks & Berga, 2012; Azziz, 2016; Unluturk et al., 2016; Delitala et al., 2017). As seen in Figure 2, it is understood that women with PCOS are particularly affected by modern dietary excesses leading to increased fat storage and when coupled with a sedentary lifestyle, are susceptible to metabolic instability and impaired fertility.

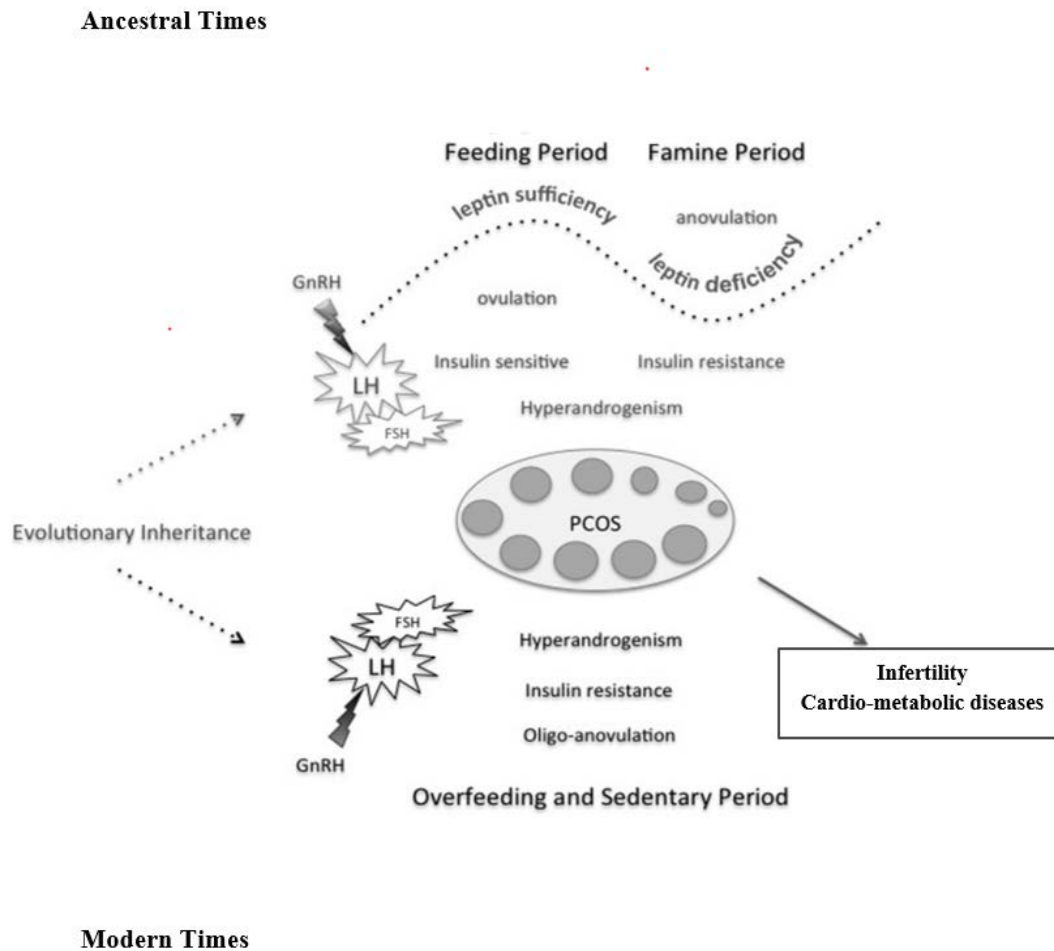


Figure 2: The positive energy balance paradox whereby in modern-day societies of chronic overfeeding and low physical activity, women with genetic vulnerability (e.g. PCOS) experience pathophysiological consequences of hyperandrogenism, insulin resistance and menstrual disturbance. These in turn influence reproductive fitness. Conversely in ancestral times, intermittent feeding cycles result in reproduction adaptively being deferred during times of lean whilst at the same conferred survival advantages that enable fat storage for future times of famine. Thus, under some circumstances thrifty genes are advantageous whilst under other conditions eating behaviours that contribute to excessive fat storage can facilitate the development of diseases (Adapted from Unluturk et al., 2016 p. 38).

Yet, not all individuals appear equally metabolically vulnerable to the influences of exposure to western dietary excesses. The Barker hypothesis (Barker & Osmond, 1986; Barker et al., 1993; Barker, 2007) on the developmental origins of health and disease [DOHaD] provides an alternative perspective to explain such variability. Barker's hypothesis proposes that the propensity for disease pathogenesis in adults, including metabolic instability related to obesity, is differentially shaped by early fetal programming stemming from the preconception environment and gestational events. Research outcomes suggest that fetal programming may operate across a range of nutritional states with both prenatal under-nutrition and over-nutrition changing the body structure, function and metabolism in ways that can lead to increased susceptibility to reproductive and cardiovascular diseases in later life (Gluckman et al., 2008; Sloboda et al., 2011). Consequently, due to the immediate impact of nutritional status on the embryo in early utero development and the associated longitudinal health effects, adverse early life nutritional exposure patterns and relatedly maternal maladaptive eating behaviours are paramount to monitor in preconception care. PCOS is considered to have prenatal developmental origins influenced by a combination of genetic predisposition and dietary excesses creating biochemical abnormalities associated with infertility (Sloboda et al., 2011; Franks & Berga, 2012).

In summary, the physiological control of the human reproductive cycle is centrally mediated by the hypothalamus, a sensor and integrator of central and peripheral hormonal cues. Appropriate functioning of the HPO-axis is regulated by GnRH pulses, which in turn responds to neuroendocrine mechanisms that signal nutritional status and energy balance. Consistent with evolutionary perspectives of reproduction and relevant to preconception care and infertility, ovarian functioning may vary according to weight status and energy availability (Frisch & McArthur 1974; Ellison 1990; Loucks, 2003; Loucks & Thuma, 2003; Wade & Jones, 2004; Loucks, 2007) all of which can be influenced by latent and manifest symptoms of an eating disorder.

1.4 Eating Disorders and Reproductive Health

Eating disorders are complex and serious mental health illnesses characterized by significant medical and psychosocial consequences that occur in women of child bearing years (Hsu, 1989;

Klump et al., 2009; Linna et al., 2014). Eating disorders are associated with cognitive and behavioural disturbances relating to eating, exercise, body weight and shape concerns (Fairburn, 2008; Fairburn & Beglin, 2008). Behavioural manifestations of eating pathology include overeating, as well as unhealthy weight control practices such as fasting, purging, misuse of diuretics and laxatives, appetite suppressants and engagement in excessive exercise (Fairburn & Beglin, 2008; American Psychiatric Association [APA], 2013). Eating disorders have pervasive detrimental effects upon physical health, including reproductive functioning, psychological wellbeing and impairments to patient quality of life both in the short-term and long-term (Mond et al., 2005; Abraham et al., 2006; Godart et al., 2007; Mond & Hay, 2007; Javaras et al., 2008; Mehler & Andersen, 2010; Jenkins et al., 2011; Grilo et al., 2013; Kimmel et al., 2016; Hay et al., 2017; Karkkainen et al., 2018).

As nutritional status and the reproductive axis are intertwined, eating disorders play a pivotal role in creating hormonal dysfunctions leading to disturbances in ovulation and menstrual abnormalities impairing fertility (ESHRE Capri Workshop Group, 2006; Evans & Anderson, 2012; Kimmel et al., 2016). Whilst the focus of this thesis is on disordered eating attitudes and weight control behaviours as they relate to infertility, more widely, eating disorders also have the potential to impact both obstetric and postnatal outcomes. Eating disorders have been associated with negative consequences during pregnancy, including higher rates of miscarriage, low birth weight, early pregnancy loss not associated with chromosomal abnormalities, gestational diabetes, prolonged duration of labour, stillbirth, post-partum depression and parent-child attachment issues (Franko et al., 2001; Sollid et al., 2004; ESHRE Capri Workshop Group, 2006; Bulik et al., 2007; Micali et al., 2007; Pasternak et al., 2012; Linna et al., 2013; Linna et al., 2014; Watson et al. 2014).

1.4.1 Diagnostic Categories Associated with Eating Disorders

The Diagnostic and Statistical Manual of Mental Disorders (DSM) is the global authoritative guide to the diagnosis of mental health disorders. Published by the American Psychiatric Association (APA) it is used by mental health professionals and researchers to respectively assess and standardize classifications of mental disorders for clinical practice and research purposes. The DSM has undergone several revisions since its inception in 1952 and is currently in its fifth edition (DSM-5,

APA, 2013). The DSM-5 nomenclature is inclusive of five eating disorder diagnostic categories: anorexia nervosa (AN), bulimia nervosa (BN), binge eating disorder (BED), other specified feeding and eating disorder (OSFED) and unspecified feeding or eating disorder (UFED). OSFED and UFED are diagnoses made in situations characterized by subclinical or atypical presentations of eating disorders, where concerning physical and psychological symptoms are present however, symptoms are insufficient to meet stringent diagnostic classification. The DSM-5 further outlines less common variants of eating pathology including pica, rumination disorder and avoidant restrictive food intake disorder (ARFID).

1.4.2 Types of Eating Disorders influencing Menstrual Functioning

Of all psychiatric diagnoses, anorexia nervosa (AN) has the highest mortality rate (Arcelus et al., 2011). Individuals with AN typically present with features of an intense fear of gaining weight and body weight that is significantly below the recommended weight for their age and height. In addition, due to their concerns with body image, individuals with AN maintain a driven attitude to thinness despite the seriousness of their low BMI (APA, 2013; Phillipou et al., 2018). Weight control behaviours endorsed by women with AN are primarily oriented towards extreme food restriction, rigid calorie counting and for some individuals, purging and exercise behaviours. These criteria usually occur in the context of other core psychological features including depression, anxiety, perfectionism, need for control, low self-esteem and body image dissatisfaction (Polivy & Herman, 2002; Stice, 2002; Fairburn et al., 2003a; Fairburn, 2008; Egan et al., 2011; Phillipou et al., 2018). Whilst no longer a required diagnostic criterion in DSM-5 (APA, 2013), many post-menarche women with AN experience amenorrhea. Therefore, within the context of infertility, amenorrhea remains a diagnostic feature associated with eating pathology that is still relevant to investigate (Poyastro Pinheiro et al., 2007; Kimmel et al., 2016). The underlying physiological reproductive mechanisms for amenorrhea in women with AN are disruption of the pulsatile release of GnRH secondary to negative energy balance and low BMI (ESHRE Capri Workshop Group, 2006; Usdan et al., 2008; Germain et al., 2017).

Bulimia nervosa (BN) was first described as a clinical entity in 1979 and was initially construed as a variant of AN (Russell, 1979). BN is an eating disorder characterized by the presence

of recurrent cycles of over-eating a large quantity of food in a short period of time (i.e. binge eating), followed by the endorsement of compensatory weight control practices such as purging, laxative use or excessive exercise designed to prevent weight gain (APA, 2013). A sense of loss of control, distress and dissatisfaction about body weight and shape are core features of BN (Stice, 2002; Stice & Shaw, 2002). Binge eating episodes appear to be pre-empted by negative affect and anxiety which originate from psychosocial pathways, including life stressors, idealized images of thinness and body dissatisfaction (Stice et al., 2001; Polivy & Herman 2002; Dakanalis et al., 2017). Unlike the anorexic patient with marked low weight, the bulimic patient typically presents with weight status in the normal or overweight range, making detection of this eating disorder more complex (Masheb & White, 2012; Kimmel et al., 2016). Many women suffering from BN also experience irregular menstrual patterns (Pirke et al., 1988; Kimmel et al., 2016). Pirke et al. (1988) reported that approximately 50% of women with BN experience menstrual dysfunction such as amenorrhea or oligomenorrhea.

Binge eating disorder (BED) was formalized as an independent diagnostic category in the DSM-5 (APA, 2013). Stunkard (1959, p. 288) was the first to use the term “eating binge” to describe a specific pattern of eating behaviour demonstrated by obese people. However, being obese does not equate to having a diagnosis of BED. Rather, level of psychopathology, weight and shape concerns can vary amongst obese individuals, with BED representing a distinct phenotype in obese women (Fitzgibbon & Kirschenbaum, 1991; Fitzgibbon et al., 1993; De Man Lapidoth et al., 2006; Hudson et al., 2006).

BED is defined as a disorder that involves the consumption of an unusually large amount of food within a discrete time frame (APA, 2013). The binge eating episode is accompanied by a sense of distress, guilt and loss of control without the use of compensatory weight control behaviours. BED has an elevated risk for physical health impairment and psychiatric co-morbidity (Johnson et al., 2001; Grilo et al., 2013). Analogous to other forms of eating disorders, there appears to be an underlying physiological link between BED and menstrual dysfunction. Algars et al. (2014) proposes that binge eating behaviour culminating longitudinally in incremental weight gain, insulin resistance and increased production of androgens, are the likely underlying physiological mechanisms interconnecting binge eating to menstrual dysfunction.

Other specified feeding and eating disorders (OSFED), a newly defined diagnostic category within DSM-5 (APA, 2013), was previously identified in DSM-IV-TR (APA, 2000) as EDNOS, i.e. eating disorders not otherwise specified. The OSFED category, captures feeding and eating disorders of clinical severity that warrant clinical intervention but do not meet sufficient criteria for a formal diagnosis of AN, BN, or BED. Collectively, individuals with OSFED commonly present with disordered eating habits, distorted body image and a fear of gaining weight (APA, 2013). As the diagnostic group OSFED is new, epidemiological data regarding the prevalence of menstrual disorders associated with OSFED are not available. However, using the former EDNOS diagnosis, in an investigation of menstrual history in 1705 women, Poyastro Pinheiro et al. (2007) found that up to 30.4% of women with EDNOS exhibited secondary amenorrhea.

Avoidant/restrictive food intake disorder (ARFID), is defined as a persistent feeding or eating disturbance leading to avoidance of food (APA, 2013). Previously primarily viewed as a paediatric condition, ARFID is now considered an applicable diagnosis across the lifespan. ARFID is associated with the avoidance of food typically due to sensory sensitivity, fear of aversive consequences or lack of interest in food or eating, which results in weight loss or nutritional deficiencies and/or impairment in psychosocial functioning. Unlike other eating disorders, there does not appear to be a preoccupation with body weight or shape. Studies suggest that individuals with ARFID have high rates of psychiatric and medical morbidity with some individuals subsequently developing a diagnosis of AN (Norris et al., 2014). Incorporated as a newer diagnostic category in the Feeding and Eating Disorders section of the DSM-5 (APA, 2013), there is no reproductive medicine or eating disorder literature available demonstrating the link between ARFID and reproductive health. Intuitively though, restrictive food choices may have bearing upon energy balance and nutritional status with relevance to infertility and obstetric outcomes.

1.4.3 Prevalence of Eating Disorders

Prevalence figures on eating disorders vary widely and are contingent upon a number of factors. These include diagnostic nomenclature used, point prevalence estimate definitions, assessment inventories selected to guide differential diagnosis and participant factors such as age, gender and

culture (Hoek & van Hoeken, 2003; Keski-Rahkonen et al., 2006; Hudson et al., 2007; Soh & Walter, 2013). Using DSM-IV-TR criteria (APA, 2000), Wade et al. (2006) reported AN, BN and BED in an Australian population to have lifetime prevalence rates of 1.9%, 2.9% and 2.9%, respectively. Currently, limited epidemiological studies exist that examine the prevalence and incidence of eating disorders in adult women in the context of contemporary DSM-5 diagnostic schema. Hay et al. (2015), who re-analysed their cross-sectional data previously collected in 2008 and 2009 ($N = 6041$), found a 3-month point prevalence rate for AN and BN of less than 1% with BED and sub-threshold BED disorder ranging from 5.6 to 6.9%. Other specified (OSFED) and unspecified (UFED) eating disorders including purging disorder were less commonly reported and estimated to occur between 1-1.4%. Overall the 3-month point prevalence of any form of DSM-5 eating disorder or disordered eating behaviour was estimated to be 16.3% (95% CI 15.4 to 17.3), highlighting the incidence of eating disorders, as an area of important clinical concern.

In summary, eating disorders are associated with physical and mental-health related burdens. In women of reproductive age, eating disorders represent an issue of clinical consideration. When considered in the context of the influence of eating disorders on female reproductive health, research relevant to the interconnection between these two clinical areas is therefore important.

CHAPTER 2

LITERATURE REVIEW

2.1 FOREWORD

Chapter 1 aimed to provide general background information relating to the two key areas under investigation in this thesis – infertility, particularly ovulatory disorders, and eating disorders. To give theoretical context, the specific interconnection between ovulatory disorders and eating pathology was explained in terms of an evolutionary framework and physiological mechanisms relevant to energy balance and BMI. As a rationale to this thesis, and as a prelude to the analytical studies presented in Chapters 4 to 7, Chapter 2 provides a synopsis of representative empirical literature specifically relating to eating pathology and infertility. This includes: (i) the prevalence of eating pathology in women attending a fertility clinic, (ii) the psychological correlates associated with eating pathology in infertile obese and PCOS women, (iii) the specific influences of perceived stress and coping style on eating pathology, and (iv) the importance of eating disorders mental health literacy in fertility health care providers. The chapter concludes by highlighting the research gaps in the literature in this field, followed by the aims of this thesis.

2.2 Prevalence of Eating Disorders in Women Undergoing Fertility Treatment

Although there is general consensus that both under-nutrition and sustained overeating influence ovulation, alter responses to assisted reproductive treatment, and that eating disorders influence pregnancy outcomes (ESHRE Capri Workshop Group, 2006; Linna et al., 2013; Linna et al. 2014; Kimmel et al., 2016; Tabler et al., 2018), little data exists on the prevalence of eating pathology in women actively pursuing fertility treatment. This section of the thesis provides a synthesis of studies that were indexed in an English language peer-reviewed journal published between 1980 and 2016, that investigate the presence and prevalence of eating pathology in women actively undergoing fertility treatment. Studies that have recruited cohorts of women who were potentially infertile (e.g. women with menstrual irregularities, women who have PCOS and women diagnosed with functional hypothalamic amenorrhea), but who were not actively intending to conceive, are not reviewed. This is because non-fertility treatment seeking cohorts attending outpatient clinics may be comprised of women pursuing medical treatments to address heterogeneous life health objectives other than infertility (e.g. assistance with contraception, low bone density, insulin resistance and/or skin conditions such as acne or hirsutism) (Cussons et al., 2005; Gordon, 2010; Teede et al., 2010; Meczekalski et al., 2014).

The importance of examining the prevalence and history of eating pathology in women undergoing fertility treatment has been clearly stated (ESHRE Capri Workshop Group, 2006; Kimmel et al., 2016; Tabler et al., 2018). A study by Bates et al. (1982) was one of the first to discuss the possibility of energy balance deficits in women with unexplained infertility. Forty-seven women (29 women diagnosed with unexplained infertility who had been actively attempting to conceive and 18 women with menstrual disturbances who did not wish to conceive) aged between 16 years and 36 years were reviewed at an outpatient reproductive medicine clinic. All women presented with low ideal body weight (IBW). Of note, despite the initial diagnosis of unexplained infertility, 27/29 infertile women were assessed to have evidence of menstrual cycle disturbances. When 26 of the 29 infertile women adopted the recommended clinical dietary intervention and restored their weight to 95% of their IBW, 73% (19/26) spontaneously ovulated and subsequently conceived. Similarly, whilst

only 10/18 menstrual disordered women agreed to endorse the dietary intervention, 9/10 (90%) resumed menstruation. The authors concluded that the endorsement of weight control practices may account for unexplained infertility and menstrual dysfunction in what would normally be considered healthy women. This study, whilst providing evidence for the energy balance theory and IBW, did not provide sufficient information about the disordered eating attitudes and exercise practices of participants and nor were details provided about the psychometric measure used to gauge underlying eating pathology. Moreover, though not explored by the researchers, a focus on the 11 women who resisted intervention to gain weight may have yielded more information about the issues relating to disordered eating and weight control practices.

A study by Allison et al. (1988) of 30 women ($n=12$ anovulatory; $n=18$ ovulatory) was one of the earliest Australian studies to examine eating pathology in the context of women attending an IVF clinic. The primary objective of this study was to highlight the issue of weight status (underweight and overweight) and weight loss practices as risk factors for infertility, particularly ovulatory disorders. Women were assessed using the Eating Disorder Inventory (EDI) and General Health Questionnaire (GHQ). Variables examined included eating patterns (dieting and bulimia) and comorbid psychological disturbance. While no between group differences were observed on the GHQ score, the authors found that women with forms of anovulatory infertility demonstrated significantly higher scores on the Drive for Thinness subscale of the EDI ($p = .01$). This suggested that women in the anovulatory group were more concerned about their weight and dieting practices and had a greater fear of fatness than women with normal ovulatory function. Furthermore, the authors noted there was a trend for significance on the Interoceptive Awareness subscale ($p = .075$), indicating that anovulatory women had less awareness of the emotional experiences associated with their disordered eating symptoms. The findings of this study highlighted the presence of symptoms of weight pre-occupation amongst infertile women who had been diagnosed with ovulatory dysfunction. Allison et al. (1988) concluded that prior to fertility treatment intervention it was important to enquire about the role of dieting and weight loss behaviours in infertile women with ovulatory disorders.

Similar conclusions were drawn in another Australian study by Abraham et al. (1990). This study investigated the issue of disordered eating and excessive exercise amongst patients undergoing

OI. Fourteen underweight women diagnosed with secondary amenorrhea completed a semi-structured interview and were assessed for eating pathology using two standardized questionnaires; the Eating Attitudes Test (EAT) and the EDI. The main findings revealed that of the 14 women, 36% (5/14) exhibited symptoms of an active eating disorder (i.e. EDNOS) with a large proportion of participants (13 of 14 women) at some stage in the past having met DSM-III-R (APA, 1987) diagnostic criteria for an eating disorder. Two patients were also reported to be compulsive exercisers. Importantly, this study highlighted the potential for adverse perinatal complications in the participants who subsequently became pregnant after OI. These pregnancy complications included three miscarriages, one perinatal loss and four babies (33% of live births) with low birth weight (LBW) (i.e. less than 2500 grams). LBW babies are at greater risk of morbidity and mortality (Sollid et al., 2004). The researchers concluded that women presenting with a diagnosis of secondary amenorrhea, should not be entered into a fertility treatment programme, without an assessment of their eating, exercise and weight histories being completed. One aspect of this study which remains unclear is the assessment of exercise since objective measures of exercise were not reported. Compulsive or driven exercise is important as it often accompanies forms of eating disorders and as a lifestyle factor can influence ovulatory functioning (De Souza & Williams, 2004; Mond et al., 2006a; Hakimi & Cameron, 2017; Monell et al., 2018). Sample size further represents a limiting factor of this study.

In a Canadian study, Stewart et al. (1990) were the first to examine the prevalence of eating disorders in women seeking fertility treatment. Their study prospectively screened 66 consecutive women attending a fertility clinic, 12 of whom were diagnosed with menstrual dysfunction. Women were assessed for eating pathology using a two-part process: (i) completion of the 26-item Eating Attitudes Test (EAT-26), a standardized test administered to examine dysfunctional beliefs associated with AN or BN, and (ii) participant interview using the eating disorder (ED) module of the Structured Clinical Interview for DSM-III-R (APA, 1987). These researchers found that 7.6% of participants had a past or current diagnosis of AN or BN. Furthermore, when the diagnostic category EDNOS was included, 16.7% of patients met the criteria for an eating disorder, a rate considered to exceed community prevalence figures. Of further interest was the finding that in the clinical subgroup of 12 women who presented with menstrual irregularities, 58% met the criteria of an eating disorder

compared to 7% of normal cycling women. Corroborating the findings of previous research (Allison et al., 1988; Abraham et al., 1990), this study emphasized the issue of screening for symptoms of eating disorders since no participant had spontaneously disclosed their eating disorder history to their doctor.

Exploring infertility as part of an investigation of psychiatric morbidity in an Italian cohort, Sbaragli et al. (2008) investigated mental health issues including binge eating concerns in 81 infertile heterosexual couples who had completed their gynaecological and andrology investigations but who had yet to commence their first fertility treatment cycle. The type of fertility treatment was unspecified. These infertile women were compared to a control group of 70 women who were in their first trimester of pregnancy. Women in the infertile group were allocated to one of three groups according to their primary infertility diagnosis. All participants were interviewed by a psychiatrist who assessed for Axis I mood disorders using the Structured Clinical Interview for DSM-IV (SCID-1) (First et al., 2002). The authors found that couples with infertility exhibited higher levels of psychiatric disorders (adjustment disorder and mixed anxiety disorders) when compared to fertile controls ($p = .01$) and significantly more binge eating ($p = .02$). Specifically, 18% ($n = 15/81$) of infertile women when compared to 0% of controls presented with current histories of binge eating disorder. Whilst a significant finding, the authors recommended that more data was required to strengthen the conclusions drawn from their preliminary findings. Moreover the control group, an obstetric cohort, was considered unlikely to be representative of the eating patterns of the general population.

In an American study, Freizinger et al. (2010) further endeavoured to investigate the prevalence of disordered eating attitudes and exercise behaviours in 82 female patients who were about to undergo their first stimulated IUI treatment cycle. Participants were administered several assessments including the Eating Disorder Examination – Questionnaire (EDE-Q) which is a self-report version of the interview based Eating Disorder Examination (Fairburn & Cooper, 1993; Fairburn & Beglin, 1994), the Structured Clinical Interview for DSM-IV (SCID-I) Module H-Eating (First et al., 2002), the International Physical Activity Questionnaire [IPAQ] (Craig et al., 2003) and a

Lifestyle Questionnaire. This study included 54 women with unexplained infertility, six with male factor infertility, 10 women with PCOS and 12 women with mixed infertility presentations ('Other' category) recruited from one ART clinic. Using the DSM-IV (SCID-I) Module H, the authors found 20.7% (i.e. 17 of 82 patients) of their infertile cohort met the criteria for a past or current history of an eating disorder. The authors reported this rate to be five times higher than the American lifetime population rate. In addition, the researchers found that of participants who reported symptoms of an eating disorder, 76.4% failed to divulge their current or past history of an eating disorder to their treating fertility specialist with the remainder of patients failing to respond to the question. Of note, the eating disorder group did not statistically vary from the non-eating disorder group according to presence or absence of menstrual disturbance or infertility diagnosis categorization. This may be due to sample configuration including overall small sample size within each infertility category limiting statistical power. Alternatively, this finding points to the clinical observation that an eating disorder can also occur without the presence of menstrual irregularities (APA, 2013), affirming the importance of routine screening of infertile women for eating disorders beyond those presenting with ovulatory disorders, or women who are overtly underweight.

Advancing upon the research design of prior studies, Cousins et al. (2015) used a multivariate, comparative control group design to investigate the issue of prevalence of eating pathology and co-morbid psychological issues (anxiety and depression). Fifty-one fertility treatment seeking women with either ovulatory disorders or unexplained infertility were compared to a non-fertility seeking control group (i.e. 34 women accessing routine medical health care). Participants in this study were interviewed on a battery of measures gauging self-reported eating disorder symptoms, 'drive for thinness', bulimic symptoms and body image dissatisfaction as assessed from the Eating Disorder Inventory-3-Referral Form (Garner, 2004). In addition, the Herman and Polivy Revised Restraint Scale (Herman & Polivy, 1980) was used to gauge dietary restraint and disinhibition and the Beck Depression Inventory-II (Beck et al., 1996) and the Spielberger State Trait Inventory (Spielberger, 1989) were administered to assess depression and anxiety respectively. Consistent with prior research, participants who had infertility (i.e. unexplained infertility and ovulatory disorders) had elevated

scores on the Drive for Thinness ($p = .001$) and the Bulimic subscales ($p = .002$) when compared to the community control group. However, the comparison control group receiving routine medical care exhibited higher scores on body image index ($p < .001$) and the dietary restraint factor ($p < .001$), both specific risk factors for eating pathology. In addition, and contrary to expectations, both the infertility group and the control group exhibited elevated levels of eating pathology when compared to the American community lifetime prevalence rate, with the control group having the highest lifetime prevalence rate of eating disorders. Moreover, no statistical differences were found between the infertility and control groups in either their current or past history of an eating disorder, nor in their symptoms of anxiety and depression. There are several factors which might account for the unexpected findings on the control group in this study; these being: (i) a significantly higher BMI in the control group when compared to the infertile group (Control group: $M = 27.8$; $SD = 8.9$; Infertile group: $M = 23.8$; $SD = 4.1$; $p = .019$), (ii) the recruitment process, and (iii) the statistical differences in demographic variables. As elevated BMI is a risk factor for body image dissatisfaction and dietary restraint, and both are central features of eating pathology (Stice, 2002; Stice & Shaw, 2002), women in the control group may similarly have been susceptible to eating pathology. Statistically controlling for BMI would have added clarity to the findings. With respect to recruitment, in this study the control group participants were recruited from women accessing medical services from a centrally based academic medical environment. Incidences of eating disorders, particularly sub-clinical presentations, can be a hidden phenomenon amongst patients attending health care outpatient settings where undetected diagnoses are common (Johnson et al., 2001). Consequently, the eating patterns and behaviours of this study's control group may not have been representative of that found in the general community. Finally, whilst the strength of this study was an inclusion of a comparison control group, the infertile and control groups statistically varied on important demographic parameters known to influence eating pathology such as age, BMI, marital status, education and income level making the comparisons between the two groups less viable (Hudson et al., 2007; Mitichson et al., 2014).

Examining a different aspect of the consequences of eating pathology, Coker et al. (2016) compared the quality of life experiences relating to eating pathology and exercise in PCOS women (n

= 21) to the experiences of infertile women without PCOS ($n = 128$). Recruited from two metropolitan Australian fertility clinics, women were administered the eating and exercise examination scale (Abraham et al., 2006). This scale contains items about quality of life relating to eating and exercise (QOL ED). The study revealed that amongst the women, approximately 48% of PCOS participants (10/21) versus 17% of non-PCOS infertile women (22/128), exhibited elevated global QOL ED scores. When the sample was reduced to observe the frequency of eating pathology in only non-obese women, the authors reported 44% of PCOS women (4/9) compared to 12% of the non-PCOS group (14/114), had elevated QOL ED global scores above non-eating disordered norms (i.e. greater than a score of six). The authors concluded that there was a greater probability of symptoms of eating pathology in women with PCOS when compared to non-PCOS women. Moreover, they highlighted the importance of screening women with PCOS for eating pathology irrespective of their BMI, prior to commencing fertility treatment. Owing to the small number of participants with a diagnosis of PCOS, the authors characterized their study as a pilot study warranting further investigation with a larger sample.

In summary, the results from previous research highlight the following. First, there is a presence of undetected eating disorders in women attending fertility clinics represented primarily in women who have forms of ovulatory disorders. Second, the incidence of undetected eating disorders appears to exceed reported lifetime community rates. Third, there appears to be a failure of patients to disclose their past or current history of an eating disorder to their fertility specialist provider and fourth, screening of infertile women with forms of ovulatory disorders is recommended. Whilst existing studies are broadly consistent in their findings it is likely that methodological factors have shaped the observations and conclusions. A primary critique of these earlier studies is small sample size limiting the type of analyses that can be undertaken, statistical power and generalization of results. A further limitation noted is restriction in categories of infertile patients included in previous studies thereby permitting conclusions to be made only on a narrow sub-set of the fertility clinic population. That is, whilst some researchers (e.g. Sbaragli et al., 2008; Freizinger et al., 2010) endeavoured to delineate infertility categories, albeit small cell numbers, most studies targeted

patients with forms of an ovulatory disorder, a diagnostic group that is likely to be influenced by eating pathology (see Sections 1.3 and 1.3.1 of this thesis). Focussing on a restrictive sample innately biases the estimation rates by the selection approach and therefore it is unsurprising that there is a higher prevalence of eating pathology symptoms noted in these groups, when compared to community prevalence rates. Specifically, to provide a robust investigation of the hypothesis of a higher prevalence of eating pathology within the context of patients undertaking fertility treatment requires an investigation of a larger, diverse sample of patients. This would include patients characterized by different forms of infertility and who are accessing different types of fertility treatment. Finally, whilst most studies used objective measures to gauge eating pathology and some noted BMI, methodologically the statistical adjustment to partial out the effects of BMI from measures gauging eating pathology is absent. Consequently, it has not been possible to discern whether elevated symptoms of eating pathology are a product of BMI status or of the infertility category. Empirically, adjusting for this confound is important, as negative attributions about BMI have been found to play a key role in contributing to disordered eating cognitions and behaviours (Striegel-Moore & Bulik, 2007; Puhl & Suh, 2015). With these limitations in mind, *Study One* (see Chapter 4) of this thesis endeavoured to replicate and advance upon previous research focussing on prevalence of eating pathology by addressing the issues of sample size, clinical patient diversity and BMI confound.

2.3 Psychological Correlates Impacting on Infertility and Eating Pathology

In the context of reactions to infertility diagnosis and treatment, research has shown that many individuals experience a myriad of symptoms relating to depression, anxiety, low self-esteem, stress, negative affect, relationship concerns and lower quality of life (Lancastle & Boivin, 2005; Cousineau & Domar, 2007; Wang et al., 2015; Gana & Jukubowska, 2016; Toftager et al., 2018; Schweiger et al., 2018; Zurlo et al., 2018). Of relevance, these same negative emotions are also known to influence the development and maintenance of symptoms of eating pathology. For instance, symptoms of depression, anxiety and stress can contribute to behavioural disturbances in eating styles including restrained eating (i.e. undereating), emotional eating (i.e. over-eating) and food choices (Mueller et al., 1995; Fairburn & Brownell, 2002; Gluck, 2006; Macht, 2008; Pallister & Waller, 2008; Errisuriz et

al., 2016; Paans et al., 2018). Other psychological correlates which magnify eating psychopathology include negative affect, poor body image, lower self-esteem and perfectionism (Stice, 2002; Stice & Shaw, 2002; Sassaroli & Ruggiero, 2005; Fairburn et al., 2003a; Schulz & Laessle, 2010; Egan et al., 2011; Stice et al., 2011; Grilo et al., 2013). Moreover, increased psychological vulnerability can be both the contributor to, or the consequences of, an eating disorder (Blinder et al., 2006; Grilo, 2006; Hudson et al., 2007; Fairburn, 2008; Mattar et al., 2011; Grilo et al., 2013; Dakanalis et al., 2017).

As a prelude to the rationale for *Study Two*, the next section of this thesis briefly discusses the aforementioned psychological factors as they pertain to eating pathology. This is followed by a discussion of psychological variables as they relate to elevated BMI (i.e. obesity) owing to the increasing relevance of obesity as a lifestyle factor impacting upon fertility and fertility treatment outcomes (ESHRE Capri Workshop, 2006 Group; Norman et al., 2008; Anderson et al., 2010a).

2.3.1 Psychological Correlates Associated with Eating Pathology

The role of negative affect in binge eating disorder has been documented and is one of the most commonly reported precipitants of binge eating episodes (Stice et al., 2001; Schulz & Laessle, 2010). From an affect-regulation perspective, individuals who rate higher on negative affectivity identify as having greater levels of anxiety or distressed states (Watson et al., 1988). Negative affect in its association with life stress has also been proposed as a precursor to eating pathology and is closely linked to poor body image and dissatisfaction (Ball & Lee, 2000; Stice et al., 2001; Stice & Shaw, 2002; Downey & Chang, 2007; Stice et al., 2011).

Poor body image is a central feature of eating disorders (Stice, 2002; Stice & Shaw, 2002; Stice et al., 2011; Phillipou et al., 2018). Body dissatisfaction pertains to the negative self-evaluation of weight and shape and refers to a mental image of appearance (Stice & Shaw, 2002). Body dissatisfaction, which can be predicted by BMI, can occur when an individual evaluates their body weight to vary from some culturally normative ideal of thinness (Markey, 2004; Cafri et al., 2005; Tantleff-Dunn et al., 2011). Body dissatisfaction has been shown to predict the development of depressed mood and is linked to the onset and maintenance of maladaptive weight control behaviours such as dietary restraint, purging and laxative use to influence appearance (Stice, 2002; Stice & Shaw,

2002, Paxton et al. 2006; Neumark-Sztainer et al., 2007). Moreover, body dissatisfaction is a predictor of relapse for eating disorders (Stice & Shaw, 2002; Keel, et al., 2005; Ganem et al., 2009; Jacobi et al., 2011) and is a predictor of change in self-esteem (Tiggemann, 2004).

Self-esteem, the evaluation of one's self-worth (Rosenberg, 1965), is considered central to psychological wellbeing. Studies investigating the role of self-esteem have shown it to play a key aetiological role in the development and maintenance of eating pathology (Fairburn et al., 2003a; Sassaroli & Ruggiero, 2005; Shea & Pritchard, 2007). Low core self-esteem is prevalent amongst women with high BMI (Kiviruusu et al., 2016). Using latent growth curve modelling to track self-esteem and BMI trajectories in 1334 individuals across a 26-year follow-up period, Kiviruusu et al. (2016) found women with baseline higher BMI levels exhibited lower and more slowly increasing levels of self-esteem across time into mid-adulthood. Thus, self-esteem and factors that maintain self-esteem are important to consider in broader mental health care interventions.

Beliefs about self-worth can be influenced by dimensions of perfectionism (Fairburn et al., 2003a; Shafran et al., 2002; Shafran et al., 2010). Shafran et al. (2002) define perfectionism as the striving to achieve high standards despite negative consequences with the resultant judgement of self-worth determined by achievement. Perfectionism has been associated with a spectrum of psychological disorders and is implicated as a maintaining factor for eating disorders and compulsive, obligatory driven exercise (Shafran et al., 2002; Egan et al., 2011). Studies illustrate that individuals with clinical levels of eating pathology have higher levels of perfectionism when compared to community samples (Egan et al., 2011; Egan et al., 2016). Perfectionism may specifically contribute to eating disorders through standards about eating, ideal body weight and shape. Perfectionism is considered a robust transdiagnostic feature across multiple forms of eating disorders (Fairburn et al., 2003a; Egan et al., 2011).

2.3.2 Elevated BMI, Physical and Mental Health

Obesity is defined as accrued body fat that exceeds a clinically defined weight threshold (World Health Organization [WHO], 2000). In outpatient clinical settings, BMI is the most common and pragmatic metric used to determine the threshold of weight status. As previously discussed in

Sections 1.3.2, using the WHO (2000) criteria, a woman is classified as being overweight if her BMI is between the range of 25 to 29.9 and obese if her BMI is greater than or equal to a BMI of 30 (WHO, 2000). Obesity is associated with adverse physical, mental health and quality of life outcomes (WHO, 2000) and is a major contributor to increases in the global burden of ill-health including reproductive health (WHO, 2009; Finucane et al., 2011; Pasco et al., 2012; Di Angelantonio et al., 2016; Global BMI Mortality Collaboration, 2016). In Australia, over 56% of adult women are reported to be overweight or obese (Australian Bureau of Statistics, 2015), representing a health priority.

Whilst obesity per se is not classified in the DSM-5 (APA, 2013) as a mental health disorder, nor as an eating disorder, it shares important psychological precursors to eating disorders, particularly BED (Haines & Neumark-Sztainer, 2006; Neumark-Sztainer et al., 2007; Marcus & Wildes, 2009; Homes et al., 2015). Therefore, psychological burdens associated with binge eating and obesity in women, are clinically important to gauge. These include the symptoms of depression (De Wit et al., 2010; Luppino et al., 2010), anxiety (Garipey et al., 2010), stress (Roberts et al., 2007; Klatzkin et al., 2016), poor self-esteem (Shea & Pritchard, 2007), poor body image (Stice et al., 2000; Stice, 2002; Stice & Shaw, 2002), negative affect (Stice et al., 2001; Schulz & Laessle, 2010) and perfectionism (Bardone-Cone et al., 2007; Egan et al., 2011). Whilst the psychological burdens of obesity and eating pathology are apparent in community based samples, how these correlates present in obese infertility clinic cohorts remains unclear.

2.3.3 Obesity, PCOS and Mental Health

Fundamental to fertility is the extent to which extremes of BMI influence reproductive success. Overweight and obese women are more susceptible to conception difficulties in both natural and artificial conception cycles (Pasquali et al., 2003; ESHRE Capri Workshop Group, 2006; Maheshwari et al., 2007; Koning et al., 2011; Pinborg et al., 2011; Bellver et al., 2013; Practice Committee of the American Society for Reproductive Medicine, 2015). Consequently, given obesity related fertility treatment setbacks, the prospect that overweight and obese infertile patients have comorbid mood issues would be anticipated. Studies that specifically investigate the interplay between weight status and mood within the infertility context, however, have not received significant research

attention. One area of exception within the assisted reproduction field is the mental health status of women diagnosed with PCOS due to their metabolic susceptibility to the influences of obesity (Balen, 2004; Lim et al., 2012; Veltman-Verhulst et al., 2012; Delitala et al., 2017). PCOS is the most common endocrine disorder contributing to infertility, with obesity being a common manifestation in these patients (Adamson & Baker, 2003; Pasquali et al., 2003; Azziz, 2016).

Studies investigating the impact of elevated BMI on the psychological wellbeing and quality of life issues in women with PCOS have found evidence of increased psychological vulnerability. This includes symptoms of depression, anxiety, stress, low self-esteem, body image and symptoms of eating pathology (McCluskey et al., 1991; Jahanfar et al., 1995; Elsenbruch et al. 2003; Trent et al., 2005; Himelein & Thatcher, 2006; Barnard et al. 2007; Hollinrake et al. 2007; Mansson et al., 2008; Kerchner et al. 2009; Bhattacharya & Jha, 2010; Barry et al., 2011; Deeks et al., 2010; 2011; Lee et al., 2017). For instance, recruiting women attending a university hospital, Hollinrake et al. (2007) explored the risk of depression in women with PCOS. The authors found women with PCOS ($n=103$) to have higher risks of depression than matched controls ($n=103$) (21% vs 3%; OR, 5.11; 95% CI: 1.26-20.69; $p < .03$). Similarly, Mansson et al. (2008) assessing broader psychiatric diagnoses, found women with PCOS ($n=49$) to have higher lifetime incidences of major depressive episodes, social phobia and eating disorders, compared to age matched population controls ($n=49$) (all $p < .05$). Moreover, in a cross-sectional community based study on predictors of mental health distress in women with PCOS ($n=177$) and healthy controls ($n=109$), Deeks et al. (2011) reported that women with PCOS had higher levels on the Hospital Anxiety and Depression Scale and poor body image, as indexed on 7 out of 10 scales of the Multidimensional Body-Self Regulations Questionnaire.

With specific reference to eating pathology, McCluskey et al. (1991) explored the prevalence of bulimia nervosa in PCOS women attending an endocrinology outpatient clinic using the Bulimia Investigation Test, Edinburgh (BITE). The 153 women who had been diagnosed with PCOS had a higher incidence of bulimic symptoms than a comparative group of 109 women with other organic endocrinopathies (6% versus 1%). This finding of increased symptoms of eating pathology in women with PCOS has been supported by Jahanfar et al. (1991) and Lee et al. (2017).

Recruiting women registered with the Australian National Health and Medical Council twin registry, Jahanfar et al. (1991) explored the relationship between one aspect of PCOS (i.e. ovary morphology) and symptoms of BN. Using the BITE to detect eating pathology and transabdominal ultrasound to determine evidence of polycystic ovary morphology, Jahanfar et al. (1991) found that women with manifestations of polycystic ovary (PCO) exhibited higher mean BITE scores than women with normal ovary morphology ($p < .001$). Moreover, the groups were divergent on severity of eating pathology, with 20.6% of women with PCO (7/34) compared to 2.5% of non-PCO women (1/40), having attained BITE scores in the moderate-severe range. The authors concluded that symptoms of BN appeared to be associated with polycystic ovaries.

In the most recent investigation on PCOS, Lee et al. (2017) explored the prevalence of eating pathology in non-conceiving PCOS women ($n=148$) attending an outpatient university clinic for routine gynaecological care. Women with PCOS were compared to non-PCOS women ($n=106$) on the EDE-Q (Fairburn & Beglin, 2008) and measures of anxiety, depression, quality of life and night eating behaviours. The researchers found that compared to controls, women with PCOS had higher levels of eating pathology scores across all scales of the EDE-Q, and higher levels of anxiety and depression compared to the control group of women (all $p < .05$). Having PCOS was also inversely associated with total quality of life score ($r = -0.57$). No differences between groups were observed on night eating behaviours ($p=.20$). Using multivariate analysis to control for BMI, the researchers found that compared to controls, PCOS women had higher odds of having elevated EDE-Q global scores (score ≥ 4) (Adjusted OR, 4.67; 95% CI, 1.16, 18.80). This risk was magnified in the presence of symptoms of anxiety (Adjusted OR, 5.91; 95% CI, 0.61, 56.9). The authors concluded that women with PCOS with co-occurring symptoms of anxiety were at higher risk of disordered eating psychopathology and lower quality of life, warranting mental health screening.

Notwithstanding the findings by Lee et al., (2017), which emerged post publication of *Study Two* (see Chapter 5), an inspection of the above-mentioned studies in this area reveals several limitations. First, in several PCOS studies, there has been a failure to control for the influence of BMI on mood or measures of eating pathology. Consequently, it is unclear whether the reported differences in psychopathology vary in relation to BMI status or are secondary to the diagnosis and/or physical

features of PCOS. Secondly, a review of the literature demonstrates that the majority of the PCOS and mood studies (including the study by Lee et al., 2017) have primarily been conducted on non-fertility attempting cohorts with diverse clinical concerns rather than partnered women focussing on a life circumstance such as infertility. As previously highlighted, a diagnosis of PCOS may confer different health, psychological and relationship implications across the lifespan (e.g. desire for conception versus desire for contraception) (Cussons et al., 2005; Pasquali et al., 2006; Teede et al., 2010). Consequently, it may be inappropriate to extrapolate the mental health findings determined from community based or university cohorts of women with PCOS, to partnered women with PCOS actively seeking fertility treatment. Finally, and not considered in previous investigations of weight status and reproductive health, are the measures used to detect mood. To date, studies exploring the mental health of women with PCOS have used standardized measures of mood relevant to a community population but which may be insensitive to detect infertility specific concerns. To further advance the knowledge on the relationship between weight status, mood and infertility, use of an infertility specific measure is important. The Fertility Problem Inventory (FPI) (Newton et al., 1997) is a measure that gauges infertility specific stress across five domains of life including social, sexual and relationship concerns, expressed need for parenthood and attitudes towards a child-free lifestyle. This measure has never been appraised in the context of patient weight status and is of interest to explore as it provides an overall global measure of infertility specific distress. Therefore, if weight status is associated with distress in infertile women, it is anticipated that FPI will differentiate weight groups.

In summary, the community based findings on weight status and mood reported in earlier studies may have limited generalization to infertile women undergoing fertility treatment. Thus, research exploring the interface between obesity and psychological vulnerability inclusive of an infertility specific distress measure in women undergoing fertility treatment is warranted. Furthermore, research that considers the assessment of mood specifically in the context of PCOS/non-PCOS women who are undergoing fertility treatment and which addresses the confounding variable BMI is limited, contributing to the rationale for *Study Two* (see Chapter 5). Importantly, information about weight-related psychological profiles may be beneficial in the early identification of at risk

patients for psychological burden including eating pathology. This may help define information about targets for intervention in preconception care (Frieder et al., 2008; Gameiro et al., 2012).

2.4 Understanding the Manifestations of the Stress Response and Coping Style

Stress, a complex term to define, is considered a biopsychosocial health phenomenon that is described interchangeably in the literature as both a stimulus (stressor) and a response (Ice & James, 2007). Several factors help shape an individual's response to a stressor. These include the nature, duration and severity of the stressor in addition to the individual's fundamental personality characteristics and coping style (Lazarus & Folkman, 1984; Carver & Connor-Smith, 2010). As a biopsychosocial health problem, there are at least three inter-related pathways by which stress could affect reproduction and psychological wellbeing in women undergoing fertility treatment. These include physiological mechanisms, psychosocial pathways and the endorsement of maladaptive lifestyle behaviours, reported to disrupt optimal reproductive functioning (Schneiderman et al., 2005).

From the physiological perspective, there are two axes of the stress response, these being the sympathetic nervous system and the hypothalamic-pituitary-adrenal cortical axis (HPA). The HPA axis is a key component of the stress response. In times of stress, corticotrophin releasing hormone (CRH) is secreted from the paraventricular nucleus of the hypothalamus, triggering the anterior pituitary gland to release adrenocorticotrophic hormone (ACTH). A primary function of ACTH when released into the bloodstream is to activate the adrenal cortex to produce the stress hormone cortisol (Dickerson & Kemeny, 2004; Schneiderman et al., 2005; Miller et al., 2007; Gordon, 2010). As seen in Figure 3, elevated cortisol has a widespread effect on physiological systems throughout the body relevant to eating and fertility. This includes changes in neurotransmitters associated with hunger and pleasure, a reduction in thyroid functioning, a decrease in leptin, an increase in ghrelin, and from a fertility perspective, a down regulation of the HPO axis (Berga, 2008; Chuang & Zigman, 2010; Gordon, 2010; Evans & Anderson, 2012; Frank, 2013). Stress, therefore, has the potential to contribute to infertility by affecting the signalling pathways of the hypothalamus impacting hormonal equilibrium and thereby disrupting ovulation and chances of fertilization and implantation.

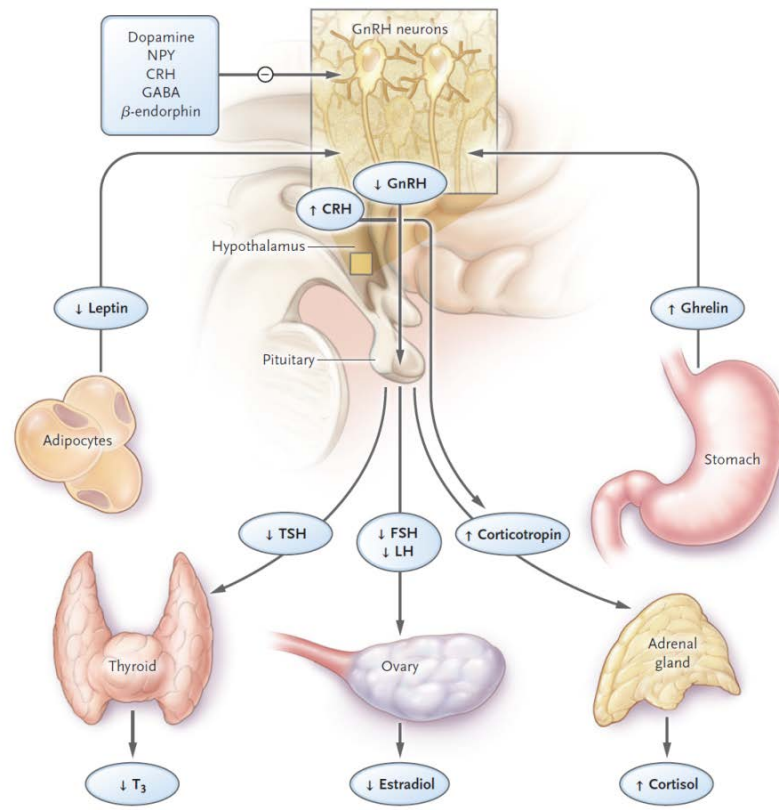


Figure 3: Key physiological changes following increases in level of cortisol and links between nutrition and reproduction. These include suppression of the hypothalamic-pituitary-ovarian-axis and changes in peripheral appetite hormones mediated by signals emanating from adipose, gastrointestinal and other endocrine tissues (Reproduced with permission from Gordon, 2010, p. 366. Copyright Massachusetts Medical Society).

From the perspective of psychological pathways, psychological reactivity to a stressor involves a subjective appraisal and a coping process (Lazarus, 1966; Lazarus & Folkman, 1984). According to Lazarus and Folkman (1984), stress must first be appraised as threatening to an individual's personal, physical or psychological integrity before it can be perceived as stressful. It is then through the appraisal and perception of the event that an individual endorses a particular course of action to emotionally or behaviourally cope, as a means to reduce the affective intensity of the stressor (Lazarus & Folkman, 1984).

Behaviourally, studies have shown associations between stress and negative externalizing behaviours (Kassel et al., 2003; Park & Iacocca, 2014; Clark et al., 2016). Common maladaptive health behaviours are triggered including the use of alcohol and drug consumption, nicotine use and emotional over-eating or under-eating (Greeno & Wing, 1994; Ball & Lee, 2000; Homan et al., 2007; Gormack et al., 2015). Thus, an individual's coping style can influence the behavioural manifestations of stress (Lazarus & Folkman, 1984). In preconception care, these behaviours are recognised as having the potential to influence reproductive functioning or fertility treatment outcomes due to their reciprocal inhibitory effect on ovulatory function (Hassan & Killick, 2004; Homan et al., 2007; Gormack et al., 2015).

To establish the rationale for *Study Three* (see Chapter 6), the next section of this thesis provides an overview of a theoretical model integrating the concepts of stress and coping style, i.e. the Transactional Model of Stress and Coping (Lazarus & Folkman, 1984). This will be followed by a discussion of the role played by avoidant coping style in the independent research areas of perceived stress and infertility and then perceived stress and eating pathology.

2.4.1 Transactional Model of Stress and Coping

The Transactional Model of Stress and Coping is a framework that evaluates coping with the physiological and psychological components of stressful situations (Lazarus & Folkman, 1984). It recognizes that the stress response is dependent upon the personal ramifications placed upon a stressful situation by the perceiver (Lazarus, 1966; Glanz et al., 2008). Lazarus and Folkman (1984) defined coping as cognitive and behavioural strategies used to manage encounters, either internally or

externally driven, that are appraised as taxing or exceeding that individual's resources. Coping is therefore initiated in response to a perceived stressor, however, as a dynamic process, can vary across the course of stressful conditions (Lazarus & Folkman, 1984; Boivin & Lancaster, 2010). In addition, coping strategies can either be construed as reactive (i.e. situational) or dispositional (i.e. trait-based or habitual) (Moos & Holahan, 2003).

Whilst various terminology has been used to describe categories of coping style (Skinner et al., 2003), three primary coping styles have been examined in the independent fields of infertility and eating disorders literature. These are problem-focused coping (i.e. active-approach oriented strategies to proactively manage the stress), emotion-focussed strategies (i.e. strategies involving cognitive re-appraisal or adaptation techniques aimed to emotionally manage stressful situations typically viewed as uncontrollable) and avoidant-coping (cognitive or behavioural strategies which incorporate elements of denial, distraction, escapism or social diversion from the stressor) (Lazarus & Folkman, 1984; Endler & Parker, 1990b; Aldao et al., 2010). Studies generally demonstrate that individuals who endorse the use of an active approach/problem-focussed coping style (e.g. problem solving and seeking information) tend to adapt better to stress and stressful situations and report greater emotional and physical health (Holahan & Moos, 1991). This contrasts to individuals who primarily rely on the use of avoidant coping strategies such as denial, distraction and disengagement, who report poorer emotional and physical outcomes (Moos & Holahan, 2003; Holahan et al., 2005; Yu & Sheerman, 2015).

2.4.2 Infertility, Perceived Stress and Avoidant Coping Style

For many women diagnosed with infertility, the experience creates significant psychosocial challenges. Unexpected diagnosis, changes in self-identity, impairment to mood, changes in intimate sexual relationships and challenges in managing the rigors and uncertainty of fertility treatment processes, can exhaust a woman's capacity to cope, culminating in higher levels of perceived stress (Wilson & Kopitke, 2002; Cousineau & Domar, 2007; Zurlo et al., 2018). High infertility related stress and concomitant psychological burden also increases the likelihood of premature discontinuation of fertility treatment, even in those situations where unlimited treatment is funded by

national health services (Boivin et al., 2012; Gameiro et al., 2012; Lande et al., 2015). Consequently, it is pivotal to understand how women cope with stress as they undergo their fertility treatment.

A number of studies have examined the coping style used by women embarking upon fertility treatment (Hynes et al., 1992; Litt et al., 1992; Edelman et al., 1994; Terry & Hynes, 1998; Lancaster & Boivin, 2005; Schmidt et al., 2005a; Peterson et al., 2009; Van Den Broeck et al., 2010; Gourounti et al., 2012). Much of the literature in this area has focussed on three aspects of coping style: (i) type of coping style endorsed by the infertile patient particularly in situations of perceived low control, (ii) the impact of coping style on mood/distress and relationships, and (iii) the dynamic aspects of coping style endorsed according to temporal factors, i.e. duration or stage of treatment.

For instance, after controlling for initial levels of distress, Hynes et al. (1992) examined mood and coping style (active-problem focussed and avoidant-oriented) in 100 infertile women who were attending an ART clinic and compared these to 73 fertile control participants. Assessing symptoms of depression, confidence and self-esteem at two time points (i.e. prior to and post IVF treatment), the authors found that women who endorsed problem-focussed coping strategies experienced lower levels of negative emotions. The authors further observed that the use of avoidant coping strategies was associated with lower levels of wellbeing, as was the seeking of social support, following a negative treatment outcome.

Research shows that an individual's sense of controllability and coping style endorsed can influence adaptation to a stressful situation (Lazarus & Folkman, 1984). Exploring this hypothesis, Litt et al. (1992) interviewed 41 couples undergoing their first IVF treatment. Issues that were assessed included pre-treatment emotional status, impact of infertility on relationship with others, their perceptions of control over life, coping strategies and a measure of post fertility treatment adjustment. The authors concluded that participant coping style characterized by trait optimism was protective of mental health whilst use of avoidant-oriented, 'escapist' coping strategies accompanied by a general sense of low control predicted poorest emotional adjustment in infertile patients. These findings about the negative effects of avoidant-oriented coping strategies in situations of low control were further corroborated in a subsequent study by Terry and Hynes (1998). Terry and Hynes (1998) concluded that the utilization of avoidant-oriented coping strategies by IVF patients following failed IVF (a low

control situation) was maladaptive to emotional adjustment not only in the short-term, but longitudinally (i.e. up to eight weeks), post failed-IVF treatment outcome.

With a focus on gender differences and longitudinal infertility outcomes, Schmidt et al. (2005a) investigated coping and communication styles as predictors of infertility-related distress in 816 individuals requiring fertility treatment. Participants in this study included men and women who were initially assessed at treatment baseline and then reviewed 12 months later if they had not achieved a pregnancy or birth. At pre-treatment baseline participants were assessed on their communication style and four types of coping strategies. These being: (i) active-avoidance strategies, (ii) active-confronting strategies, (iii) passive-avoidance strategies, and (iv) meaning-based, positive re-appraisal coping. Schmidt et al. (2005a) found women who endorsed avoidant-oriented coping strategies (e.g. avoidance of proximity to pregnant women and children; distraction with work) exhibited higher levels of infertility distress. In contrast women who utilized positive meaning based coping techniques over time experienced a reduction of infertility specific distress. Similarly, men who utilized active assistance from others reported lower infertility related distress.

In a study designed to investigate the dynamic nature of coping, Boivin and Lancaster (2010) monitored daily emotions and coping style in 61 women across various stages of an active IVF treatment cycle: (i) 7-days of active hormone stimulation, (ii) 7-days prior to receiving pregnancy test results, (iii) pregnancy test result day, and (iv) 3-days post pregnancy test result. The investigators found that both mood and trait optimism coping style varied to fit the demands and stages of fertility treatment, with depression and anxiety being lowest in the active stimulation phase and increasing as the patient approached their pregnancy test day. Depression levels were highest upon receiving a negative pregnancy result. The authors concluded that coping styles endorsed in the earlier stages of treatment were characterized by distraction strategies and seeking support strategies. In the waiting stage of IVF treatment coping strategies were less differentiated, on the pregnancy test day seeking support peaked, whilst in the post pregnancy period coping became more directed towards acceptance-oriented techniques. Clinically, this study highlights the importance of facilitating coping strategies that suit the different stages and challenges of fertility treatment.

Gourounti et al. (2012) further re-visited the issue of low sense of control in a Greek population of women ($n=137$) undergoing an IVF treatment cycle. This study investigated mood, perceptions of control and coping style. Improving upon previous research designs this study included a larger sample size and controlled for potentially confounding demographic variables. The researchers concluded that perceptions of a low personal level of control and use of avoidance-oriented coping strategies were both associated with increased levels of patient distress, re-affirming the findings of Litt et al. (1992) on emotional adjustment.

In summary, the endorsement of an avoidant-oriented coping style by infertile patients is associated with poorer adjustment preceding IVF treatment, during and post IVF treatment (Hynes et al., 1992; Litt et al., 1992; Terry & Hynes, 1998; Schmidt et al., 2005a; Gourounti et al., 2012). To date, however, empirical investigations within the ART field have focussed on the role of coping style as it relates to psychological adjustment and fertility treatment outcomes. Whether the endorsement of avoidant coping strategies serves as an antecedent to stress related maladaptive lifestyle behaviours relevant to infertility, however, has not been previously assessed within an infertility context. Thus, as a prelude to *Study Three*, the concepts of avoidant coping style and stress as they pertain to one dimension of a behavioural manifestation of stress (i.e. eating pathology) will be discussed.

2.4.3 Perceived Stress, Eating Pathology and Avoidant Coping Style

Stress is recognised as a precipitator to changes in eating behaviours (Greeno & Wing, 1994; Ball & Lee, 2000; Dallman et al., 2005; Adam & Epel, 2007; Goldfield et al., 2008; Costarelli & Patsai, 2012). Eating pathology occurs both as a physiologically and psychologically driven behaviour. That is, stress may disrupt normal appetite regulation through neuroendocrine pathways impacting upon eating behaviours influencing food selection and calorie consumption (Oliver & Wardle, 1999; Crowther et al., 2001; Gluck, 2006; Adam & Epel, 2007; Newman et al., 2007; Habhab et al., 2009; Dallman, 2010). Alternatively, disturbed eating behaviours may emerge secondary to the appraisal of stress leading to disinhibited and increased comfort eating. These behavioural observations have been reported in diverse investigations involving animal and human paradigms, stress-induced laboratory experiments, naturalistic situations and intervention studies (Greeno &

Wing, 1994; Ball & Lee, 2000; Coyne & Racioppo, 2000; Epel et al., 2001; Pendleton et al. 2001; O'Connor et al., 2008; Hilbert et al., 2011; Klatzkin et al., 2016).

For instance, Epel et al. (2001) in a laboratory-based study of 59 healthy pre-menopausal women exposed to laboratory stressor challenges (a visuospatial puzzle, mental number subtraction task and delivering of a video-taped speech), explored post stress snacking intake. Assessing salivary samples of the stress hormone cortisol and self-reported measures of negative mood, the researchers found that increases in perceived stress were positively associated with increases in cortisol and with episodes of overeating, particularly sweet foods. This observation was magnified in women who at baseline had higher negative mood and who were high cortisol reactors, highlighting both psychological and physiological factors as relevant to explore in stress-induced eating behaviours.

Crowther et al. (2001) investigated the impact of stress on binge eating behaviour in 17 normal weight undergraduate students who were assessed to be binge eaters and compared them to 17 female controls without binge eating patterns. All participants completed a life hassle scale gauging frequency of stress in various life domains over a 14-day period and maintained a daily food schedule which charted daily eating episodes. This study found that binge eaters did not report a greater frequency of stressful events compared to non-binge eaters, however, binge eaters rated daily life hassles as significantly more stressful and in response, consumed significantly more calories during high stress days.

Similarly, Pendleton et al. (2001) further explored the influence of life stressors on eating behaviours in 62 obese women with BED who were undergoing intervention for their BED disorder. The influence of negative life event stressors (e.g. death) versus positive life stressors (e.g. marriage) on frequency of binge eating were explored over a 16-month intervention period. Pendleton et al. (2001) found that participants who reported high levels of negative stress endorsed binge eating episodes 3.3 times greater than individuals who experienced low levels of negative stress. The authors concluded that positive stressors were not associated with treatment outcome. Rather, level of negative life stressors predicted the rate at which binge eating changed during the course of treatment.

Examining the relationship between different types of life hassles and eating style on snacking activity, O'Connor et al. (2008) also concluded that stress promoted snacking behaviours, particularly

in those individuals with vulnerable eating styles. In this large field study, 422 participants completed a daily diary on daily hassles and food intake across a 4-week time span. The aims of this study were to determine what types of stressors (i.e. physical, interpersonal, ego-sensitive or work-related) led to increased levels of snacking and what type of snacks were consumed. The researchers found that daily hassles were associated with selection of comfort high fat and sugar food and a reduction in main meals and vegetable consumption, highlighting the role played by stressors in the disruption of food intake. Moreover, ego-threatening, work and interpersonal life stressors resulted in greater snacking behaviours than did physical stressors. Importantly, this study revealed that whilst stress generally increased hassle-snacking behaviours, snacking was particularly marked in those individuals characterized by pre-existing emotional eating tendencies. Collectively this study, and the aforementioned studies suggest, that perceived stress and different forms of stress, particularly negative, ego-sensitive and interpersonal forms of life stress, contribute to increased snacking and binge eating behaviours, which longitudinally can be problematic owing to the association between binge eating and obesity.

There is however another body of literature that postulates that women who engage in maladaptive eating patterns endorse less adaptive coping strategies to emotionally deal with the demands of stressful events (Schmidt & Treasure, 2006). Specifically, avoidant coping style has been linked to disordered eating attitudes and behaviours (Heatherton & Baumeister, 1991; Troop et al. 1994; Freeman & Gil, 2004; Spoor et al. 2007; Sulkowski et al., 2011). For example, Freeman and Gil (2004) reported in a study of 46 binge eating college students who kept daily diaries, that higher levels of psychological stress, depressed affect and use of distraction coping strategies were associated with a greater likelihood of same-day binge eating. When women accessed social support as an adaptive coping mechanism, this reduced the risk of binge eating that day. Of all variables, distraction, a form of avoidant-oriented coping, was found to be the only variable positively associated with an increased risk of next-day binge eating.

Exploring the relationship between emotion regulation and emotional eating, Spoor et al. (2007) investigated coping styles in 125 women diagnosed with an eating disorder (AN = 31; BN = 40; BED = 37; EDNOS = 15; Unspecified = 2) recruited through a Danish outpatient mental health

institute. Participants were compared to a group of community based, non-eating disordered women ($n=132$). Women were assessed on measures relating to negative affect, dimensions of coping style (Positive and Negative Affect Schedule, Watson et al., 1988; Coping Inventory for Stressful Situations; Endler & Parker, 1990a) and emotional eating pathology. The researchers found that emotion oriented and avoidance-distraction strategies were associated with emotional eating in both groups. However, when compared to the community group, women in the eating disorder group had higher mean scores on emotional eating, emotion-oriented and avoidance distraction coping strategies and endorsed a lower use of active/task-oriented strategies (all $p < .01$).

Davies et al. (2011) further examined the role of coping strategies and co-morbid psychopathology as predictors to symptom reduction (bulimic symptoms and emotional eating) in 93 eating disordered patients aged 18-57 years. Coping styles were assessed with the Utrecht Coping List (Scheurs et al., 1993), yielding three coping factors for analysis. These factors were, 'Active Problem Solving by Seeking Social Support', 'Active Problem Solving by Reassuring Thoughts' and 'Passive/Palliative Reactions' reflective of avoidance distraction strategies. This study highlighted: (i) that active problem solving with reassuring thoughts was associated with greatest improvements in bulimic symptoms, (ii) that low level of patient psychopathology was prognostic of improved changes to eating pathology, and (iii) patient endorsement of a passive/avoidance distraction coping style was associated with smaller improvements in levels of emotional eating and bulimic symptomatology. The authors concluded that patients who endorse avoidant oriented strategies could benefit from learning new adaptive active coping skills to deal with their emotions.

2.4.4 Integrated Perspective: Perceived Stress, Coping Style, Eating Pathology and Infertile Women

Evidence exists that stress levels and coping strategies have an impact upon the presence of eating pathology (Greeno & Wing, 1994; Troop et al., 1994; Epel et al., 2001; Spoor et al., 2007; O'Connor et al., 2008; Davies et al., 2011). These findings have been extrapolated from diverse research populations. Currently there is also accumulating evidence of eating pathology in women undergoing fertility treatment (see Section 2.2 of this thesis). However, an investigation of

contributing factors to eating pathology specifically within the infertility population remains unexplored, representing a gap of knowledge within the infertility literature.

Since little definitive information about perceived stress, maladaptive coping efforts and their relationship to eating pathology in infertile women is known, the primary objective of *Study Three* (see Chapter 6) was to examine the effects of perceived stress on eating pathology and then to investigate the potential mediating role that avoidant cope style may play in this relationship. *Study Three* furthermore offers a methodological advantage to the investigation of stress, coping and eating studies as the involvement of infertile patients undergoing stressful fertility treatments (Domar et al., 1993), provides a robust and naturalistic framework for the investigation of the stress and eating pathology paradigm.

2.5 Challenges for Fertility Specialist Providers (Mental Health Literacy)

Although the medical and psychological complications associated with eating pathology can be severe, timely screening for an eating disorder, facilitating early detection and clinical intervention, can significantly improve outcomes (Hill et al., 2010; Gilbert et al., 2012). Mental health literacy (MHL), a term coined by Jorm et al. (1997), encompasses knowledge about an individual's capacity to recognize aspects of psychological disorders, including knowledge relating to aetiology, physical symptoms, risk factors and awareness about referral pathways for mental health care.

The detection of eating pathology can be challenging for health care providers as women with eating disorders may not openly disclose their illness, may minimise symptoms and can be in denial about the magnitude of their eating disorder (Mitchell-Gielegheem et al., 2002; Becker et al., 2005; Ali et al., 2017). This in part, can be due, to issues of a patient's sense of shame and perceived stigma (Crisafulli et al., 2008; Bannatyne & Stapleton, 2015; Ali et al., 2017). Detection of eating pathology can be further complicated as overt symptoms are not always evident. This can occur when women with an eating disorder present with BMI levels that are considered "healthy" by population health norms (WHO, 2000), albeit covertly being maintained by maladaptive eating and exercise practices. Factors relating to low clinical priority, blaming attitudes about patient responsibility for their eating disorders and time pressures to complete assessments for eating disorders may influence doctor

competence in this clinical area. Additionally, limited doctor confidence and tertiary training in eating disorders, doctor hesitancy to work outside mainstream clinical practice, and a low suspicion for disordered eating problems may also represent barriers for early detection (Fleming & Szmukler, 1992; Abraham, 2001; Clarke & Polimeni-Walker, 2004; Andersen & Ryan, 2009; Currin et al., 2009; Thompson-Brenner et al., 2012; Bannatyne & Stapleton, 2015).

Studies investigating the knowledge and attitudes of health specialists towards eating disorders have been completed across diverse medical disciplines (Fleming & Szmukler, 1992; Abraham et al., 2001; Currin et al., 2009; Linville et al., 2010; Jones et al., 2013), each yielding similar findings with respect to deficits in eating disorders MHL. For example, in one of the first Australian studies on MHL, Fleming and Szmukler (1992) investigated health professionals' attitudes towards patients presenting with an eating disorder who attended a general hospital. Both nurses and doctors ($N= 352$) reported viewing patients with AN, less favourably, compared to patients with other mental health issues (e.g. schizophrenia). Moreover, pejorative views were expressed about severity of illness and attributions of blame relating to the aetiology of AN, factors reflective of deficits in health provider MHL towards individuals with AN.

Abraham (2001) further explored MHL in the context of women undertaking antenatal care. In this study, 67 obstetricians completed a questionnaire gauging doctor practices relating to assessment and discussions about eating disorders, BMI, pre-pregnancy body weight and mood concerns during patient antenatal appointments. Abraham (2001) found that whilst the majority of obstetricians enquired about common maladaptive health behaviours such as alcohol consumption (84%) and smoking (96%), few doctors enquired about eating disorders at the patient's first antenatal visit (18%) and only 37% of obstetricians routinely asked/recorded a patient's pre-pregnancy body weight. Of concern, despite the clinical experience of this sample of obstetricians, two thirds of doctors (44/67) indicated that they had not seen a patient with an eating disorder within their practice over the last year, highlighting the low suspicion for eating disorders amongst this sample. This finding is concerning given the lifetime prevalence rate of major categories of eating disorders for women has been approximated to range between 5%-7.5% in the obstetric population (Bulik et al., 2007; Easter et al., 2013; Watson et al., 2014).

Using a mixed method approach, Linville et al. (2010) further investigated medical providers screening practices on eating disorders and training needs in a diverse sample of health care providers. Surveys were mailed to 750 potential respondents with 183 participants completing their survey. The researchers found that up to 78% of doctors were unsure how to treat patients with an eating disorder and 92% believed they had missed a diagnosis of an eating disorder in their clinical work. Approximately 54% of respondents supported the use of screening practices for eating disorders irrespective of patient presentation and 67% felt additional educational training and expert consultation in this area were essential. Another main objective of this study was to determine through qualitative interviews with health care providers, the barriers that influenced eating disorder MHL. Twelve participants completed a follow-up face-to-face, in-depth interview. Four themes emerged from the qualitative data: (i) reasons to avoid screening for eating disorders, (ii) training needs, (iii) challenges and barriers to working with eating disorders, and (iv) myths and assumptions hindering effective screening. Whilst the survey low response rate (24.5%) in this study is acknowledged by the authors, the quantitative and qualitative results resonate with other findings in this area.

In a study on 126 psychiatrists in the United Kingdom, Jones et al. (2013) found gaps in doctor knowledge and treatment confidence with regards to eating pathology. This study demonstrated that while 60.5% of psychiatrists were confident in their ability to diagnose eating disorders, few psychiatrists (approximately 14.9%) expressed confidence in their ability to manage eating disorders. In addition, a minority of psychiatrists (25.4%) indicated they were satisfied with their level of tertiary training on this area. When viewed in combination with the findings in other studies on MHL, deficits in clinical practice may serve to cloud clinical judgement impacting upon diagnosis, treatment and referral to relevant collaborative mental health networks.

As discussed in Chapter 1, symptoms of eating disorders present as significant concerns to women during their children bearing years (Hsu, 1989; Linna et al., 2014; Watson et al., 2014; Kimmel et al. 2016). Yet research evaluating eating disorders and MHL as they relate to the field of infertility is lacking. The proposition that fertility specialists as front-line doctors in women's health should routinely screen a patient for a lifetime history of an eating disorder when there is evidence of an ovulatory disorder has been previously raised in the reproductive medicine literature (Stewart et al.,

1990; Freizinger et al., 2010; Rodino et al., 2016a). This suggestion is important when viewed with the findings that women who have a lifetime history of an eating disorder do not tend to spontaneously disclose this history to their fertility specialist (Stewart et al., 1990; Freizinger et al., 2010; Rodino et al., 2016a), although are more likely to disclose if directly asked (Becker et al., 2005; Gilbert et al., 2012). Consequently, *Study Four* (see Chapter 7) was conceptualized to explore fertility specialist knowledge, attitudes and clinical practice skills with respect to assessment and referral of infertile patients with eating disorders. Moreover, in line with the common finding in MHL studies highlighting lack of training for health care professionals in the area of eating pathology, *Study Four* further endeavoured to explore fertility specialists training needs for this clinical area.

2.6 Significance and Original Contributions of Thesis

In summarising the background information, healthy female reproduction is an energetically costly process that is tightly regulated through an energy-monitoring network operated by the HPO axis. In line with LHT and evolutionary perspectives to reproduction, disordered eating attitudes and maladaptive behaviours can influence energy balance (deficits and excesses) and are therefore relevant to investigate in the context of preconception assessments for infertility. Relatedly, eating disorders are associated with psychological distress having implications for patient emotional wellbeing. Yet, despite the relevance of eating disorders to fertility, the literature review in the present chapter has highlighted the dearth of empirical literature within the infertility context in relation to prevalence of eating disorders, psychological correlates of distress associated with eating disorders, fertility doctor knowledge and training needs. This lack of research coupled with methodological limitations relating to sample size, clinical diversity, statistical analyses, limited range of psychological measures and issues relating to eating disorder MHL have been outlined. This thesis therefore aims to address these shortfalls. Awareness of these issues could assist fertility health care providers in improving infertility patient outcomes, including timely referrals for relevant mental health intervention programmes. Accordingly, the overarching aim of the thesis is to increase the understanding of the relationship between eating disorders in infertile women actively pursuing

fertility treatment and to provide both a patient and fertility health care provider perspective to this clinical area.

Four peer-reviewed publications emerged from two overarching projects associated with this thesis thereby contributing to the field in at least four distinctive ways. *Study One* contributed to the area of prevalence of eating disorders within an infertility context. This study expanded the earlier work of others by addressing methodological limitations of sample size, infertility category diversity and control of the confound BMI (Abraham et al., 1990; Stewart et al., 1990; Freizinger et al., 2010; Cousins et al., 2015; Coker et al., 2016).

Unique to infertility research, *Study Two* critically explored the relationship between weight status, psychological health and indices of eating pathology across infertile women with and without a diagnosis of PCOS and across categories of weight status. The study was distinctive not only in the use of well-established psychological measures but the inclusion of an infertility specific measure of distress, novel in its application to weight status. Moreover, *Study Two* controlled for the BMI confound not routinely adjusted for in studies on PCOS.

Measuring perceived stress, coping behaviours and eating patterns within community and laboratory contrived conditions may influence participant responses and may be different to an in-vivo appraisal of stress (Coyne & Racioppo, 2000). Consequently, the stress of fertility treatment, a naturalistic stressor with negative self-evaluative components, represents a framework for the investigation of an integrated model of stress, coping style and disordered eating. Using mediation analysis, *Study Three* served to integrate three areas of research, i.e. perceived stress, coping style and eating pathology, not previously explored within an infertility context.

The preconception phase represents a judicious opportunity to enquire about lifestyle factors that impinge upon fertility. *Study Four* is a novel investigation of the mental health literacy of Australian and New Zealand fertility specialists with respect to their knowledge, attitudes and clinical practices regarding eating pathology.

2.6.1 Study Objectives

The detailed aims of this thesis are summarized as follows:

Aims of Study One

- To investigate the incidence of eating disorders amongst women undergoing fertility treatment at an IVF clinic.
- To assess disclosure rates of past or current history of eating disorders to a fertility specialist.
- To assess the pattern of eating pathology according to category of infertility diagnosis whilst controlling for the influence of BMI.

Aims of Study Two

- To examine psychological vulnerabilities according to weight status in infertile women undertaking fertility treatment.
- To investigate psychological predictors of distress specific to infertile women with obesity.
- To examine psychological correlates in women with PCOS in comparison to women without PCOS, whilst controlling for the influence of BMI.

Aims of Study Three

- To determine whether stress predicts eating pathology within an infertility population.
- To test whether avoidant coping style mediates the relationship between stress and eating pathology in women undergoing fertility treatment.
- To ascertain whether level of perceived stress or avoidant coping style provides a superior explanation of eating pathology in women undergoing fertility treatment.

Aims of Study Four

- To assess fertility specialist knowledge and attitudes about eating pathology in infertile patients.
- To ascertain preconception clinical practices used by fertility specialists with respect to patients undergoing treatment for infertility.
- To gauge fertility specialists' training needs in regard to eating disorders.

2.6.2 Thesis Organization and Structure

The subsequent chapters of this thesis are presented as allowable and in accordance with The University of Western Australia PhD Rules 41.1c, as a series of four inter-related scientific papers (Chapters 4 through to 7). Each chapter has *Foreword*, *Introduction*, *Methods* and *Materials*, *Results* and *Discussion* sections, which explore the thesis aims as detailed in Section 2.6.1. These studies are preceded by Chapter 3, a *Materials* and *Methods* chapter. Some overlap in the details of the methodology sections in Chapters 3 to 6 is unavoidable, owing to the usage of the broader study design associated with Project One. The main findings relevant to the empirical studies in this thesis are then summarized and discussed in the *General Discussion* section in Chapter 8. In addition, Chapter 8 outlines consideration for future research and discusses the strengths and limitations of this thesis. Chapter 8 further proposes possible directions for the development of clinical guidelines and ends with concluding remarks. Lastly, whilst references are cited at the end of each published chapter (i.e. Chapters 4 to 7), an integrated bibliography of all references cited is provided.

CHAPTER 3

MATERIALS AND METHODS

3.1 FOREWORD

This thesis consists of two inter-related projects. *Studies One, Two and Three* (see Chapters 4 to 6) were derived from Project One and *Study Four* (see Chapter 7) advanced from research Project Two. Using standardized psychometric tests, Project One entitled, “Psychosocial Factors and Fertility Study” gauged the experiences of infertile female patients actively undergoing fertility treatment according to eating pathology, level of exercise and aspects of mood. Project Two, “Fertility Specialists’ Knowledge, Attitudes and Clinical Practices regarding Eating Disorders” elicited the perspectives of fertility specialists (gynaecologists) on their clinical practice and patient assessment strategies in regard to eating pathology.

This chapter provides an overview of the methodology used in these two projects. This includes general information in relation to the participants, recruitment process, study protocols, study measures, ethics approval and statistical analyses relevant to each of the projects. The information outlined in this chapter is presented in briefer form in the Methodology sections of respective Chapters 4 to 7 (i.e. *Studies One to Four*) in accordance with specific journal requirements.

3.2 Project One (*Studies One to Three*)

3.2.1 Participants

Four hundred and twenty-nine eligible participants represented the base cohort for Project One (utilized in *Studies One to Three*). This sample consisted of English speaking heterosexual infertile women aged between 20 to 47 years, who were actively trying to conceive. Women were all partnered and had been recruited from one of three fertility clinics located in Perth, Western Australia. Most participants did not have children (79%). Participants self-identified their ethnicity as Australian (58%), as being from the United Kingdom (12%), as European (11%), Asian (8%) and from New Zealand (3%). Participants who nominated alternative nationalities were collated into an “Other” ethnicity category (8%). Most participants (93%) indicated they did not smoke and a small proportion (13.5%) reported they completely abstained from alcohol consumption. As this study’s primary hypotheses were focussed on women who were presenting for active fertility treatment using their own gametes, women presenting for donor assisted conception, surrogacy arrangements, pre-genetic diagnosis or requiring fertility preservation were not targeted in the recruitment process.

Of the 429 patients, the primary self-reported causes of infertility problems were: 16% male factor related infertility (e.g. abnormality of semen parameters), 31% unexplained infertility (no abnormality detected on baseline endocrine and uterine assessments), 14% ovulatory disorders (excluding PCOS), 14% PCOS and 25% heterogeneous/other female causes (i.e. infertility primarily related to diverse uterine and tubal anatomical issues). Due to the anonymous nature of data collection, a review of patient health records could not be undertaken to verify the self-reported infertility diagnosis, although, all women included in Project One had been seen by their fertility specialist for confirmatory diagnosis and had commenced fertility treatment assessments and procedures.

Of respondents, approximately 39% were undergoing their first treatment cycle, 56% a repeated cycle with the remainder failing to provide a response. Reported treatments status was as follows: approximately 18% of women were undergoing tracking and/or OI, 18% were engaged in treatment using IUI, 37% were undertaking IVF treatment and 27% ICSI-related procedures.

3.2.2 Measures

In Project One (*Studies One to Three*), participants completed a battery of surveys with questionnaires designed to answer different aspects of this thesis. Table 1 located at the end of this chapter, delineates the 10 specific questionnaires used to achieve the objectives of each study. The psychometric questionnaires utilized in Project One have been widely used and validated within psychological research. The questionnaires used in this thesis, 'Participant Information Sheet' and 'Patient Debriefing' instructions are found in *Appendix A*.

3.2.2.1 Demographics Questionnaire

An author developed demographics questionnaire was used to obtain participant socio-demographic background information. Embedded within this questionnaire were key questions to capture information on age, anthropometric measures (weight, height), details of fertility treatments, social factors (ethnicity, relationship status, living arrangements, education level, occupation and income), lifestyle factors (exercise, smoking, alcohol habits and sleep duration), weight changes over the last 3 months (i.e. gains, losses), physical health status including medication use, reproductive history (infertility diagnosis including time trying to conceive) and mental health history inclusive of eating disorders.

BMI was calculated from self-reported height and weight with the ratio BMI derived from weight (kg)/height(m)². BMI was then categorised according to WHO (2000) recommendations as underweight (BMI < 18.5), normal (BMI between 18.5 and 24.9), overweight (BMI between 25 and 29.9) and obese (BMI ≥ 30).

Primary infertility category status was delineated according to key diagnostic nomenclature (Evers, 2002; Adamson & Baker, 2003; Speroff & Fritz, 2005). These included male factor infertility, unexplained infertility, ovulatory disorders, PCOS and a 'heterogeneous/other mixed group' inclusive of diverse anatomical factors. Fertility treatments were categorized according to cycle tracking with OI, IUI, IVF and ICSI. Participants further recorded whether their treatment cycle was an 'Initial' attempt at treatment versus a 'Repeat Cycle'.

Descriptive indicators of social factors including family structure (presence/absence of children), ethnicity (divided into 6-categories), education level (3-levels) and income level (8-bands) were ascertained. Presence or absence of lifestyle factors such as smoking and alcohol use, were first dichotomized as categorical variables (yes/no) and then qualified by a measure of frequency – daily, weekly, monthly and social occasions. Health parameters such as sleep were first defined in terms of number of hours of sleep during an average night followed by a rating of quality of sleep on a 5-item Likert scale. Health was rated on a 4-item Likert scale.

3.2.2.2 Eating Disorder Examination – Questionnaire (EDE- Q - Fairburn & Beglin, 2008)

The Eating Disorder Examination (EDE) is a semi-structured interview that assesses cognitive and behavioural factors relating to eating pathology (Fairburn & Cooper, 1993). Whilst the EDE is considered the ‘gold standard’ in structured clinical interviews for the diagnosis of an eating disorder, it is lengthier to administer and therefore from a resources perspective, less time and cost effective (Ro et al., 2015). The EDE-Q (Fairburn & Beglin, 2008) is a self-report measure of the full-length EDE interview (Fairburn & Cooper, 1993). It generates comparable subscale scores to the EDE and a high level of concordance between the interview format of the EDE and the self-report version of the EDE-Q has been demonstrated (Fairburn & Beglin, 1994; Mond et al., 2004b). The self-report EDE-Q provides the participant the advantage of anonymity on the disclosure of sensitive disordered eating attitudes and behaviours (Fairburn & Beglin, 1994).

In this thesis, the EDE-Q version 6.0 (Fairburn & Beglin, 2008) was used to gauge eating psychopathology. Respondents were asked to consider the previous 28 days and to indicate the number of days they felt best represented the item they were addressing. The EDE-Q has 22 attitudinal items giving rise to four subscales: (1) restraint, (2) shape concern, (3) eating concern, and (4) weight concern. An example of restraint is demonstrated by the statement, “*Have you gone for long periods of time (8 waking hours or more) without eating anything at all in order to influence your shape or weight.*” Shape concern is reflected in the statement, “*Have you had a definite desire to have a totally flat stomach?*” Eating concern is demonstrated by the item, “*Have you had a definite fear of losing*

control over eating?” and weight concern by the statement, *“How dissatisfied have you been with your weight?”*

Items for each of the EDE-Q subscales are rated on a 7-point Likert scale (0-6), with higher scores reflecting greater severity or frequency on that item and indicative of higher levels of eating psychopathology. Item scores within each subscale are summed and divided by the total number of items forming that subscale to give a subscale score. A global score of eating psychopathology can also be produced by the average of the four subscales. Subscales or a global EDE-Q score of four or more are deemed clinically significant (Fairburn & Beglin, 1994; Fairburn & Beglin, 2008).

The EDE-Q also contains an additional six diagnostic items allowing assessment of key features of disordered eating behaviours such as binge eating and bulimic maladaptive compensatory behaviours. For instance, it assesses the frequency of over-eating including objective bulimic episodes (OBE), vomiting, laxative misuse and engagement in “compulsive” exercise as a means to change weight and shape. Behavioural items are gauged as frequencies, number of episodes or days depending upon the questionnaire item. Self-induced vomiting or misuse of laxatives as a means to controlling weight or shape in excess of four or more times over a 28-day time frame, are considered clinically significant, as are 20 episodes or more of compulsive exercise (Luce et al., 2008; Lavender et al., 2010).

The robustness of the EDE-Q has been empirically investigated in studies with diverse clinical and community groups with good test-retest reliability (Mond et al., 2004b; Reas et al., 2006). Overall the EDE-Q has high internal consistency (Berg et al. 2012). For the present study, Cronbach’s alpha for this measure were as follows: EDE-Q Global = .93, Restraint = .73, Eating Concern = .75, Weight Concern = .83 and Shape Concern = .90. These alphas are in line with past research (Berg et al., 2012).

3.2.2.3 International Physical Activity Questionnaire (IPAQ – Craig et al., 2003)

The IPAQ is a widely used measure to gauge level of physical activity (low, moderate or vigorous) undertaken across leisure, home activities, work-related activities and transport. The IPAQ is suitable for assessing physical activity in young and middle-aged adults (Hagstromer et al., 2006).

There are two forms of the IPAQ. For brevity, the short form version of the IPAQ (Craig et al. 2003; IPAQ Research Committee, 2005) was used.

The short form version of the IPAQ has a reference period of seven days and consists of seven primary questions. Participant's report on the frequency (number of days), type of activity (e.g. walking, moderate or vigorous) and duration of time (hours, minutes) engaged in physical activity. The type of activity is assigned a weighting based on energy expenditure outlined in the compendium of physical activities (Ainsworth et al., 2000). The algorithms assigned for weightings are: walking=3.3, moderate activity = 4.0 and vigorous activity=8.0. A physical activity score based on metabolic equivalents of task (METS) is calculated by multiplying the duration of minutes that an individual is engaged in a specific level of activity, by the weighting assigned for that level of activity, by the number of days per week (see Figure 1). The METS provide a continuous variable of total METS suitable for analysis. The IPAQ can also be used as a categorical variable for analysis with low, moderate or high categories determined by MET criteria (Craig et al., 2003; IPAQ Research Committee, 2005).

Continuous Score

Expressed as MET-min per week: MET level x minutes of activity/day x days per week

Sample Calculation

MET levels

Walking = 3.3 METs
 Moderate Intensity = 4.0 METs
 Vigorous Intensity = 8.0 METs

MET-minutes/week for 30 min/day, 5 days

$3.3 \times 30 \times 5 = 495$ MET-minutes/week
 $4.0 \times 30 \times 5 = 600$ MET-minutes/week
 $8.0 \times 30 \times 5 = 1,200$ MET-minutes/week

TOTAL = 2,295 MET-minutes/week

Total MET-minutes/week = Walk (METs*min*days) + Mod (METs*min*days) + Vig (METs*min*days)

Figure 1: Sample calculation of Total METS. In this example an individual is engaged in 30 minutes of walking, 30 minutes of activity of moderate intensity and 30 minutes of vigorous intensity for five days of a week. Minutes per activity level are multiplied by designated activity weight loading being 3.3, 4.0 or 8 according to activity level and then multiplied by days engaged in the activity level. MET=metabolic equivalents; min=minutes; Walk=walking; Mod=moderate; Vig=vigorous (IPAQ Research Committee, 2005, p.13).

3.2.2.4 Rosenberg Self-Esteem Scale (RSES - Rosenberg, 1965)

The RSES is a 10-item scale widely used to gauge an individual's global level of self-esteem. The scale consists of positively and negatively worded statements and measures self-worth, self-confidence, self-satisfaction, self-respect and self-deprecation. A statement reflecting positive self-esteem is demonstrated in the test item, "*On the whole, I am satisfied with myself*". A test item indicative of lower self-esteem is, "*I wish I could have more respect for myself*". The RSES is scored on a 4-point Likert scale using response choices ranging from strongly agree to strongly disagree, with five items scored in the reverse direction. Item scores are summed to calculate the total RSES, with higher scores associated with a higher level of self-esteem. Overall Rosenberg (1965) reports that the RSES has demonstrated good construct validity and internal consistency across various population samples (alphas > .75). Cronbach's alpha for this measure in this study was .90.

3.2.2.5 Depression, Anxiety and Stress Scale (DASS-21 – Lovibond & Lovibond, 1995)

Symptoms of depression, anxiety and stress were measured using the 21-item Depression, Anxiety and Stress Scale (DASS-21; Lovibond & Lovibond, 1995). The DASS-21 consists of a set of three self-report scales designed to measure the extent an individual has experienced the negative emotional states of depression, anxiety and stress during the previous week. Variables such as dysphoria, helplessness, devaluation of life, self-deprecation, lack of interest/involvement, anhedonia and inertia are assessed on the depression dimension. Autonomic arousal, skeletal musculature effects, situational anxiety and subjective experience of anxious effects are elicited on the anxiety domain. Difficulty relaxing, nervous arousal, agitation, irritability/over-reactiveness and impatience are assessed on the stress dimension (Lovibond & Lovibond, 1995). Responses are made on a 4-point Likert scale ranging from "0=Did not apply to me at all" to "3=Applied to me very much", or "most of the time". Scores for depression, anxiety and stress are calculated by summing the scores for the relevant subscale items. On each subscale, higher scores reflect more severe symptoms. The subscales of the DASS-21 have been found to have high internal consistencies (Cronbach's alphas = .94, .87 and .91 for depression, anxiety and stress, respectively) (Antony et al., 1998). The depression, anxiety and

stress subscales in this study demonstrated comparable internal consistency (Cronbach's alpha = .90, .82 and .87 for depression, anxiety and stress, respectively).

3.2.2.6 Positive and Negative Affect Schedule (PANAS; Watson, Clark & Tellegen, 1988)

The PANAS is a 20-item scale used to measure both positive affect (PA) and negative affect (NA) dimensions of mood. Each subscale has 10 adjectives describing mood. Depending on how items are posed to the participant, the PANAS can be used to gauge dispositional/trait or transient/situational affect. In this study, the instruction to participants included the descriptor "on average" mood to gauge trait affect. Positive affect reflects the degree to which a person reports feeling enthusiastic, alert and active. Conversely, individuals in a state of negative affect exhibit negative moods suggestive of distress and unpleasurable engagement including hostility, fear and nervousness (Watson et al., 1998).

The PANAS asks participants to rate on a 5-point Likert scale the extent to which they generally experience each of the listed emotions (1=very slightly or not at all to 5=very much). The PA and NA affect subscales are determined by aggregating the 10 items with total scores ranging from 10 to 50. Higher scores represent higher levels on the respective subscale. Thus, a higher score on the PA dimension reflects greater positive affect (i.e. the participant is happier). Conversely, a higher score on the negative domain indicates greater negative affect (i.e. the patient is unhappier).

Watson et al. (1998) have investigated the PANAS scores across different time points (current, weekly, monthly) and found that the reliability and stability of scales are unaffected by time instructions. The PANAS has been demonstrated to have a relatively high internal consistency with the PA scale (alpha = .88) and NA (alpha = .87) over a general time-frame (Watson et al., 1988). These alphas have been replicated by Crawford and Henry (2004) with Cronbach's alpha estimated at 0.89 for PA and 0.85 for NA. The Cronbach alphas for the PA and NA in the present study were respectively .89 and .88.

3.2.2.7 Fertility Problem Inventory (FPI – Newton, Sherrard & Glavac, 1999)

The FPI is a 46-item questionnaire developed to measure infertility-specific stress. It was initially normed with individuals (1,153 women and 1,149 men) referred for medically assisted fertility treatment. The FPI conceptualizes five separate domains: (1) Social Concern, (2) Sexual Concern, (3) Relationship Concern, (4) Need for Parenthood, and (5) Rejection of a Childfree Lifestyle and produces an overall global infertility-related stress index.

The ‘Social Concern’ dimension relates to the social pressures and reminders of infertility by social interactions. This is reflected in the item, *“When I see families with children I feel left out”*. ‘Sexual Concern’ highlights the impact of infertility and ART treatment protocols on the couple’s sexual intimacy. An example being, *“I feel I have failed at sex”*. ‘Relationship Concern’ emphasizes communication differences and concerns about the impact of infertility on the relationship. This is demonstrated by the example, *“When we try to talk about our fertility problem, it seems to lead to an argument”*. The ‘Rejection of a Childfree Lifestyle’ items gauge the perception of whether an individual’s future happiness or satisfaction is dependent upon having a child. This is reflected in the statement, *“I could visualize a happy life together, without a child”*. ‘Need for Parenthood’ is exemplified by the close identification with the role of a parent, with parenthood perceived as a primary and essential goal to life. This is reflected in the statement, *“Pregnancy and childbirth are the two most important events in a couple’s relationship.”*

Raw scores for each subscale are calculated by summing responses indicated by individuals on a 6-point Likert scale (1=Strongly Disagree to 6=Strongly Agree), with 18 items reverse scored. The FPI-Global score is then determined by combining all the subscale scores. A higher score is indicative of a higher level of infertility specific stress. This measure has been demonstrated to possess high internal consistency, test-retest reliability and discriminant and convergent validity (Newton et al., 1999). Newton et al. (1999) report Cronbach’s alphas ranging from .77 (Sexual Concern) to .93 (Global Stress). For the present sample, the Cronbach’s alphas were comparable with alphas as follows: Social Concern (.85), Sexual Concern (.78), Relationship Concern (.86), Rejection of Childfree Lifestyle (.82) and Need for Parenthood (.83). The Cronbach’s alpha for the overall FPI Global stress score was .93.

3.2.2.8 Clinical Perfectionism Questionnaire (CPQ - Fairburn, Cooper & Shafran, 2003b).

Clinical perfectionism has been conceptualized as a pathological pursuit of demanding standards across various life domains typically pursued at a personal consequence. It has been applied to a range of adult mental health concerns, particularly eating disorders (Egan et al., 2016). The CPQ has been derived from the cognitive behavioural model proposed by Shafran et al. (2002) and assesses the behavioural and affective components of striving to meet goals and the consequences to this striving when goals have not been met. The CPQ is a 12-item self-report scale that asks participants to report on how they responded to situations over the last month. An example, “*Over the past month, have you kept trying to meet your standards, even if this has meant that you have missed out on things*”. Responses are rated on a 4-point Likert scale from “1=not at all” to “4=all of the time.” Two items are reverse scored. Scores range from 12 to 48 with higher scores signifying higher levels of perfectionism. Whilst the CPQ does not have extensive published data on reliability or validity, preliminary data suggests the test yields adequate convergent reliability and is able to distinguish between clinical and nonclinical populations (Chang & Sanna, 2012; Egan et al. 2016). Estimates of Cronbach’s reliability on the total CPQ score have ranged from .70 to .83 (Chang & Sanna, 2012; Steele et al., 2013). In this study the Cronbach’s alpha was comparable (.74).

3.2.2.9 The Brief Coping with Problems Experienced (Brief COPE - Carver, 1997)

The 28-item Brief COPE is a multidimensional instrument derived from the larger 60-item version of the COPE (Coping with Problems Experienced) inventory (Carver et al., 1989). The COPE was developed from two theoretical models investigating stress (Lazarus & Folkman, 1984) and behavioural self-regulation (Scheier & Carver, 1988). The Brief COPE is an abbreviated version of the COPE and can be used to measure dispositional coping reactions to stressful situations in adults aged 18 to 64 years of age (Carver, 1997).

The Brief COPE is comprised of 14 scales with each scale consisting of two items. Each scale assesses a conceptually different aspect of coping: (1) Active Coping (e.g. “*I take action to try to make the situation better*”); (2) Planning (e.g. “*I try to come up with a strategy about what to do*”); (3) Positive Re-Framing (e.g. “*I try to see it in a different light, to make it seem more positive*”); (4)

Acceptance (e.g. *“I accept the reality of the fact that it has happened”*); (5) Humour (e.g. *“I make fun of the situation”*); (6) Religion (e.g. *“I pray or meditate”*); (7) Using Emotional Support (e.g. *“I get comfort and understanding from others”*); (8) Using Instrumental Support (e.g. *“I get help and advice from other people”*); (9) Self-Distraction (e.g. *“I turn to work or other activities to take my mind off things”*); (10) Denial (e.g. *“I refuse to believe that it has happened”*); (11) Venting (e.g. *“I say things to let my unpleasant feelings escape”*); (12) Substance Use (e.g. *“I use alcohol or other drugs to make myself feel better”*); (13) Behavioural Disengagement (e.g. *“I give up trying to deal with it”*); and (14) Self-Blame (e.g. *“I blame myself for things that happened”*).

In this study participants rated how they “generally” responded to difficult or stressful events on a 4-point Likert scale from 1=Never to 4=Often. Therefore, with each scale consisting only of 2-items, total scores on any one scale could range from a minimum of two to a maximum of eight. Higher scores on any one scale indicate a higher frequency of use on that coping mechanism. Carver (1997) reports that the Brief COPE has acceptable internal consistency, with Cronbach’s alphas ranging from .50 (Venting) to .90 (Substance Use). In this study six coping scales were used to create the composite avoidant coping variable (see Chapter 6). These were denial, distraction, venting, self-blame, substance use and distraction. Cronbach’s alpha for the 12-item avoidant coping composite was .78.

3.2.2.10 Perceived Stress Scale (PSS - Cohen, Kamarck & Mermelstein, 1983)

The 14-item Perceived Stress Scale (PSS) measures the level of stress that an individual perceives they have experienced during the preceding month. It specifically measures the degree to which an individual appraises the situations in their life as being stressful in terms of unpredictability, uncontrollability and overload. For example, one item asks, *“In the last month how often have you been upset because of something that happened unexpectedly”*. Ratings are given using a 5-point Likert scale from 0=never to 4=very often, with seven items scored in the reverse direction. The total possible scores range from 0 to 56 with higher scores reflective of a higher level of perceived stress during the last month. The PSS-14 also has good construct validity due to its significant correlations with other measures of mood and inventories of life events (Cohen et al., 1983). High PSS scores have

also been correlated with biomarkers of stress such as cortisol (Van Eck & Nicholson, 1994). Previous research has demonstrated that the PSS has adequate internal reliability with internal consistency reported as ranging from .84 to .86 across diverse samples (Cohen et al., 1983). The Cronbach's alpha for this study was .88 suggestive of good internal consistency.

3.2.3 Procedure - Project One (*Studies One to Three*)

Initial patient recruitment was instigated by a fertility clinic nurse who introduced the PhD Candidate to patients who were waiting to have routine blood tests completed for their fertility treatment cycle. Participants who verbally acknowledged an interest in the study were given a study package and were advised of the aims and procedural requirements of Project One. As detailed in *Appendix A*, the study package included a Participant Information Sheet outlining a statement about consent to participate, the study questionnaires and a participant debriefing sheet. Included within the package was a pre-addressed postage paid envelope for anonymous questionnaire return.

Participants were verbally instructed that they were being invited to participate in a study investigating, "How do mood, behaviour and stress interact to affect fertility?" and that participation was voluntary. Patients were informed that in entirety the study questionnaire package took approximately one hour to complete and could be completed in the privacy of their own home over the next two weeks. Participants were advised that they should not record their names or any other identifying details on their completed questionnaires and that the questionnaires should be returned in the included pre-paid envelope addressed to The University of Western Australia, rather than their treating fertility clinic. This was to ensure that their participation remained confidential both to their fertility clinic and to the PhD Candidate. Participants were informed that their survey data would be aggregated for the purposes of analyses for this thesis and would also be utilized in conference oral presentations and publications.

During the months of June 2011 to June 2012, 1000 study survey packs were distributed by the PhD Candidate to patients attending one of three fertility clinics. These being Concept Fertility Centre (450 patients), Fertility North (300 patients) and Hollywood Fertility Centre (250 patients). Of survey packs issued, a total of 445 participants returned their completed questionnaires, although data

from 16 participants could not be used as the patients reported they were pregnant. Thus, for the purposes of Project One, data from 429 patients (Concept Fertility Centre, $n = 193$; Fertility North, $n = 117$; Hollywood Fertility Centre, $n = 119$) were used as the base dataset for *Studies One to Three*.

The decision to use self-administered surveys to elicit data, as opposed to direct interviews, was to provide patients, who were undergoing fertility treatment, a format of confidentiality and comfort to disclose sensitive psychological information at their own discretion. All aspects of the methodology including ethics approval, participant recruitment, completion of the questionnaire battery, participant consent and participant debriefing sheet were identical for each of *Studies One to Three*. Project One was approved by the Human Research Ethics Committee (HREC) of The University of Western Australia (reference RA/4/1/4642) and by the HREC boards of Joondalup Health Campus and Hollywood Private Hospital, respectively responsible for managing ethics applications for the participating fertility clinics (HREC References: JHC1111; HPH334). *Appendix B* outlines details of HREC Project approvals.

3.3 Project Two (*Study Four*)

3.3.1 Participants

Participants were English speaking male and female Fertility Specialists (i.e. gynaecologists) who practiced in Australia and New Zealand. Gynaecologists having special interests in male factor infertility, endometriosis, fertility preservation, pelvic surgery, PCOS and menopause were included. All participants were current members of the Fertility Society of Australia (FSA), Australia and New Zealand's peak professional body dedicated to the treatment of infertility (<https://www.fertilitysociety.com.au/home/about/>).

3.3.2 Online Doctor Survey

The online survey used in *Study Four*, was adapted from a study protocol previously utilized in an investigation of mental health literacy (MHL) in psychiatrists practicing in the United Kingdom (Jones et al., 2013). With permission of the principal author (Jones et al., 2013), the questionnaire was modified to include participant specific demographics and medical practice areas relevant to

infertility. Details of the study protocol are found in *Appendix C*. This includes the Participant Information Sheet, a statement about what participation involved, information about data management and participation and consent statements. The online survey consisted of five sections: (1) Participant demographics (6 questions gauging gender, age, location of practice, years in practice, participation in advanced training, and special clinical interests), (2) Assessment of current practice protocols (12 questions), (3) Knowledge of diagnostic criteria questions relating to anorexia nervosa, bulimia nervosa and binge eating disorder (17 diagnostic items), (4) Attitudes to eating disorders (7-items rated on a 5-point Likert scale from ‘Do Not Agree’ to ‘Strongly Agree’), and (5) Training needs (4 questions rated on a 5-point Likert scale from ‘Strongly Disagree’ to ‘Strongly Agree’).

3.3.3 Procedure

Prior to participant recruitment, to ensure correct terminology and interpretation of items, the survey was piloted on three fertility clinic staff members; two fertility specialists and the scientific director from Concept Fertility Centre. These data were not used in the formal study analyses.

With approval of the FSA, all fertility specialist members were emailed a link to the online survey by a senior Western Australian Fertility Specialist. To encourage participation, two follow-up reminder emails were sent to doctors. The questionnaire took approximately 10-minutes to complete. Data were collected between February 2014 and August 2014. The online survey protocol was approved by the HREC of The University of Western Australia (reference RA/4/6552 – *Appendix B*).

Anonymous completion of the questionnaire through online methodology rather than interview was considered more suitable due to the ease of transnational data collection and time effectiveness for participants. Moreover, it provided a benign forum for eliciting sensitive information about doctor competency in their knowledge about eating disorders and endorsement of clinical practice protocols.

3.4 Data Management and Analyses (*Studies One to Four*)

In *Studies One to Four*, all data were first observed for outliers to ensure accurate data entry and screened for missing or aberrant values. Sporadic missing values which were assumed to be

random in nature were imputed with scale item averages where necessary (Tabachnick & Fidell, 2001). Within any study, where subscales were missing more than 10% of responses, that subscale was omitted from analysis. Skewed data distributions were transformed to normality using either a Log or square root transformation as appropriate. Whilst transformed variables were used for significance testing, for clarity, untransformed data were reported for descriptive statistics.

All analyses in this thesis were performed using Microsoft Excel software and Statistical Package for Social Sciences (SPSS for Windows, Chicago, SPSS Inc.). SPSS versions 20 to 24 were used across the course of this thesis. In *Study Three* AMOS (analysis of moment structures), version 24 (Arbuckle, 2016) was used for structural equation modelling. In all studies a two-tailed $p \leq .05$ was required to achieve statistical significance.

A methodological summary for each study is presented in Table 1. Projects One and Two both utilised a cross-sectional design. Participant sample size varied between studies according to the study aims and completeness of data on the psychological measures required for any specific study. For *Study One*, age was used as an additional eligibility criterion. This is because maternal age is a major factor influencing ovulatory functioning, independent of energy balance (Balasch, 2010). Therefore, an age cut-off of 40 was set to diminish the impact of this confound, thereby reducing the overall working sample to 385 women. Additional details of specific attrition rates for each study are outlined in Chapters 4 to 7.

Table 1: An overview of final sample sizes, measures, diagnostic groups and statistical analyses for Studies One to Four

Study	One	Two	Three	Four
Sample	n=385 Female patients Age range (20-40 years)	n=403 Female patients Age range (20-47 years)	n=416 Female patients Age range (20-47 years)	n=80 Fertility Doctors Male (58%); Female (42%) 82% Australian 18% New Zealand <u>Age Bands</u> 25-35 yrs; 36-45 yrs 46-55 yrs; 56-65 yrs 66+ yrs CREI/non-CREI
Groupings for statistical analyses	Unexplained infertility Male factor Ovulatory disorder PCOS Heterogeneous causations	Normal vs overweight vs obese PCOS vs non-PCOS	N/A	Male vs Female Junior vs Senior doctor
Measures	Demographics BMI EDE-Q; IPAQ	Demographics; BMI EDE-Q; IPAQ; PANAS RSES; DASS-21; CPQ FPI	Demographics EDE-Q; DEB Brief COPE; PSS	Demographics Study survey based on DSM-IV criteria; ICD-10 criteria
Study specific inclusion criteria	Age ≤ 40 years No missing data on EDE-Q or Infertility Category	No missing data on BMI or infertility diagnostic category	No missing data on PSS; EDE-Q and Brief COPE	Actively practicing fertility specialist
Statistical Analyses	Mean; SD; SE t-Test; LSD; OR Percentages Chi-square Profile analysis ANOVA Logistic regression	Mean; SD; Percentages t-Test; Chi-square Pearson product correlations; MANOVA logistic regression Bonferroni adjusted alphas; OR General linear modelling (backward regression)	Mean; SD t-Test Pearson product correlations; Principal Components Analysis; Structural Equation Modelling (SEM)	Mean; SD Percentages t-Test Chi-Square Fisher's exact test

Note: Studies *One* to *Three* used data from a base dataset of 429 participants. Sample size varies between Studies *One* to *Three* owing to individual study aims and adequacy of data completed on required questionnaires.

CREI = Certificate of Reproductive Endocrinology and Infertility; PCOS = Polycystic ovary syndrome

Measures: Demographics questionnaire; BMI=Body mass index; EDE-Q=Eating Disorder Examination Questionnaire; IPAQ=International Physical Activity Questionnaire; DASS-21=Depression, Anxiety and Stress Scale-21 items; PANAS=Positive and Negative Affect Schedule; RSES=Rosenberg Self-Esteem Scale; CPQ=Clinical Perfectionism Questionnaire; FPI=Fertility Problem Inventory; Brief Coping with Problems experienced (COPE); PSS=Perceived Stress Scale; DEB=Disordered Eating Behaviours; DSM=Diagnostic and Statistical Manual of Mental Disorders – 4th Edition; ICD-10=International Classification Diseases Manual, 10th revision.

Statistical Analyses: SD=Standard deviation; SE=Standard error; LSD=Least significant differences; OR=Odds ratio; AMOS=Analysis of moment structures; ANOVA=Analysis of variance; MANOVA=Multivariate analysis of variance; SEM=Structural equation modelling.

CHAPTER 4 - STUDY ONE

(Peer-Reviewed Publication)

Disordered Eating Attitudes and Exercise in Women Undergoing Fertility Treatment

Iolanda S. Rodino, Susan Byrne, Katherine A. Sanders.
Australian and New Zealand Journal of Obstetrics and Gynaecology 2016; 56: 82-87.

DOI: 10.1111/ajo.12407

4.1 FOREWORD

Study One builds upon previous research investigating the topic of eating disorders within an infertility context (Bates et al., 1982; Allison et al., 1988; Abraham et al., 1990; Stewart et al., 1990; Freizinger et al., 2010; Cousins et al., 2015; Coker et al., 2016). This study improved on the design shortfalls of earlier work by sampling across three fertility clinics and thus recruiting a larger sample size facilitating statistical power for analyses across clinically diverse infertility diagnoses. This study furthermore accounted for the potential confound of the effects of BMI, not previously considered. At the time of thesis submission, *Study One* provided the largest set of data on the EDE-Q questionnaire for women attending a fertility clinic, representing a distinctive population dataset. Moreover, the study provided novel information on maladaptive compulsive exercise behaviour in women with ovulatory disorders and PCOS. Collectively the clinical findings of this study inform fertility specialists about the importance of the evaluation of eating pathology and exercise amongst infertile women actively undertaking fertility treatment. This chapter has been published in the *Australian and New Zealand Journal of Obstetrics and Gynaecology* 2016; 56: 82-87.

Original Article

Disordered eating attitudes and exercise in women undergoing fertility treatment

Iolanda S. RODINO,^{1,2} Susan BYRNE^{2,3} and Katherine A. SANDERS¹¹School of Anatomy, Physiology & Human Biology, The University of Western Australia, Perth, Western Australia, Australia, ²School of Psychology, The University Of Western Australia, Perth, Western Australia, Australia and ³Centre for Clinical Interventions, Perth, Western Australia, Australia**Background:** Previous research has found a higher lifetime prevalence of eating disorders in women undergoing fertility treatment.**Aims:** This study aimed to gauge the prevalence of eating disorders in women attending a fertility clinic and to compare current disordered eating attitudes and exercise amongst different infertility categories.**Materials and Methods:** Three hundred and eighty-five women were grouped according to infertility diagnosis: male factor, unexplained infertility, ovulatory disorders, polycystic ovarian syndrome (PCOS) and heterogeneous causations. Participants anonymously completed the Eating Disorder Examination Questionnaire (EDE-Q), the International Physical Activity Questionnaire (IPAQ) and a Demographics questionnaire.**Results:** The lifetime history of self-reported eating disorders for women in the sample was similar to Australian community rates. Profile analysis revealed on the EDE-Q that women with ovulatory disorders were not significantly different from women with PCOS; however, they were significantly different to women with other infertility diagnoses (all $P < 0.05$), suggesting increased vulnerability to disordered eating. There were no between-group differences in exercise quantity (IPAQ, $P = 0.625$) although women with ovulatory disorders and PCOS had a significantly higher risk of engaging in compulsive, 'driven' exercise (OR = 6.98, CI = 1.39, 34.90, $P = 0.018$) as a means to control weight or shape.**Conclusions:** Contrary to previous research, our findings do not confirm a greater lifetime prevalence rate of eating disorders in women attending an infertility clinic. This study does highlight the importance of screening women with forms of an ovulatory disorder for features of disordered eating attitudes and driven exercise behaviours.**Key words:** disordered eating, exercise, female infertility, ovulatory disorders, polycystic ovarian syndrome.

Introduction

Eating disorders are characterised by problematic thinking and behavioural patterns related to food consumption (either over- or undereating), weight perception and/or exercise. Eating disorders are associated with mental and physical health concerns and are known to disrupt ovulatory functioning through energy balance effects on the hypothalamic–pituitary–ovarian (HPO) axis.^{1–3} Chronic fluctuations in energy balance (eg through dieting, overeating or overexercising) can disrupt physiological feedback loops relevant to fertility.^{1,3–6} For

patients undergoing assisted reproductive technology, status of energy balance potentially influences reproductive performance and treatment outcomes. Research indicates that there is an increased incidence of cancelled fertility treatment cycles, poorer drug response rates, lower fertilisation rates, reduction in embryo quality, poorer pregnancy rates and increased incidence of early pregnancy losses in underweight and obese patients.^{1,7} Consequently in the context of reproduction, knowledge of patients' attitudes towards eating and exercise is important.

Studies investigating the prevalence of disordered eating within an infertility clinic population are limited.^{8–10} Existing studies are typically characterised by small sample size or by patient samples undergoing single treatment protocols (eg intra-uterine insemination (IUI)). Collectively, existing studies have found that women with ovulatory disorders exhibit higher rates of past or current diagnoses of eating disorders compared to community norms. These studies^{9,10} further revealed a tendency for patient nondisclosure of their history of eating disorder to

Correspondence: Ms Iolanda S. Rodino, School of Anatomy, Physiology & Human Biology, School of Psychology, The University of Western Australia, 35 Stirling Highway, Perth, WA 6009, Australia. Email: iolanda@perthivf.com

Received 2 June 2015; accepted 17 August 2015.

their doctor, highlighting the importance of doctor enquiry.

Using a large sample size, broader infertility sample and multicentre recruitment strategy, the objectives of this study were twofold: firstly, to investigate the lifetime prevalence of eating disorders in women attending a fertility clinic; and secondly, to explore the presence of disordered eating attitudes and exercise across different infertility categories.

Material and Methods

Women accessing fertility treatment (ovulation tracking, ovulation induction (OI), IUI, *in vitro* fertilisation (IVF) and intracytoplasmic sperm injection (ICSI)) were recruited from three fertility clinics located in Perth, Western Australia. Patients undergoing donor conception, oncology treatment or pre-implantation genetic diagnosis or who had not had their medical consultation with their fertility doctor were excluded. All participants spoke English and were aged between 20 and 40 years.

Participants completed three questionnaires: an author-developed Demographics questionnaire, the Eating Disorders Examination Questionnaire (EDE-Q)¹¹ and the short-form version of the International Physical Activity Questionnaire (IPAQ).¹² The Demographics questionnaire was used to gauge background information, anthropometric measures (eg weight and height) and participant history and disclosure pattern of eating disorders. Specifics of infertility-related information (diagnosis, medications and fertility treatment) were also recorded. The EDE-Q is a 28-item self-report questionnaire used for the assessment of eating disorders. The EDE-Q yields data loading on four subscales – Weight Concern, Shape Concern, Eating Concern and Dietary Restraint as well as a Global score. Diagnostic items used to assess the frequency of maladaptive weight control behaviours (eg bingeing, purging, laxative use and ‘compulsive’ or ‘driven’ exercise attitude) are also included in the EDE-Q. The IPAQ was used to provide a measure of a participant’s participation in physical activity (low, moderate or vigorous). Activity-related energy expenditure was calculated for each type of physical activity according to the formulae outlined by Craig *et al.*¹² providing an index of total energy expenditure.

Participants were provided with an information sheet outlining the details of the study, consent and a survey package by the chief investigator. Participation involved anonymous completion of a questionnaire battery that could be completed at the participant’s own discretion and returned via a prepaid envelope. Participation was entirely voluntary, and declining to participate did not influence a participant’s access to fertility treatment.

In total, 1000 questionnaires were distributed to participants. From these, 401 eligible participants returned their questionnaires, with 16 protocols subsequently excluded due to the respondent noting

being pregnant. A final sample size of 385 was retained. Approval for this study was granted from the Human Research Ethics Committee from The University of Western Australia (RA/4/1/4642), Joondalup Health Campus (JHC1111) and Hollywood Private Hospital (HPH334) covering each of the participating research sites.

Statistical analyses

Data were combined across fertility clinics and subsequently stratified for analyses by infertility category factor. Infertility diagnoses were categorised into one main cause for each participant based on reported fertility diagnosis. Five infertility categories were defined as male factor infertility, unexplained infertility, polycystic ovarian syndrome (PCOS), other ovulatory disorders (all forms of menstrual/ovulatory disorders excluding PCOS) and a group reflecting ‘heterogeneous’ causations (eg uterine and fallopian tube pathology, sexual dysfunction). Where a woman recorded multiple causations to her infertility (eg ovulatory disorder and male factor), group allocation was made in line with the energy balance and HPO axis association,^{1,3–6} and accordingly, the participant was placed in either the ovulatory group or PCOS group according to the type of ovulatory disorder specified. Body mass index (BMI) level was categorised according to the World Health Organization (WHO)¹³ recommendations with underweight being a BMI < 18.5 kg/m², normal weight BMI range being 18.5 ≤ 24.9 kg/m², overweight BMI 25 ≤ 29.9 kg/m² and obese BMI ≥ 30 kg/m².

Participants were compared across infertility categories using ANOVA. Where ANOVA revealed significant differences between infertility categories on EDE-Q subscales or exercise, *post hoc* tests using least significant differences (LSD) were applied to determine the source of difference. To assess whether different infertility categories responded to the EDE-Q subscales in a similar manner, profile analysis was applied with BMI included as a covariate to adjust for potential confounding. Profile analysis is an application of multivariate analysis of variance (ANOVA) suitable for comparison between groups on multiple dependent variables which are scored on a similar Likert scale.¹⁴ Logistic regression was used to examine the odds ratio of maladaptive compensatory weight control behaviours according to infertility diagnosis whilst adjusting for BMI. The statistical package SPSS for Windows, version 20 (SPSS, Chicago, IL, USA), was used for analyses. The significance level of 0.05 was used to test for statistical differences.

Results

The mean age of all participants was 33.5 years (SD = 4 years). On average, women had been attempting to conceive for 30.4 months (SD = 23.7) with no difference found between women across infertility

categories ($F(4, 374) = 0.613$; $P = 0.65$). Overall, 36.4% of participants were undergoing IVF, 26.8% undertaking ICSI treatment, 18.7% undergoing IUI and 18.2% being monitored for cycle tracking and/or OI treatments. Additional demographic information is given in Table 1.

BMI derived from self-reported height and weight ranged from 16.33 to 45.25. Overall, participants had a mean BMI of 24.75 (SD = 5.1). A total of 2.9% of the sample were underweight, 58.5% were in the healthy weight range, 20.9% were overweight and 17.7% were obese. ANOVA revealed that mean BMI varied across the five infertility categories, ($F(4, 373) = 3.023$, $P = 0.018$) with women with PCOS being significantly heavier than those participants in the unexplained ($P = 0.004$) and heterogeneous ($P = 0.001$) infertility categories. The PCOS group did not differ to either the male factor group ($P = 0.06$) or ovulatory disorders group ($P = 0.08$) on BMI.

Two respondents (0.5%) indicated that they currently had an eating disorder. Neither respondent indicated disclosing their symptoms to their fertility specialist. Scores on the global scale of the EDE-Q revealed six women (1.6%) with scores greater than four suggestive of a clinical level of disordered eating. Of these six, none acknowledged that they had a current eating disorder. A total of 6.8% ($n = 26/382$) of respondents reported a past history of an eating disorder. Of this group with an eating disorder history, only 23% ($n = 6$) had informed their fertility specialist of their history. Those with a history of an eating disorder scored higher on average across the EDE-Q ($F(1, 372) = 38.94$, $P < 0.001$). History of an eating disorder was not associated with the presence or absence of a current ovulatory disorder (OR = 1.388, CI = 0.498, 3.865, $P = 0.53$).

Infertility category responses to the EDE-Q are shown in Figure 1. Profile analysis controlling for BMI revealed that the pattern of responses to the four subscales of the EDE-Q was the same across the infertility category factor (Wilks'

lambda, $F(12, 979.22) = 0.65$; $P = 0.80$); however, there were infertility category differences on the EDE-Q ($F(4, 372) = 2.38$, $P = 0.05$). *Post hoc* analysis revealed that once BMI was controlled, the ovulatory infertility group was significantly different on the EDE-Q compared to male factor infertility ($P = 0.046$), unexplained infertility ($P = 0.047$) and the heterogeneous category of infertility ($P = 0.017$) groups. The ovulatory group did not significantly differ from the PCOS group ($P = 0.855$). The PCOS group was different from the heterogeneous group ($P = 0.034$) and demonstrated a nonsignificant trend to difference to the male infertility group ($P = 0.077$) and unexplained infertility group ($P = 0.084$).

As cell numbers were too small to compare maladaptive weight control behaviours across all five infertility categories and the responses of women in the ovulatory and PCOS group to the EDE-Q were the same ($P = 0.855$), we collapsed infertility categories into two groups: ovulatory group (ie combined ovulatory and PCOS group) compared to nonovulatory group (consisting of male factor, unexplained infertility and heterogeneous groups). Logistic regression revealed a tendency towards binge eating episodes with a sense of loss of control in the combined ovulatory-PCOS group compared to the nonovulatory group; however, this was not significant (OR = 2.04, 95% CI = 0.89, 4.70, $P = 0.09$). Two participants, both with ovulatory disorders, reported weekly purging as a means to control weight and/or shape. One of these women also endorsed a clinical level of laxative use.

Overall, 28.6% of the sample population were engaged in low levels of physical activity, 40.3% in moderate levels and 30.1% in vigorous levels of activity. These physical activity levels are higher than reported corresponding Australian community-based levels of activity of 72.% (low), 19.4% (moderate) and 8.2% (high).¹⁵ Analysis of IPAQ scores revealed no significant differences amongst infertility categories in their total energy expenditure over

Table 1 Comparison of demographic characteristics by infertility category

Variable	Male ($n = 67$)	Unexplained ($n = 116$)	Ovulatory ($n = 60$)	Polycystic ovarian syndrome ($n = 57$)	Heterogeneous ($n = 85$)
Age (years) mean (\pm SD)	33.1 (3.8)	34.3 (3.8)	32.6 (4.3)	31.4 (4.2)	34.8 (3.5)
Education attainment (%)					
High school	9.0	10.3	25.0	24.6	15.3
Vocational certificate	28.4	18.1	13.3	31.6	23.5
University	62.7	71.6	61.7	43.9	61.2
Household income (%)					
Less than \$50 000	4.5	1.7	5.1	3.6	1.2
\$50 000–\$110 000	24.2	17.4	22.0	25.0	39.3
\$110 000–150 000	34.8	19.1	23.7	30.4	21.4
\$150 000+	36.4	61.7	49.2	41.1	38.1
Group BMI (kg/m^2) mean (\pm SD)	24.9 (5.8)	24.3 (4.3)	25.0 (4.9)	26.6 (6.6)	23.8 (4.1)
Underweight (BMI < 18.5) %	3.0	2.7	3.4	3.6	2.4
Normal (BMI 18.5–24.99) %	62.1	58.4	52.5	50.0	65.5
Overweight (BMI 25–29.99) %	16.7	23.9	25.4	16.1	20.2
Obese (BMI 30+) %	18.2	15.0	18.6	30.4	11.9

Sample size for analyses: Age & Education: $n = 385$; Household Income: $n = 380$; BMI: $n = 378$.

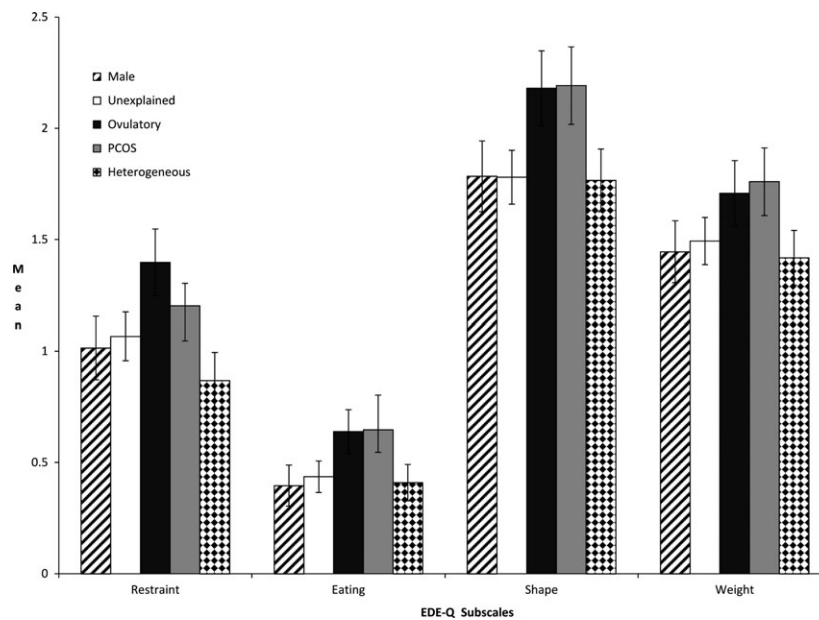


Figure 1 Estimated marginal mean score for each Eating Disorder Examination Questionnaire subscale stratified by infertility category. Means have been adjusted for the effects of BMI. Error bars represent 1 SE. Infertility categories are male factor infertility, anatomical infertility, unexplained infertility, ovulatory disorder and heterogeneous causations.

a seven-day period ($F(4, 376) = 0.653, P = 0.625$). Of note, when questioned in the EDE-Q about obligatory exercise behaviour, women in the combined ovulatory–PCOS group had a significantly higher risk of engaging in compulsive, ‘driven’ exercise (OR = 6.98, CI = 1.39, 34.90, $P = 0.018$) as a means to control ‘weight, shape or to burn off calories’ compared to the combined nonovulatory infertility group.

Discussion

Contrary to other studies investigating disordered eating within an infertility population,^{8–10} this research did not find an overall increased prevalence of present or past history of eating disorders in infertile patients. Only two participants indicated that they had a current eating disorder, and 26 participants (6.8%) reported a past history of eating disorders similar to the lifetime prevalence rates reported in studies on nonclinical Australian community samples.^{16,17} A further six women (1.6%) had clinically elevated scores on the global scale of the EDE-Q although they did not report an eating disorder. It is possible that the results of this study are an underestimate of the presence of an eating disorder and that assessment of eating psychopathology using the Eating Disorder Examination (EDE) interview¹⁸ or criteria from the Diagnostic and Statistical Manual of Mental Disorders (DSM-5)¹⁹ may have yielded greater diagnostic frequency. To maintain patient discretion, our study’s methodology using anonymous completion of the questionnaire and the time needed for administration and follow-up interview of our large sample size made this

impracticable. Researchers^{18,20} also have reported a high degree of concordance between the EDE-Q and the EDE interview, thereby adding support to the validity of this study’s results.

Similar to the Freizinger *et al.*¹⁰ study was our finding of limited disclosure of history of eating disorder to a patient’s doctor (ie 23%). It is unclear whether this nondisclosure rate related to a failure of the fertility doctor to elicit this information and/or a failure of a patient to divulge their eating disorder history. Research suggests that women with eating disorders are open to disclosing their eating concerns and emotional symptoms in clinical settings when directly queried²¹ with early detection and management of symptoms improving prognosis. Consequently, it is suggested that fertility doctors who complete preconception assessments have a role to play in the surveillance and referral of at-risk patients identified with disordered eating attitudes and exercise behaviours to mental health services. This includes women with difficulties attaining optimal weight secondary to entrenched disordered eating attitudes. Therefore, the inclusion of brief eating disorder screening techniques (eg the five-item SCOFF questionnaire)²² into routine fertility patient assessment could be important.

The reproductive axis is sensitive to disruptions in energy balance^{1,3–6} with evidence of disordered eating and/or exercise having impact on ovulation. In this study, women with forms of an ovulatory disorder were found to have elevated scores on EDE-Q subscales compared to other infertility groups. In particular, higher values on the EDE-Q subscales measuring weight and shape were noted. These are identified as maintaining factors of eating disorders and are associated with emotional distress.^{23,24}

A unique finding of this study was that women with an ovulatory disorder and PCOS reported engaging in driven exercise as a means to control weight and shape more frequently than women in other infertility categories. It is known that women who feel compelled to exercise out of specific concern for weight or shape as opposed to reasons of general well-being are more likely to have eating disorder psychopathology and/or are at greater risk of developing an eating disorder than those that do not exercise for these reasons.^{25,26} Our study draws the link that in comparison with women with other determinants of infertility, the drive for exercise in women with an ovulatory disorder and PCOS may relate to disordered eating psychopathology, as opposed to exercising simply for the purposes of physical well-being. Future studies investigating exercise within an infertility population would therefore benefit from including an assessment of motivations for exercise and emotional attitude to exercise, as opposed to simply reporting on quantity of exercise undertaken. This additional clinical information is more likely to give insight into the presence of unhealthy attitudes to weight control and eating disorder symptomatology.

Eating disorders and obesity have been associated with a spectrum of negative emotional and physical issues during pregnancy and the postpartum period.^{1,27,28} Knowledge and awareness about disordered eating within a fertility population is therefore valuable in the context of identifying at-risk prenatal patients potentially requiring ongoing medical and psychological support during pregnancy and in transition to motherhood.

The results of our study need to be considered in the context of the following methodological limitations. First, the study relied on anonymously completed, self-report measures with a potential for underreporting of weight and eating psychopathology. However, Stommel and Osier²⁹ in reviewing health trends over the last 20-year period reported an increasing tendency for respondents to 'admit' to accurate weight in surveys. Second, no information is available in regard to the characteristics of participants who failed to return their questionnaire with the potential of sampling bias operating. Empirical studies investigating eating disorders have failed to find that patients with active eating disorders disproportionately refuse to participate in survey completion,³⁰ and whilst a response rate of 40% is less than anticipated, it is within the acceptable response rate parameters for paper questionnaire methodology.³¹ Finally, whilst this study has provided information on disordered eating attitudes and behaviours in infertile women with normal to elevated BMI levels, comparative EDE-Q profiles and exercise motivations of infertile women with low to very low BMI levels within a fertility population are still to be determined.

Conclusions

Disordered eating symptomatology has the potential to influence patient well-being, reproductive functioning,

obstetric and perinatal outcomes. The findings from this study reveal infertility category differences in disordered eating attitudes and driven exercise behaviours particularly in those patients with an ovulatory disorder and PCOS. As patient disclosure rates of an eating disorder are low, this study further highlights the importance of screening women attending infertility clinics for features of disordered eating attitudes and exercise behaviours with consideration of referral of at-risk patients to mental health services.

Acknowledgements

We are grateful to the women who participated in the study. We thank the nurses of Concept Fertility Centre, Fertility North and Hollywood Fertility Centre who assisted with advertising of the study and participant recruitment.

References

- 1 ESHRE Capri Workshop Group. Nutrition and reproduction in women. *Hum Reprod Update* 2006; **12**: 193–207.
- 2 Grilo CM. *Eating and Weight Disorders*. Hove and New York: Psychology Press, 2006.
- 3 Evans JJ, Anderson GM. Balancing ovulation and anovulation: integration of the reproductive and energy balance axes by neuropeptides. *Hum Reprod Update* 2012; **18**: 313–332.
- 4 Loucks AB, Thuma JR. Luteinizing hormone pulsatility is disrupted at a threshold of energy availability in regularly menstruating women. *J Clin Endocrinol Metab* 2003; **88**: 297–311.
- 5 Schneider JE. Energy balance and reproduction. *Physiol Behav* 2004; **81**: 289–317.
- 6 Mircea CN, Lujan ME, Pierson RA. Metabolic fuel and clinical implications for female reproduction. *J Obstet Gynaecol Can* 2007; **29**: 887–902.
- 7 Pinborg A, Gaarslev C, Hougaard CO *et al.* Influence of female bodyweight on IVF outcome: a longitudinal multicentre cohort of 487 infertile couples. *Reprod Biomed Online* 2011; **23**: 490–499.
- 8 Abraham S, Mira M, Llewellyn-Jones D. Should ovulation be induced in women recovering from an eating disorder or who are compulsive exercisers? *Fertil Steril* 1990; **53**: 566–568.
- 9 Stewart DE, Robinson GE, Goldbloom DS, Wright C. Infertility and eating disorders. *Am J Obstet Gynecol* 1990; **163**: 1196–1199.
- 10 Freizinger M, Franko DL, Dacey M *et al.* The prevalence of eating disorders in infertile women. *Fertil Steril* 2010; **93**: 72–78.
- 11 Fairburn CG, Beglin SJ. Eating Disorder Examination Questionnaire (EDE-Q 6.0). In: Fairburn CG, ed. *Cognitive Behaviour Therapy and Eating Disorders*. New York: Guildford Press, 2008; 309–313.
- 12 Craig CL, Marshall AL, Sjostrom M *et al.* International Physical Activity Questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc* 2003; **35**: 1381–1395.
- 13 World Health Organization. Obesity: Preventing and managing the global epidemic. Report of a WHO consultation. WHO technical report series: 894. Geneva: WHO, 2000.

- 14 Tabachnick BG, Fidell LS. Using Multivariate Statistics. Needham Heights: Allyn and Bacon, 2001.
- 15 Australian Bureau of Statistics. Sports and Physical Recreation: A statistical overview Australia, 2012. Source: Australia Health Survey: First results, 2011-12 (cat. no. 4364.0.55.001), 2012.
- 16 Wade TD, Bergin JL, Tiggemann M *et al.* Prevalence and long-term course of lifetime eating disorders in an adult Australian twin cohort. *Aust N Z J of Psychiatry* 2006; **40**: 121-128.
- 17 Mond JM, Hay PJ, Rodgers B, Owen C. Eating Disorder Examination Questionnaire (EDE-Q): norms for young adult women. *Behav Res Ther* 2006; **44**: 53-62.
- 18 Fairburn CG, Beglin SJ. Assessment of eating disorders: interview or self-report questionnaire? *Int J Eat Disord* 1994; **16**: 363-370.
- 19 American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders (DSM-5), 5th edn. Arlington, VA: American Psychiatric Association, 2013.
- 20 Berg KC, Peterson CB, Frazier P, Crow SJ. Psychometric evaluation of the eating disorder examination and eating disorder examination-questionnaire: a systematic review of the literature. *Int J Eat Disord* 2012; **45**: 428-438.
- 21 Becker AE, Thomas JJ, Franko DL, Herzog DB. Disclosure patterns of eating and weight concerns to clinicians, educational professionals, family, and peers. *Int J Eat Disord* 2005; **38**: 18-23.
- 22 Morgan JF, Reid F, Lacey JH. The SCOFF questionnaire: assessment of a new screening tool for eating disorders. *Br Med J* 1999; **319**: 1467-1468.
- 23 Wilksch SM, Wade TD. Risk factors for clinically significant importance of shape and weight in adolescent girls. *J Abnorm Psychol* 2010; **119**: 206-215.
- 24 Blechert J, Ansorge U, Beckmann S, Tuschen-Caffier B. The undue influence of shape and weight on self-evaluation in anorexia nervosa, bulimia nervosa and restrained eaters: a combined ERP and behavioral study. *Psychol Med* 2011; **41**: 185-194.
- 25 Mond JM, Hay PJ, Rodgers B, Owen C. An update on the definition of "excessive exercise" in eating disorders research. *Int J Eat Disord* 2006; **39**: 147-153.
- 26 Thome JL, Espelage DL. Obligatory exercise and eating pathology in college females: replication and development of a structural model. *Eat Behav* 2007; **8**: 334-349.
- 27 Micali N, Simonoff E, Treasure J. Risk of major adverse perinatal outcomes in women with eating disorders. *Br J Psychiatry* 2007; **190**: 255-259.
- 28 Watson HJ, Torgersen L, Zerwas S *et al.* Eating disorders, pregnancy, and the postpartum period: findings from the Norwegian Mother and Child Cohort Study (MoBa). *Nor Epidemiol* 2014; **24**: 51-62.
- 29 Stommel M, Osier N. Temporal changes in bias of body mass index based on self-reported height and weight. *Int J Obes* 2013; **37**: 461-467.
- 30 Wade T, Tiggemann M, Martin NG, Heath AC. Characteristics of interview refusers: women who decline to participate in interviews relating to eating. *Int J Eat Disord* 1997; **22**: 95-99.
- 31 Baruch Y, Holtam BC. Survey response rate levels and trends in organizational research. *Hum Relat* 2008; **61**: 1139-1160.

CHAPTER 5 - STUDY TWO

(Peer-Reviewed Publication)

Obesity and Psychological Wellbeing in Patients Undergoing Fertility Treatment

Iolanda S. Rodino, Susan Byrne, Katherine A. Sanders.
Reproductive Biomedicine Online 2016; 32: 104-112.

DOI: 10.1016/j.rbmo.2015.10.002

5.1 FOREWORD

Empirical evidence has shown that obesity is an increasing global health problem that has implications for physical and mental health outcomes. As discussed in Chapters 1 and 2, obesity (i.e. BMI \geq 30) is associated with significant impairments in reproductive functioning including difficulties with ovulation, longer time to conception, pregnancy and obstetric complications. Obesity is also associated with an array of poorer psychological outcomes, including symptoms of eating pathology. However, these conclusions have been determined from studies with participants recruited from community based settings. Thus, the general mental health profile of treatment-seeking infertile women according to their weight status represents a gap in knowledge within the reproductive medicine literature. *Study Two* aimed to: (i) provide a comparison of psychological variables of infertile women undergoing fertility treatment according to weight status (normal, overweight and obese), (ii) to determine specific psychological predictors of distress in obese infertile women, and (iii) to examine psychological differences in women with and without PCOS, whilst controlling for BMI. This study represents an important step forward in understanding the psychological wellbeing of infertile women undergoing fertility treatment, according to their weight status. Particularly, the results of this study highlight the psychological constructs of low self-esteem, shape concerns and binge eating as a triad of variables to observe in obese infertile women. This chapter has been published in the journal *Reproductive Biomedicine Online* 2016; 32: 104-112.



ELSEVIER

www.sciencedirect.com
www.rbmonline.com



ARTICLE

Obesity and psychological wellbeing in patients undergoing fertility treatment




Iolanda S Rodino ^{a,b,*}, Susan Byrne ^{b,c}, Katherine A Sanders ^a

^a School of Anatomy, Physiology and Human Biology, The University of Western Australia, Perth, Western Australia 6009, Australia; ^b School of Psychology, The University of Western Australia, Perth, Western Australia 6009, Australia; ^c Centre for Clinical Interventions, Perth, Western Australia, Australia

* Corresponding author. E-mail address: iolanda@perthivf.com (IS Rodino).



Iolanda Rodino is a clinical psychologist with 18 years of clinical experience in the fields of infertility, antenatal and postnatal services. Iolanda is a PhD Candidate in the School of Anatomy, Physiology and Human Biology and School of Psychology at The University of Western Australia. Iolanda's research interests are diverse and include the areas of third-party reproduction and the emotional effects of disordered eating and stress on fertility.

Abstract Obesity negatively affects reproductive functioning and psychological wellbeing. Distress experienced by infertile women with elevated body mass index (BMI) was investigated. Infertile women ($n = 403$) were stratified according to World Health Organization (2000) BMI categories (normal, overweight and obese) and infertility category (polycystic ovary syndrome [PCOS] or non-PCOS). Participants anonymously completed a Demographics Questionnaire, International Physical Activity Questionnaire, Depression, Anxiety and Stress Scale, Positive and Negative Affect Schedule, Rosenberg Self Esteem Scale, Fertility Problem Inventory, Clinical Perfectionism Questionnaire and the Eating Disorder Examination Questionnaire. Women in the obese BMI group were no more psychologically vulnerable to general mood (depression, anxiety and stress) or fertility-specific distress than normal or overweight BMI women. Independent of their PCOS status, obese women reported more frequent episodes of binge eating, shape concerns and low self-esteem symptoms associated with disordered eating. Women with PCOS had elevated shape concerns and anxiety independent of their BMI category compared with women who did not have PCOS. Obese infertile women presenting with the characteristics of binge eating, low self-esteem and body shape concerns may represent a vulnerable subgroup that could benefit from accessing targeted psychological interventions as do women with PCOS who have body shape concerns. 

© 2015 Reproductive Healthcare Ltd. Published by Elsevier Ltd. All rights reserved.

KEYWORDS: binge eating, infertility, obesity, psychological wellbeing, shape concerns

Introduction

Obesity is a significant global health problem that has reached pandemic proportions (Finucane et al., 2011). Obesity is broadly defined as accrued body fat that exceeds a clinically defined weight threshold. The World Health Organization (World Health Organization, 2000) uses reference criteria of body mass index (BMI) to determine severity of obesity, with BMI greater than 30 kg/m² indicative of obesity and BMI greater than 40 kg/m² indicating morbid obesity. Obesity is associated with a spectrum of adverse physical outcomes (Calle et al., 2003; Guh et al., 2009), poorer psychological wellbeing (De Wit et al., 2010; Luppino et al., 2010; Ostrovsky et al., 2013) and lower health quality of life markers (Lillis et al., 2011).

Patient-obese weight status is of particular concern to fertility healthcare providers. Elevated BMI is associated with reduced reproductive potential and, for obese women contemplating conception, there is an increased incidence of weight-related subfertility in both natural, IVF and donor-related treatment cycles (ESHRE Capri Workshop Group, 2006; Fedorcsak et al., 2004; Landres et al., 2010; Bellver et al., 2013). Given the possibility of fertility treatment setbacks, obese infertile patients undergoing fertility treatment may be expected to have poorer psychological wellbeing compared with either healthy weight or overweight infertile patients.

Studies comparing weight status and psychological wellbeing in infertile women are lacking, with conclusions to date being extrapolated from research on women with polycystic ovary syndrome (PCOS) owing to their propensity towards central obesity (Lim et al., 2012; Veltman-Verhulst et al., 2012). This, however, narrows the clinical focus of mental health to a subset of infertile women. Contributors to distress in women with PCOS are multifactorial (Elsenbruch et al., 2003; Veltman-Verhulst et al., 2012), and include insulin resistance, hirsutism, acne, androgens and infertility, although elevated BMI in at least some studies seems to be the determinant of psychological disturbance (Barnard et al., 2007; Barry et al., 2011; Hahn et al., 2005; Jannsen et al., 2008; Trent et al., 2005). Studies have generally found that women with PCOS experience decreased health quality of life indices, with increased levels of depression, anxiety, lower sexual satisfaction and poorer body image (Barnard et al., 2007; Barry et al., 2011; Bazarganipour et al., 2013; Elsenbruch et al., 2003; Himelein and Thatcher, 2006; Hollinrake et al., 2007; Jones et al., 2008; Kerchner et al., 2009; Trent et al., 2005). Many of these studies investigating the link between PCOS and mood have, however, been conducted on young community cohorts receiving routine gynaecological or medical care rather than patients undergoing active fertility clinic treatment, thereby limiting the applicability of these findings to a population undergoing fertility treatment.

As obesity is a risk factor for both reproductive functioning and mental wellbeing, this exploratory study aimed to investigate psychological wellbeing in the context of weight status (BMI category) among a cohort of women (PCOS and non-PCOS) attending a fertility clinic. As standardized psychological measures may be insensitive to gauge fertility-related adjustment and distress (Moura-Ramos et al., 2012) both general psychological measures of mood in addition to fertility specific measures of mood were used. From a

clinical perspective, information about weight-related psychological distress before treatment would be beneficial in early identification of at-risk patients requiring psychological support.

Materials and methods

Participants

Women were recruited from three fertility clinics in Perth, Western Australia. Eligible participants had been assessed by their fertility doctor and were undergoing fertility treatment that did not involve third-party reproduction, assistance for hereditary-related conditions or fertility preservation. Women aged between 20 and 47 years were recruited from participating IVF clinics between June 2011 and June 2012.

Measures

Demographics

A demographics questionnaire developed by the authors, consisting of 23 questions, was used to obtain participant personal background history, anthropometric measures (height, weight), fertility-related information, i.e. fertility issues, time trying to conceive, fertility treatment, health history, alcohol and cigarette use. In accordance with World Health Organization (2000) classifications, BMI (kg/m²) was calculated and categorized into underweight (BMI <18.5), normal (BMI between 18.5 and 24.9), overweight (BMI between 25 and 29.9) and obese (BMI ≥30).

International Physical Activity Scale

The short form of the The International Physical Activity Questionnaire (IPAQ) (Craig et al., 2003) was used to determine exercise patterns. The IPAQ was used to provide an index of a participant's level of physical activity (low, moderate or vigorous) by measuring frequency (number of days), intensity of activity (vigorous, moderate or walking) and duration (hours, minutes) of physical activity over the last 7 days. Energy expenditure was measured in metabolic equivalents (METs), which describes the rate of energy expenditure of a specific category of physical activity relative to resting metabolic rate, and was calculated according to formulae by Craig et al. (2003).

Depression, Anxiety and Stress Scale

The Depression, Anxiety and Stress Scale (DASS-21) (Lovibond and Lovibond, 1995) is a 21-item scale composed of three self-report scales measuring the extent an individual has experienced depression, anxiety and stress over the past week. Responses are made on a four-point scale with responses rated as 'Did not apply to me at all' to 'Applied to me most of the time'.

Positive and Negative Affect Schedule

The Positive and Negative Affect Schedule (PANAS) (Watson et al., 1988) is a 20-item scale used to measure both positive and negative affect. Each subscale has 10 adjectives

describing mood. The scale asks participants to rate on a five-point Likert scale, the extent to which they generally experience each of the emotions (1 = very slightly or not at all to 5 = very much) in the indicated time frame.

Fertility Problem Inventory

The Fertility Problem Inventory (FPI) (Newton et al., 1999) is a 46-item self-report questionnaire that gauges beliefs and attitudes related to specific infertility-related stress on five separate domains: social concern; sexual concern; relationship concern; need for parenthood; and rejection of a childfree life. Items are assessed on a six-point Likert scale ranging from '1 = Strongly disagree' to '6 = Strongly agree'.

Rosenberg Self-Esteem Scale

The Rosenberg Self-Esteem Scale (RSES) (Rosenberg, 1965) is a 10 item self-report scale that measures self-worth, self-confidence, self-satisfaction, self-respect and self-deprecation. The scale uses a four-point Likert scale rating from 'strongly disagree' to 'strongly agree'.

Clinical Perfectionism Questionnaire

The Clinical Perfectionism Questionnaire (CPQ) (Fairburn et al., 2003b) was used to assess perfectionism. It is a 12-item self-report scale that gauges demanding standards associated with personal performance that are pursued at a personal consequence. Responses are rated on a four-point Likert scale from 'not at all' to 'all of the time'.

Eating Disorder Examination – Questionnaire

The Eating Disorder Examination – Questionnaire (EDE-Q) (Fairburn and Beglin, 2008) (version 6.0) is a self-report version of the Eating Disorder Examination interview. The EDE-Q has 22 items giving rise to four subscales: dietary restraint, shape concern, eating concern and weight concern. The EDE-Q also contains an additional six diagnostic items allowing assessment of key eating-disordered behaviours, such as binge eating and other maladaptive weight control behaviours. Because of covariance of the four EDE-Q subscales, only the Shape subscale (which is a proxy marker for body image concerns) and information pertaining to the diagnostic questions on binge eating behaviour are reported.

Procedure

A general introduction was given by a clinic nurse. Patients waiting to have their treatment-related blood tests were then approached by the chief investigator, a clinical psychologist, to gauge interest in participating in a study investigating, 'How do mood, stress and behaviour interact to affect fertility?' To ensure unbiased participant selection by the assisting nurse, the nurse was not made aware of the aims of the study. Interested participants were provided with a participant package inclusive of details for consent, a participant information sheet, questionnaire battery and a prepaid return envelope that could be taken away for independent anonymous completion and submission in the participant's own time. No participant identifying information was elicited at the point of introduction so as to maximize confidentiality and

encourage a frank response to the questionnaires. Participation in the study was voluntary and declining to participate in the study did not influence a participant's access to treatment. In total, 1000 questionnaires were distributed to participants. Study procedures including consent, the Participant Information Sheet and questionnaires were approved before the start of the study by each Human Research Ethics Committee (HREC) responsible for managing ethics applications for the participating fertility clinic – these being The University of Western Australia (reference RA/4/1/4642 on 3rd May 2011), Joondalup Health Campus (reference JHC1111 on 19th May 2011) and Hollywood Private Hospital (reference HPH334 on 2nd December 2011).

Statistical methods

Data were combined across fertility clinics and were subsequently stratified for analyses by BMI and PCOS category as the key independent variables. Classification of BMI level was in accordance with World Health Organization (2000) recommendations described previously. Participants (PCOS and non-PCOS) were compared across BMI categories (normal, overweight, obese) using two-way analysis of variance and two-way multivariate analysis of variance (MANOVA) for continuous variables. Before undertaking the MANOVA, Pearson product-moment correlations between dependent psychological outcome variables confirmed a meaningful pattern of correlations in the low to moderate range, suggesting the appropriateness of MANOVA (Meyers et al., 2006). Box's M test value was 241.749 ($P = 0.039$), although not deemed significant based on Huberty and Petoskey's (2000) guidelines ($P < 0.005$). Logistic regression was used to examine the odds ratio of an occurrence of an episode of binge eating according to BMI category and PCOS category.

Subsequent to MANOVA, the predictors of mental health among the obese women were further examined, adjusting for PCOS status. All relevant psychological variables, age, IPAQ and length of time trying to conceive were entered into general linear models and backward eliminated until only significant predictors remained.

Responses to the IPAQ and psychological variables DASS-depression, DASS-anxiety, PANAS-NA, CPQ and 'length of time trying to conceive' were not normally distributed and were log transformed to correct normality before statistical analyses. The data are reported as untransformed means and standard deviations (SD) where indicated for continuous data and frequencies (%) for categorical data. To reduce the likelihood of Type I errors, a conservative Bonferroni adjusted alpha level of $P \leq 0.005$ was applied for all post-hoc comparisons. The statistical package SPSS for Windows version 21 (IBM Inc., USA) was used for all statistical analyses.

Data management, analyses and missing data

A total of 445 participants returned their questionnaire, i.e. 44.5% response rate, with 16 questionnaires being eliminated as the participant indicated they were pregnant. A further 13 questionnaires either lacked weight or height details, or had missing psychological data and were omitted

from data analyses. As only 13 participants were classified as underweight (BMI ≤ 18.5), these were excluded from analyses owing to limited capacity to conduct meaningful analyses on such a small sample. The final study sample for statistical analyses with valid BMI and psychological data sets consisted of 403 participants.

Results

Participant characteristics

Sociodemographic details for the study sample ($n = 403$) are found in **Table 1**. A total of 14% of the sample ($n = 55$) reported a diagnosis of PCOS and 86% a non-PCOS diagnosis ($n = 348$). The average age of women in the study sample was 34.5 years ($SD = 4.8$). Mean age for women with PCOS was 31.8 years ($SD = 4.4$ years) compared with 34.9 years ($SD = 4.7$ years) for non-PCOS women ($t [401] = 4.675$; $P = 0.001$). Independent of PCOS status, women did not vary in age according to BMI weight category ($F[2,399] = 1.57$).

BMI

The average BMI of all participants was 25 ($SD = 5.0$) and ranged from 18.5 to 45.25. A total of 60% of the study population were in the normal BMI range, 21% in the overweight BMI range and 18% in the obese range, comparable to the BMI levels reported in a large Australian epidemiological study (Moran et al., 2013). A total of 33% of PCOS women were obese compared with 16% of women without PCOS. Women with PCOS had a mean BMI of 27.2 ($SD = 6.6$), and were significantly heavier than women in the non-PCOS group ($M = 24.7$; $SD = 4.7$) ($t [401] = -3.53$; $P = 0.001$).

Exercise

Overall, 29% of the sample population were engaged in low levels of physical activity: 40% in moderate levels and 31% in vigorous levels of activity. Analysis of log transformed IPAQ MET units revealed no significant differences between BMI categories in energy expenditure (METS) over a 7-day period ($F[2,396] = 0.975$) nor differences in exercise levels ($\chi^2 = 3.622$). Comparison between PCOS and non-PCOS groups did not reveal a difference in total energy expenditure (METS ($t [397] = -0.525$) nor differences in engagement across exercise intensity levels ($\chi^2 = 0.406$).

Length of time attempting to conceive

On average, participants had been attempting to conceive for about 31 months ($SD = 25$), with obese women trying for about 12 months longer ($M = 40.5$ months; $SD = 33.1$) than normal weight women ($M = 28.4$ months; $SD = 20.8$). Two-way ANOVA accounting for PCOS status revealed a significant interaction effect ($F[2,390] = 8.876$; $P < 0.001$) with obese women with

Table 1 Sociodemographic and treatment characteristics of the participants (total $n = 403$)^a.

Participant characteristics	%
Age (years)	
≤ 30	21
31–40	69
> 40	10
Nationality	
Australian	58
UK	12
European	12
Other	18
Educational attainment	
High school	16
Vocational certificate	23
University graduate	61
Household income	
Less than \$50,000	2
\$50,000–\$110,000	24
\$110,000–\$150,000	26
\$150,000+	48
Living with children	
Yes	18
No	82
Fertility problem ^b	
Male factor	16
Anatomical factor	15
Unexplained infertility	31
PCOS	14
Ovulatory disorder (non-PCOS)	15
Heterogeneous causations	10
Fertility treatment ^b	
Tracking, ^c ovulation induction, IUI	36
IVF	37
ICSI	26
Mental health history ^b	
Yes	38
No	61
Smoking	
Yes	7
No	93
Drinking patterns	
Never	13
2–6 days	38
Daily	5
Monthly	12
Social occasions	32

ICSI = intracytoplasmic sperm injection; IUI = intrauterine insemination; PCOS = polycystic ovary syndrome.

^aSample size variation owing to missing data: age, nationality, educational attainment, fertility problem, smoking and drinking factors ($n = 403$); fertility treatment ($n = 402$); mental health history ($n = 402$); living with children ($n = 396$); household income ($n = 395$).

^bSum of percentages not 100 owing to rounding.

^cTracking means cycle monitoring.

PCOS attempting to conceive for the longest time ($M = 59.9$ months; $SD = 42.2$ months). Pearson product-moment correlations revealed that length of time trying to conceive was positively correlated with depression ($r = 0.152$; $P = 0.002$),

negative affect ($r = 0.122$; $P = 0.015$), FPI ($r = 0.128$; $P = 0.011$) and inversely correlated with positive affect ($r = -0.135$; $P = 0.007$) and self-esteem ($r = -0.166$; $P = 0.001$).

PCOS, BMI category and mental health history

A total of 38% of participants reported a history of mental health concerns that could disrupt their normal functioning, although no difference was found according to PCOS group (chi-squared = 0.633) or BMI category (chi-squared = 3.144). In total, 23 women (PCOS [$n = 2$], non-PCOS [$n = 21$]) reported a previous history of eating disorders and only three women reported a current eating disorder. Most women with a past history of an eating disorder ($n = 17$) were of normal weight.

PCOS, BMI category and psychological test outcomes

Psychological scores according to PCOS status and BMI category are presented in Table 2. A two-way MANOVA with PCOS status and BMI category as the independent variables revealed significant multivariate effects on psychological test outcomes for both PCOS status (Wilks Lamda = 0.941; $F[9,389] = 2.688$; $P = 0.005$) and BMI category (Wilks Lamda = 0.757; $F[18,778] = 6.454$; $P < 0.001$). Independent of their BMI category, women with PCOS had on average higher DASS-anxiety scores ($M = 7.16$; $SD = 8.73$) compared with women who did not have PCOS ($M = 4.6$; $SD = 6.24$; $P = 0.002$). Shape concern

was also higher for women with PCOS ($M = 2.62$; $SD = 1.70$) compared with women who did not have PCOS ($M = 1.81$; $SD = 1.44$; $P = 0.002$). Independent of PCOS status, main effects of BMI category were found for the variables of self-esteem ($P < 0.001$) and body shape concerns ($P < 0.001$). Post-hoc pairwise comparisons revealed that obese women exhibited significantly lower levels of self-esteem ($P < 0.001$) and higher body shape concerns ($P < 0.001$) compared with women in the normal weight and overweight BMI groups (Table 2).

A separate analysis using logistic regression revealed that independent of PCOS status, women with obesity had a significantly higher risk of engaging in binge eating episodes (OR = 7.915; CI = 3.421, 18.312; $P < 0.001$) compared with normal weight women. Overweight, but not obese women, had no significant risk of binge eating compared with normal weight women. PCOS status was not associated with risk of binge eating.

Predictors of poorer psychological wellbeing in obese women

As MANOVA revealed that shape concern and self-esteem variables both distinguished obese women from normal weight and overweight women, these variables were further investigated among the obese group only using general linear models. Analysis indicated that independent of PCOS status higher shape concern was predicted by perfectionism and a trend towards lower self-esteem (Table 3). Higher self-esteem was predicted by higher positive affect, lower negative affect and lower shape concern (Table 3).

Table 2 Mean scores and standard deviations on psychological test variables according to body mass index category and polycystic ovary syndrome status (total $n = 403$)^a.

Psychological Variable	BMI Category						F ^b	P-value ^c
	Normal (n = 244)		Overweight (n = 86)		Obese (n = 73)			
	PCOS (n = 28)	Non-PCOS (n = 216)	PCOS (n = 9)	Non-PCOS (n = 77)	PCOS (n = 18)	Non-PCOS (n = 55)		
DASS-Depression	6.7 (7.8)	7.6 (8.5)	6.7 (10.0)	6.0 (7.3)	11.2 (8.9)	7.3 (8.7)	1.427	NS
DASS-Anxiety ^d	5.6 (6.0)	4.9 (6.2)	9.6 (11.4)	3.6 (5.4)	8.3 (10.7)	4.9 (7.4)	2.261	0.048
DASS-Stress	13.8 (8.8)	12.5 (8.5)	10.9 (12.0)	10.6 (9.0)	14.3 (9.8)	12.2 (9.2)	0.960	NS
PANAS - Positive Affect (PANAS-PA)	34.0 (7.7)	32.7 (7.1)	38.1 (7.4)	33.8 (6.9)	30.6 (8.1)	32.8 (7.4)	1.674	NS
PANAS- Negative Affect (PANAS-NA)	20.8 (6.6)	19.2 (6.8)	18.8 (8.2)	18.7 (6.0)	23.3 (10.4)	20.7 (8.2)	1.480	NS
Rosenberg Self Esteem Scale ^e	21.8 (5.1)	21.3 (5.2)	22.0 (6.7)	21.8 (4.9)	15.2 (4.0)	19.7 (5.1)	6.115	<0.001
Clinical Perfectionism (CPQ)	23.6 (4.7)	23.6 (4.8)	26.6 (4.2)	23.7 (4.4)	25.2 (6.2)	23.2 (4.1)	1.110	NS
Fertility Problem Inventory (FPI-Global)	149.0 (30.7)	142.0 (32.6)	139.0 (40.4)	139.5 (36.0)	160.1 (27.4)	144.8 (37.9)	1.348	NS
EDE-Q - Shape Concern ^{d,e}	1.7 (1.3)	1.4 (1.3)	2.9 (1.9)	2.1 (1.3)	3.9 (1.1)	3.0 (1.4)	25.542	<0.001

BMI = body mass index; DASS = Depression, Anxiety and Stress Scale; EDE-Q = Eating Disorder Examination - Questionnaire; MANOVA = multivariate analysis of variance; NS = not statistically significant; PCOS = polycystic ovary syndrome; PANAS = The Positive and Negative Affect Schedule.

^aCell entries represent unadjusted mean (SD).

^bF value refers to the overall MANOVA corrected model.

^cP-values are after log¹⁰ transformations.

^dComparisons between PCOS and non-PCOS groups significantly differ; $P = 0.002$.

^eComparisons between BMI categories significantly differ; $P < 0.001$.

Table 3 Psychological variables associated with shape concern and self-esteem in obese women adjusting for polycystic ovary syndrome status ($n = 73$).

Model	Beta	Standard error	t	P-Value	Partial Eta Squared
Shape concern (adjusted $R^2 = 0.298$) ^a					
Perfectionism	6.534	1.841	3.549	0.001	0.154
Self-esteem	-0.063	0.032	-1.985	NS ^c	0.054
Self-esteem (adjusted $R^2 = 0.589$) ^b					
PANAS-PA	0.252	0.054	4.670	<0.001	0.243
PANAS-NA	-12.728	2.650	-4.802	<0.001	0.253
Shape concern	-0.827	0.307	-2.691	0.009	0.096

CPQ = The Clinical Perfectionism Questionnaire; DASS = Depression, Anxiety and Stress Scale; FPI = The Fertility Problem Inventory; IPAQ = The International Physical Activity Questionnaire; METS = metabolic equivalents; PCOS = polycystic ovary syndrome; PANAS = The Positive and Negative Affect Schedule (NA = negative affect; PA = positive affect).

^aVariables included in the original model were age, IPAQ METS, length of time attempting conception, DASS-anxiety, DASS-stress, PANAS-NA, FPI-Global, CPQ, Self-Esteem.

^bVariables included in the original model were age, IPAQ METS, length of time attempting conception, DASS-depression, DASS-anxiety, DASS-stress, PANAS-PA, PANAS-NA, FPI-Global, CPQ, Shape Concerns.

^cNS = not statistically significant; $P = 0.051$.

Discussion

Patients who are obese are known to present with clinically significant health concerns, which negatively affect reproductive functioning, psychosocial wellbeing and overall quality of life. The primary purpose of the present study was to investigate the psychological wellbeing of infertile women with obesity compared with infertile women with normal or overweight BMI levels, taking into account the potential confounding effects of PCOS status. The findings of this exploratory study do not confirm that obesity in fertility patients is associated with greater general psychological vulnerability, at least on psychological measures (both fertility specific and generic) as assessed in this study. These results are surprising given the psychological literature highlighting obesity as a primer for mental health vulnerability (De Wit et al., 2010; Luppino et al., 2010; Ostrovsky et al., 2013). Of clinical relevance, however, was the finding that infertile obese women experienced body shape concern, low self-esteem and maladaptive binge eating behaviours, which collectively represent core vulnerability factors associated with disordered eating (Fairburn et al., 2003a; Lo Coco et al., 2014). Moreover, these effects were independent of PCOS status.

Several possibilities can explain why women in the obese group were no more psychologically vulnerable than women in the normal and overweight groups to depression, anxiety and stress or fertility-specific stress. First, not all research supports the perspective that obesity is associated with negative affect. Some studies suggest that women with obesity are a heterogeneous group with different temperaments and clinical characteristics, and that the negative psychological effect of obesity may only be evident in women actively seeking weight loss interventions (Fitzgibbon et al., 1993; Muller et al., 2014; Stunkard et al., 2003). As we did not gauge background information on whether obese participants were accessing a weight loss programme, and, owing to the anonymous nature of questionnaire completion, we were unable to confirm this information. Second, it is possible that acceptance into a fertility treatment programme *per se* may have resulted in its own mood-alleviating benefits, diminishing perceptions of

obesity-related reproductive concerns or stigmatizing weight bias. It is known that perceptions of weight bias can lead to worsening of mental health and weight-related maladaptive behaviours in obese women (Latner et al., 2013; Pearl et al., 2014). Consequently, obesity may have little additional psychological bearing within an infertility cohort unless that patient is being declined fertility treatment and experiences internalization of weight bias. Future research investigating the psychological effect of being denied access to fertility treatment as a function of obesity could provide insight into the validity of this proposition. Finally, in this study, irrespective of PCOS and BMI status, women were found to engage in notably high levels of moderate to vigorous levels of exercise, twice as high as that reported in Australian population norms (Australian Bureau of Statistics, 2012). A large body of empirical evidence indicates that exercise has a positive effect on physical and general emotional wellbeing (Bartholomew et al., 2005; Dimeo et al., 2001). Consequently, in this study, participation in exercise may also have served to attenuate the experiences of stress and mood across all BMI groups.

Although obesity was not associated with poorer general psychological wellbeing, the findings of the present study do highlight the need to explore psychological wellbeing in the specific context of disordered eating. Infertile women with obese weight status experienced body shape concern, low self-esteem and maladaptive binge eating behaviours, i.e. consumption of an unusually large amount of food within a discrete period of time associated with a sense of loss of control (Fairburn and Beglin, 2008). Shape concerns are thinking patterns that pertain to dissatisfaction with body shape, discomfort seeing the body and feelings of fatness and relate to body image and appearance. Body image is associated with personal evaluation of appearance, related to a perception of stigma, and is a known risk factor for bulimic and binge symptomatology (Annis et al., 2004; Brannan and Petrie, 2011). Self-esteem relates to a sense of personal worth, confidence and satisfaction that one views in oneself (Rosenberg, 1965), and is considered an essential part of emotional health. Low self-esteem is a risk factor for disordered eating and

negative body image (Brechan and Kvaalem, 2014; Shea and Pritchard, 2007). Binge eating is known to mediate the relationship between mood and obesity, with bingers more likely than obese non-binging counterparts to develop eating disorder symptomatology (Fitzgibbon and Kirschenbaum, 1991; Lo Coco et al., 2014). Importantly, even sub-threshold levels of binge eating behaviours can have a bearing upon emotional wellbeing and therefore are of clinical relevance to observe in women (Stice et al., 2009). Among obese women in the present study, perfectionism (driven and critical attitudes) made a significant unique contribution explaining the variance of shape concern as did negative affect to self-esteem. Both perfectionism and negative affect are psychological variables relevant to disordered eating (Egan et al., 2011; Fairburn et al., 2003a; Holmes et al., 2015). Although, individually, each of the abovementioned factors are specific risk factors for mental health distress, collectively they represent core vulnerability factors associated with models of disordered eating (Fairburn et al., 2003a; Lo Coco et al., 2014), warranting further exploration.

An additional finding of our study was that obesity *per se* was associated with a longer time attempting to conceive, a finding consistent with the reproductive literature (Gesink Law et al., 2007).

Similarly of interest, is the finding of the small but significant association between length of time trying to conceive with various measures of psychological distress. That is, lengthier attempts at conception were associated with increased depression, negative affect, global fertility distress and lower experiences of positive affect and self-esteem. As this study used a cross-sectional design, firm conclusions about direction of causality, i.e. whether longer time attempting conception caused the symptoms of mental distress or *vice versa*, cannot be inferred from the data, although the findings do highlight the importance of considering mood in those patients with lengthier treatment trajectories.

Similar to the results of other studies (Barry et al., 2011; Bazarganipour et al., 2013), women with PCOS showed elevated anxiety and shape concern compared with women who did not have PCOS for all weight categories, suggesting areas of clinical concern. We speculate that elevated shape concern in the context of PCOS relates to perceived negative attitudes and judgement about appearance linked to central obesity. As negative body image has the potential to influence an individual's decisions to make poor lifestyle choices, such as over eating, smoking and sedentary behaviour (Grogan, 2006), we propose it is of relevance to assess in preconception care. Consequently, body image as a psychological variable represents a potentially modifiable factor.

Clinical implications

Screening protocols for assessing women at risk of emotional problems undergoing fertility treatment are currently available (Verhaak et al., 2010); however they do not include indices of disordered eating patterns. Specifically, screening for disordered eating within fertility populations remains a relatively understudied phenomenon (Freizinger et al., 2010), although a relevant topic owing to the effect of disordered eating on reproductive functioning (ESHRE Capri Workshop Group, 2006). Our findings highlight the need for

closer examination of the psychological characteristics of obese women along the disordered eating spectrum, as some women may present with core disordered eating vulnerabilities and could benefit from adjunct psychotherapeutic interventions beyond healthy lifestyle exercise and dietary strategies (Murphy et al., 2010). Consideration of disordered eating constructs could be achieved through the incorporation of a brief screening tool for eating disorders suitable for outpatient use, e.g. the five-item SCOFF (Hill et al., 2010).

Study limitations

The results of our study need to be considered in the context of the following methodological limitations. First, the study relied upon self-report inventories with the inherent constraints of self-report data. This limitation, however, is counter-balanced by the benefits of questionnaire completion anonymity, which permitted frank responding to emotionally sensitive questions, decreasing the likelihood of responding in a socially desirable way. Second, no information is available on the characteristics of participants who failed to return their questionnaire, with the potential of sampling bias operating. It is possible that only women who were sufficiently psychologically robust were able to complete the relatively demanding research protocol of a multi-questionnaire methodology; however, our sample BMI distribution is consistent with the Australian community-based study by Moran et al. (2013). Third it is acknowledged that women participating in this study engaged in high levels of physical activity compared with population norms. We speculate that for women participating in our study exercise may have served to optimize physical health for fertility treatment while at the same time provided emotional buffering for general mood (depression, anxiety and stress). The strengths of this study included the use of fertility-specific distress variables and the use of well-established standardized psychological measures, further enhancing the validity of the current study.

In conclusion, despite the known effect of obesity on poor reproductive functioning, the overall results of this study do not support that obese women attending a fertility clinic present with poorer general psychological wellbeing such as depression, anxiety, stress or infertility specific stress, compared with clinic patients who are either normal weight or overweight. The findings of this study, however, do suggest that shape concerns (particularly in women with PCOS), low self-esteem and binge eating disturbances do distinguish the obese BMI group from the overweight and normal BMI groups. Collectively these psychological constructs can be hallmarks of disordered eating warranting further exploration and represent points of targeted psychological interventions.

Acknowledgements

We are grateful to the women who participated in the study. We thank the nurses of Concept Fertility Centre, Fertility North and Hollywood Fertility Centre who assisted with advertising of the study and participant recruitment.

References

- Annis, N.M., Cash, T.F., Hrabosky, J.I., 2004. Body image and psychosocial differences among stable average weight, currently overweight and formally overweight women: the role of stigmatizing experiences. *Body Image* 1, 155–167.
- Australian Bureau of Statistics, 2012. *Overweight and Obesity: Source: Australia Health Survey: First results, 2011–12* (cat. no. 4364.0.55.001). ABS, Canberra Australia.
- Barnard, L., Ferriday, D., Guenther, N., Strauss, B., Balen, A.H., Dye, L., 2007. Quality of life and psychological wellbeing in polycystic ovary syndrome. *Hum. Reprod.* 22, 2279–2286.
- Barry, J.A., Kuczmierczyk, A.R., Hardiman, P.J., 2011. Anxiety and depression in polycystic ovary syndrome: a systematic review and meta-analysis. *Hum. Reprod.* 26, 2442–2451.
- Bartholomew, J.B., Morrison, D., Ciccolo, J.T., 2005. Effects of acute exercise on mood and well-being in patients with major depressive disorder. *Med. Sci. Sports Exerc.* 37, 2032–2037.
- Bazarganipour, F., Ziaei, S., Montazeri, A., Foroozafard, F., Kazemnejad, A., Faghihzadeh, S., 2013. Body image satisfaction and self-esteem among patients with polycystic ovary syndrome. *Iran. J. Reprod. Med.* 11, 829–836.
- Bellver, J., Pellicer, A., Garcia-Velasco, J.A., Ballesteros, A., Remohi, J., Meseguer, M., 2013. Obesity reduces uterine receptivity: clinical experience from 9,587 first cycles of ovum donation with normal weight donors. *Fertil. Steril.* 100, 1050–1058.
- Brannan, M.E., Petrie, T.A., 2011. Psychological well-being and the body dissatisfaction-bulimic symptomatology relationship: an examination of moderators. *Eat. Behav.* 12, 233–241.
- Brechan, I., Kvale, I.L., 2014. Relationship between body dissatisfaction and disordered eating: mediating role of self-esteem and depression. *Eat. Behav.* doi:10.1016/j.eatbeh.2014.12.008; Epub ahead of print.
- Calle, E.E., Rodriguez, C., Walker-Thurmond, K., Thun, M.J., 2003. Overweight, obesity, and mortality from cancer in a prospectively studied cohort of U.S. adults. *N. Engl. J. Med.* 348, 1625–1638.
- Craig, C.L., Marshall, A.L., Sjostrom, M., Bauman, A.E., Booth, M.L., Ainsworth, B.E., Pratt, M., Ekelund, U., Yngve, A., Sallis, J.F., Oja, P., 2003. International Physical Activity Questionnaire: 12-country reliability and validity. *Med. Sci. Sports Exerc.* 35, 1381–1395.
- De Wit, L., Luppino, F., van Straten, A., Penninx, B., Zitman, F., Cuijpers, P., 2010. Depression and obesity: a meta-analysis of community based studies. *Psychiatry Res.* 178, 230–235.
- Dimeo, F., Bauer, M., Varahram, I., Proest, G., Halter, U., 2001. Benefits from aerobic exercise in patients with major depression: a pilot study. *Br. J. Sports Med.* 35, 114–117.
- Egan, S.J., Wade, T.D., Shafran, R., 2011. Perfectionism as a transdiagnostic process: a clinical review. *Clin. Psychol. Rev.* 31, 203–212.
- Elsenbruch, S., Hahn, S., Kowalsky, D., Offner, A.H., Schedlowski, M., Mann, K., Jansen, O.E., 2003. Quality of life, psychosocial well-being, and sexual satisfaction in women with polycystic ovary syndrome. *J. Clin. Endocrinol. Metab.* 88, 5801–5807.
- ESHRE Capri Workshop Group, 2006. Nutrition and reproduction in women. *Hum. Reprod. Update* 12, 193–207.
- Fairburn, C.G., Beglin, S.J., 2008. Eating Disorder Examination Questionnaire (EDE-Q 6.0). In: Fairburn, C.G. (Ed.), *Cognitive Behaviour Therapy and Eating Disorders*. Guildford Press, New York, pp. 309–313.
- Fairburn, C.G., Cooper, Z., Shafran, R., 2003a. Cognitive behaviour therapy for eating disorders: a ‘transdiagnostic’ theory and treatment. *Behav. Res. Ther.* 41, 509–528.
- Fairburn, C.G., Cooper, Z., Shafran, R., 2003b. The Clinical Perfectionism Questionnaire. Unpublished manuscript, Department of Psychiatry, University of Oxford, UK.
- Fedorcsak, P., Dale, P.O., Storeng, R., Ertzeid, G., Bjercke, S., Oldereid, N., Omland, A.K., Abyholm, T., Tanbo, T., 2004. Impact of overweight and underweight on assisted reproduction treatment. *Hum. Reprod.* 19, 2523–2528.
- Finucane, M.M., Stevens, G.A., Cowan, M.J., Danaei, G., Lin, J.K., Paciorek, C.J., Singh, G.M., Guiterrez, H.R., Lu, Y., Bahalim, A.N., Farzadfar, F., Riley, L.M., Ezzati, M., 2011. National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9.1 million participants. *Lancet* 377, 557–567.
- Fitzgibbon, M.L., Kirschenbaum, D.S., 1991. Distressed binge eaters as a distinct subgroup among obese individuals. *Addict. Behav.* 16, 441–451.
- Fitzgibbon, M.L., Stolley, M.R., Kirschenbaum, D.S., 1993. Obese people who seek treatment have different characteristics than those who do not seek treatment. *Health Psychol.* 12, 342–345.
- Freizinger, M., Franko, D.L., Dacey, M., Okun, B., Domar, A.D., 2010. The prevalence of eating disorders in infertile women. *Fertil. Steril.* 93, 72–78.
- Gesink Law, D.C., Maclehose, R.F., Longnecker, M.P., 2007. Obesity and time to pregnancy. *Hum. Reprod.* 22, 414–420.
- Grogan, S., 2006. Body image and health: contemporary perspectives. *J. Health Psychol.* 11, 523–530.
- Guh, D.P., Zhang, W., Bansback, N., Amarsi, Z., Birmingham, C.L., Anis, A.H., 2009. The incidence of co-morbidities related to obesity and overweight: a systematic review and meta-analysis. *BMC Public Health* 9, 88.
- Hahn, S., Janssen, O.E., Tan, S., Pleger, K., Mann, K., Schedlowski, M., Kimmig, R., Benson, S., Balamitsa, E., Elsenbruch, S., 2005. Clinical and psychological correlates of quality-of-life in polycystic ovary syndrome. *Eur. J. Endocrinol.* 153, 853–860.
- Hill, L.S., Reid, F., Morgan, J.F., Lacey, J.H., 2010. SCOFF, the development of an eating disorder screening questionnaire. *Int. J. Eat. Disord.* 43, 344–351.
- Himelein, M.J., Thatcher, S.S., 2006. Depression and body image among women with polycystic ovary syndrome. *J. Health Psychol.* 11, 613–625.
- Hollinrake, E., Abreu, A., Maifeld, M., Van Voorhis, B.J., Dokras, A., 2007. Increased risk of depressive disorders in women with polycystic ovary syndrome. *Fertil. Steril.* 87, 1369–1376.
- Holmes, M., Fuller-Tyszkiewicz, M., Skouteris, H., Broadbent, J., 2015. Understanding the link between body image and binge eating: a model comparison approach. *Eat. Weight Disord.* 20, 81–89.
- Huberty, C.J., Petoskey, M.D., 2000. Multivariate analysis of variance and covariance. In: Tinsley, H., Brown, S. (Eds.), *Handbook of Applied Multivariate Statistics and Mathematical Modelling*. Academic Press, New York.
- Janssen, O.E., Hahn, S., Tan, S., Benson, S., Elsenbruch, S., 2008. Mood and sexual function in polycystic ovary syndrome. *Semin. Reprod. Med.* 26, 45–52.
- Jones, G.L., Hall, J.M., Balen, A.H., Ledger, W.L., 2008. Health-related quality of life measurement in women with polycystic ovary syndrome: a systematic review. *Hum. Reprod. Update* 14, 15–25.
- Kerchner, A., Lester, W., Stuart, S.P., Dokras, A., 2009. Risk of depression and other mental health disorders in women with polycystic ovary syndrome: a longitudinal study. *Fertil. Steril.* 91, 207–212.
- Landres, I.V., Milki, A.A., Lathi, R.B., 2010. Karyotype of miscarriages in relation to maternal weight. *Hum. Reprod.* 25, 1123–1126.
- Latner, J.D., Durso, L.E., Mond, J.M., 2013. Health and health related quality of life among treatment-seeking overweight and obese adults: association with internalized weight bias. *J. Eat. Disord.* 1, 3.

- Lillis, J., Levin, M.E., Hayes, S.C., 2011. Exploring the relationship between body mass index and health-related quality of life: a pilot study of the impact of weight self-stigma and experiential avoidance. *J. Health Psychol.* 16, 722–727.
- Lim, S.S., Davies, M.J., Norman, R.J., Moran, L.J., 2012. Overweight, obesity and central obesity in women with polycystic ovary syndrome: a systematic review and meta-analysis. *Hum. Reprod. Update* 18, 618–637.
- Lo Coco, G., Salerno, L., Bruno, V., Caltabiano, M.L., Ricciardelli, L.A., 2014. Binge eating partially mediates the relationship between body image dissatisfaction and psychological distress in obese treatment seeking individuals. *Eat. Behav.* 15, 45–48.
- Lovibond, P.F., Lovibond, S.H., 1995. The structure of negative emotional states: comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behav. Res. Ther.* 33, 335–343.
- Luppino, F.S., de Wit, L.M., Bouvy, P.F., Stijnen, T., Cuijpers, P., Penninx, B.W., Zitman, F.G., 2010. Overweight, obesity and depression: a systematic review and meta-analysis of longitudinal studies. *Arch. Gen. Psychiat.* 67, 220–229.
- Meyers, L.S., Gamst, G., Guarino, A.J., 2006. *Applied Multivariate Research: Design and Interpretation*. Sage Publications, Thousand Oaks, CA.
- Moran, L.J., Ranasinha, S., Zoungas, S., McNaughton, S.A., Brown, W.J., Teede, H.J., 2013. The contribution of diet, physical activity and sedentary behaviour to body mass index in women with and without polycystic ovary syndrome. *Hum. Reprod.* 28, 2276–2283.
- Moura-Ramos, M., Gameiro, S., Canavarro, M.C., Soares, I., 2012. Assessing infertility stress: re-examining the factor structure of the Fertility Problem Inventory. *Hum. Reprod.* 27, 496–505.
- Muller, A., Claes, L., Wilderjans, T.F., de Zwaan, M., 2014. Temperament subtypes in treatment seeking obese individuals: a latent profile analysis. *Eur. Eat. Disord. Rev.* 22, 260–266.
- Murphy, R., Straebl, S., Cooper, Z., Fairburn, C.G., 2010. Cognitive behaviour therapy for eating disorders. *Psychiatr. Clin. North Am.* 33, 611–627.
- Newton, C.R., Sherrard, W., Glavac, I., 1999. The Fertility Problem Inventory: measuring perceived infertility-related stress. *Fertil. Steril.* 72, 54–62.
- Ostrovsky, N.W., Swencionis, C., Wylie-Rosett, J., Isasi, C.R., 2013. Social anxiety and disordered overeating: an association among overweight and obese individuals. *Eat. Behav.* 14, 145–148.
- Pearl, R.L., White, M.A., Grilo, C.M., 2014. Overevaluation of shape and weight as a mediator between self esteem and weight bias internalization among patients with binge eating disorder. *Eat. Behav.* 15, 259–261.
- Rosenberg, M., 1965. *Society and the Adolescent Self-Image*. Princeton University Press, Princeton, New Jersey.
- Shea, M.E., Pritchard, M.E., 2007. Is self-esteem the primary predictor of disordered eating? *Pers. Individ. Dif.* 42, 1527–1537.
- Stice, E., Marti, C.N., Shaw, H., Jaconis, M., 2009. An 8-year longitudinal study of the natural history of threshold, subthreshold and partial eating disorders from a community sample of adolescents. *J. Abnorm. Psychol.* 118, 587–597.
- Stunkard, A.J., Faith, M.S., Allison, K., 2003. Depression and obesity. *Biol. Psychiatry* 54, 330–337.
- Trent, M., Austin, S.B., Rich, M., Gordon, C.M., 2005. Overweight status of adolescent girls with polycystic ovary syndrome: body mass index as mediator of quality of life. *Ambul. Pediatr.* 5, 107–111.
- Veltman-Verhulst, S.M., Boivin, J., Eijkemans, M.J.C., Fauser, B.J.C.M., 2012. Emotional distress is a common risk in women with polycystic ovary syndrome: a systematic review and meta-analysis of 28 studies. *Hum. Reprod. Update* 18, 638–651.
- Verhaak, C.M., Lintsen, A.M.E., Evers, A.W.M., Braat, D.D.M., 2010. Who is at risk of emotional problems and how do you know? Screening of women going for IVF treatment. *Hum. Reprod.* 25, 1234–1240.
- Watson, D., Clark, L.A., Tellegen, A., 1988. Development and validation of brief measures of positive and negative affect: the PANAS scales. *J. Pers. Soc. Psychol.* 54, 1063–1070.
- World Health Organization, 2000. *Obesity: Preventing and Managing the Global Epidemic*. Report of a WHO Consultation. WHO Technical Report Series: 894. WHO, Geneva.

Declaration: The authors report no financial or commercial conflicts of interest.

Received 10 June 2015; refereed 7 October 2015; accepted 8 October 2015.

CHAPTER 6 - STUDY THREE

(Peer-Reviewed Publication)

Stress has a Direct and Indirect Effect on Eating Pathology in Infertile Women: Avoidant Coping Style as a Mediator

Iolanda S. Rodino, Gilles E. Gignac, Katherine A. Sanders.
Reproductive Biomedicine and Society Online 2018; 5: 110-118.

DOI: 10.1016/j.rbms.2018.03.002

6.1 FOREWORD

According to the Transactional Model of Stress and Coping (Lazarus & Folkman, 1984), the way an individual appraises and copes with a stressful situation may pre-empt the endorsement of unhealthy behaviours. In this thesis, the relationship between perceived stress and eating pathology was the focus of investigation. In this chapter, an integrated path model was used to investigate the simultaneous effects of perceived stress and avoidant coping style constructs on a composite of eating pathology.

Study Three investigated the following theoretically based hypotheses: (i) that women undergoing fertility treatment experience stress, (ii) stress is an antecedent to eating pathology, and (iii) that the use of avoidance-oriented coping strategies may act to mediate the relationship between perceived stress and eating pathology. Whilst these factors have independently been examined in different fields of research, *Study Three* represents the first study to integrate and explore these areas within an infertility context. The results of this study underscore the importance of targeting both patient level of perceived stress and avoidant coping style within preconception psychotherapeutic interventions. This chapter has been published in the journal *Reproductive Biomedicine and Society Online* 2018; 5: 110-118.



www.sciencedirect.com
www.rbmsociety.com



ARTICLE

Stress has a direct and indirect effect on eating pathology in infertile women: avoidant coping style as a mediator

Iolanda S. Rodino^{a,b,*}, Gilles E. Gignac^b, Katherine A. Sanders^a

^a School of Human Sciences, The University of Western Australia, Perth, Australia; ^b School of Psychological Science, The University Of Western Australia, Perth, Australia

*Corresponding author. E-mail address: iolanda@perthivf.com (I.S. Rodino).



Iolanda Rodino is a clinical psychologist in private practice in Perth, Western Australia. She has extensive counselling experience working in the fields of infertility, antenatal and postnatal services. In addition to counselling, she is currently completing a PhD at The University of Western Australia. Her research interests are diverse, and include the areas of third party reproduction and the emotional impact of disordered eating attitudes and behaviours in women undergoing fertility treatment.

Abstract Patient-perceived stress and avoidance-oriented coping strategies are mental health risk factors well documented within the infertility literature. Relatedly, these factors are associated with maladaptive eating behaviours known to influence reproductive functioning. This study aims to investigate the interconnection between perceived stress, avoidant coping style and eating pathology in infertile women, and to determine whether avoidant coping style mediates the relationship between stress and eating pathology. A multicentre cross-sectional study of 416 women (aged 20–47 years) was completed. Women were assessed on the Eating Disorder Examination Questionnaire, the Perceived Stress Scale and the Brief COPE. Correlational matrices, principal components analysis and structural equation modelling were used to develop a measurement model to test the avoidant coping style mediation hypothesis. Results showed that perceived stress had a direct effect on maladaptive eating behaviours [$\beta=0.21$; 95% confidence interval (CI) 0.065–0.346; $P=0.005$]. Furthermore, a statistically significant indirect effect between perceived stress and maladaptive eating via avoidant coping style was also observed ($\beta=0.14$; 95% CI=0.017–0.267; $P=0.018$), indicating partial mediation. These findings highlight that both perceived stress and avoidant coping style are important psychotherapy targets to consider in infertile women presenting with eating pathology.

© 2018 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

KEYWORDS: avoidant coping style, eating pathology, infertility, perceived stress, preconception counselling

<https://doi.org/10.1016/j.rbms.2018.03.002>

2405-6618 © 2018 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

In studies of human reactions to stress, stressful life events characterized by socio-evaluative elements are generally associated with greater physiological, psychosocial and behavioural sequelae (Gruenewald et al., 2004; Miller et al., 2007). The inability to conceive children is considered to be one of the greatest sources of perceived stress in a person's life, akin to a diagnosis of a major illness (Domar et al., 1993). The impact of perceived stress and psychological distress secondary to the experience of infertility has been widely investigated with respect to fertility treatment burden and outcomes, mood, coping style and quality of relationship (Boivin et al., 2011; Ebbesen et al., 2009; Gameiro et al., 2012; Schmidt et al., 2005; Van den Broeck et al., 2010; Verhaak et al., 2007). Some studies report that stress is associated with increased rates of anxiety and depression, marital dissatisfaction and a greater perception of treatment burden, increasing the potential for fertility treatment drop-out (Cousineau and Domar, 2007; Domar, 2004; Gameiro et al., 2012; Gana and Jakubowska, 2016; Pasch et al., 2016). Stress can further pre-empt engagement in maladaptive health attitudes and lifestyle behaviours, including disordered eating attitudes and behaviours (Keyes et al., 2011; Klatzkin et al., 2016; Kouvonen et al., 2005). Thus, exploration of stress and the way it is manifested, appraised and managed among women presenting for fertility treatment represent important objectives for research and intervention.

The Transactional Model of Stress and Coping (Glanz et al., 2008; Lazarus and Folkman, 1984) provides a framework to evaluate appraisal and coping with situational and chronic stressful events. Lazarus and Folkman (1984) defined coping as a response to a perceived stressor, involving cognitive and behavioural strategies aimed at reducing the psychosocial and physical burdens of an event viewed as taxing or exceeding the resources of that person. It recognizes that the stress response is influenced by the perceived significance placed upon a stressful situation, with the coping style endorsed being dependent upon whether the stressor is appraised as personally meaningful and/or whether it is viewed as something that is unchangeable (Lazarus and Folkman, 1984).

Individuals deal with stress through a diversity of coping styles. For example, problem-focused versus emotion-focused strategies, and active versus avoidant-oriented coping are common distinctions in the coping literature (Aldao et al., 2010; Endler and Parker, 1990; Lazarus and Folkman, 1984). Generally, problem-focused coping efforts are seen as adaptive. In contrast, avoidance-oriented coping strategies are deemed maladaptive and are strongly related to psychopathology and poorer behavioural health outcomes (Aldao et al., 2010). Psychosocial studies in the area of fertility coincide with the broader literature. For example, avoidant-oriented coping strategies are shown to be associated with poorer adjustment both during and after in-vitro fertilization (IVF) treatment (Benyamini et al., 2008; Gourounti et al., 2012; Lancaster and Boivin, 2005; Terry and Hynes, 1998; Van den Broeck et al., 2010).

How an individual perceives and copes with a major life stressor such as infertility may have direct bearings upon the manifestation of negative health behaviours known to compromise reproduction (e.g. alcohol and drug consumption, smoking, poor sleep and weight status) (Gormack et al., 2015;

Homan et al., 2007; Rooney and Domar, 2014). In the context of preconception care, particularly for women with forms of an ovulatory disorder, healthy reproductive function is related to a woman's optimal body weight range and weight stability (Loucks, 2007; Mircea et al., 2007; Schneider, 2004). In times of stress, weight status can fluctuate, being directionally influenced by symptoms of eating pathology such as binge eating or dietary restraint (Ball and Lee, 2000; Kupeli et al., 2017; Razzoli et al., 2017). Therefore, it is important to investigate factors that either exacerbate or ameliorate eating pathology.

The antecedents to eating pathology are multifactorial (Striegel-Moore and Bulik, 2007). Some studies propose that higher levels of perceived stress and daily life hassles are associated with greater eating pathology (Ball and Lee, 2000; Crowther et al., 2001; Greeno and Wing, 1994; Klatzkin et al., 2016). Other studies emphasize the role of coping style, and particularly avoidance-oriented coping, in disordered eating attitudes and behaviours (Davies et al., 2011; Freeman and Gil, 2004; MacNeil et al., 2012; Sulkowski et al., 2011 Troop et al., 1994). Consequently, when faced with a life stressor such as fertility-related stress, women may have a greater propensity to engage in maladaptive eating behaviours such as binge eating, or alternatively employ unhealthy weight control practices such as skipping meals, fasting and purging, or use of laxatives and diuretics (Fairburn and Beglin, 2008; Freeman and Gil, 2004; Klatzkin et al., 2016), especially when coupled with poor coping styles. Endorsement of such maladaptive eating behaviours may be expected to influence energy availability and body mass index (Mircea et al., 2007), having implications for reproductive outcomes. These include increased time to pregnancy (Gesink Law et al., 2007; Norman et al., 2008), increased incidence of cancelled treatment cycles, and reduced fertility treatment success rates (ESHRE Capri Workshop Group, 2006; Landres et al., 2010; Norman et al., 2008). Moreover, the emotional and physical burdens of ovarian stimulation as part of the fertility treatment protocol can lead to weight gain (Toftager et al., 2018), with fear of weight gain, in turn, being a potential trigger to eating pathology in women who are susceptible to body image dissatisfaction and eating disorders (American Psychiatric Association, 2013; Pearson et al., 2010).

In light of the above, the over-arching aim of this study was to investigate a model of perceived stress, avoidant coping style and eating pathology amongst infertile women attending an IVF clinic. Drawing from the extant literature, it was first hypothesized that the level of perceived stress would be positively associated with avoidant coping style and severity of eating pathology (disordered eating attitudes and behaviours). Second, consistent with reports that avoidant-oriented coping strategies are positively associated with eating pathology, it was hypothesized that avoidant coping style would be positively associated with eating pathology, and that avoidant coping style would mediate, either partially or fully, the relationship between stress and eating pathology symptoms. Third, should partial mediation be observed, this study aimed to determine whether the direct effect or the indirect effect (via avoidant coping) between perceived stress and maladaptive eating had a larger influence on the maladaptive eating scores. From a clinical perspective, research exploring the relationship between stress and coping style is important and may help

orientate treatment goals for fertility patients experiencing stress-related eating pathology.

Materials and methods

Participants

Participants were 416 partnered women recruited from three fertility clinics located in Perth, Western Australia. Patients undergoing donor conception, undertaking oncology treatment or referred for genetic testing were excluded from participation. All participants spoke English, were aged between 20 and 47 years, and had commenced a treatment cycle.

Measures

The Demographics Questionnaire is an investigator-developed sociodemographic protocol gauging background information (e.g. age, educational level, occupation, employment status, marital status, living arrangements, etc.), anthropometric measures (e.g. height, weight), treatment-related information (e.g. cause of infertility, type of fertility treatment) and physical health status.

The Eating Disorder Examination Questionnaire (EDE-Q; Fairburn and Beglin, 2008) is a self-report version of the Eating Disorder Examination Interview. It is used to assess core attitudinal and behavioural components of eating psychopathology over the last 28 days. The EDE-Q produces four subscales (restraint, eating concern, weight concern and shape concern) and an overall global score. Scores range from 0 to 6, with a higher score on either the subscales or global score indicating a greater severity of eating disorder pathology. The EDE-Q also assesses frequencies of maladaptive eating behaviour items (e.g. binge eating and bulimic weight control compensatory behaviours). These maladaptive compensatory eating behaviour items are assessed in terms of the number of episodes and/or days that these behaviours have occurred over a 4-week time frame. In this study, a disordered eating behaviour composite was generated from these items: the presence of restrained eating for greater than an 8-h period (Item 2), binge eating days with sense of loss of control (Item 15), purging behaviour (Item 16), laxative use (Item 17) and engagement in obligatory excessive exercise (Item 18). These five behavioural items were dichotomized for any occurrence (i.e. ≥ 1 episode versus 0 episodes over the past 28 days) and summed to form the disordered eating behaviour composite, with a higher score representing greater use of diverse disordered eating behaviours (range 0–5).

The Perceived Stress Scale (PSS; Cohen et al., 1983) is a 14-item scale that measures the degree to which an individual assesses the situations in their life as being stressful. The scale focuses on three aspects of stress – uncontrollability, unpredictability and overload – and is sensitive to various sources of chronic stress. Ratings are given using a five-point Likert scale (0=never, 4=very often). A higher score indicates a higher level of perceived stress. The PSS has good construct validity due to its close correlation with measures of depression and inventories of life events (Cohen et al., 1983). In this study, the PSS was

used to gauge a participant's perceived level of stress over the last 28 days.

The Brief COPE (Carver, 1997) is a 28-item self-report scale that is used to gauge the coping reactions to stress used by participants. The Brief COPE consists of 14 subscales comprising of two items each, rated on a four-point Likert scale ranging from 1 to 4. Each subscale measures a conceptually different aspect of coping (active coping, planning, positive reframing, acceptance, humour, religion, emotional support, instrumental support, self-distraction, denial, venting, substance use, behavioural disengagement and self-blame). Participants were asked to respond according to their habitual response style to stressful situations. A higher score on any subscale indicates a higher frequency of use for that particular coping mechanism.

Procedure

Between June 2011 and May 2012, partnered women attending three fertility centres in Western Australia were invited to participate in this research project. Following an introduction by a fertility nurse co-ordinator, patients waiting to have fertility-related blood tests were approached by the chief investigator regarding inclusion in a questionnaire-based study. Participants were given a research pack inclusive of a participant information form, study questionnaires, a debriefing sheet and a pre-paid envelope for anonymous questionnaire submission. Participants were instructed to complete the questionnaire within a 2-week time frame and were also advised that study participation was entirely voluntary. Returning the anonymously completed survey served as informed consent to proceed. Approval for completion of this study and the research protocol was granted by the Human Research Ethics Committee of The University of Western Australia (Reference RA/4/1/4642), Joondalup Health Campus (Reference JHC1111) and Hollywood Private Hospital (Reference HPH334), covering each of the respective data collection sites.

Data management

From 1000 test protocols issued, 445 participant protocols were returned; 16 were subsequently excluded as the participant indicated that she was pregnant. All psychological scales and subscales were examined for excessive missing test responses and values exceeding test norms. This resulted in an additional 13 response protocols being deleted, yielding a final sample size for analysis of 416 participants. For remaining participants, if less than 5% of data points were missing, omitted values on these variables were replaced with the test mean for the specific factor on which that item loaded (Tabachnick and Fidell, 2001).

Data analytic approach

Percentages were computed for all demographic data. To determine the indicators of avoidant coping style for use in the structural equation model, principal component analysis using promax rotation was initially performed on the subscales of the Brief COPE with four factors converging

(Kaiser–Meyer–Olkin Index=0.71). Only the six subscales loading on the avoidant coping style factor (i.e. denial, disengagement, venting, self-blame, substance use and self-distraction) were parcelled as indicators for use in the structural equation model. An avoidant cope composite was derived from the summed scores on these six subscales that served the basis of the bivariate analyses. Eating pathology indicators were represented by the four subscales of the EDE-Q and the disordered eating behaviours composite.

Fig. 1 shows a schematic model of the variables that were investigated. Two latent variables were represented in the structural equation model: (i) avoidant coping style and (ii) eating pathology. The full fit of the mediation model was estimated using maximum likelihood estimation. Adequacy of the model fit was evaluated based on several close-fit indices: the comparative fit index (CFI), the Tucker-Lewis Index (TLI), the Incremental Fit Index (IFI), the root mean squared error of approximation (RMSEA) and the standardized root mean squared residual (SRMSR). The following guidelines were used: CFI, TLI and IFI >0.95 and RMSEA and SRMR <0.08 as indicative of a well-fitting model (Hair et al., 2010; Hu and Bentler, 1999; Marsh et al., 2004).

In this study, the mediation model intended to evaluate the direct and indirect effects of perceived stress on

eating pathology via the intermediary variable of avoidant coping style. All standardized point estimates associated with the model were tested for statistical significance via 2000 bootstrapped re-samples. According to Preacher and Hayes (2004), mediation (whether partial or complete) is observed when a statistically significant indirect effect is estimated from a bootstrapped solution, i.e. when the 95% confidence intervals (CI) associated with the point estimate do not intersect with zero. Complete mediation was considered to be observed in the event that the direct effect between perceived stress and maladaptive eating was no longer found to be statistically significant. Partial mediation was considered to be observed in the event that the direct effect of perceived stress on maladaptive eating remained statistically significant in the presence of avoidant coping.

The numerical difference between the direct and indirect standardized beta weights was tested for statistical significance via 2000 bootstrapped re-samples through the Amos user-estimand utility. SPSS for Windows, Version 24 (SPSS, Chicago, IL, USA) and AMOS, Version 24 (Arbuckle, 2016) were used for all statistical analyses. In all cases, a two-tailed P -value of <0.05 was considered to indicate statistical significance.

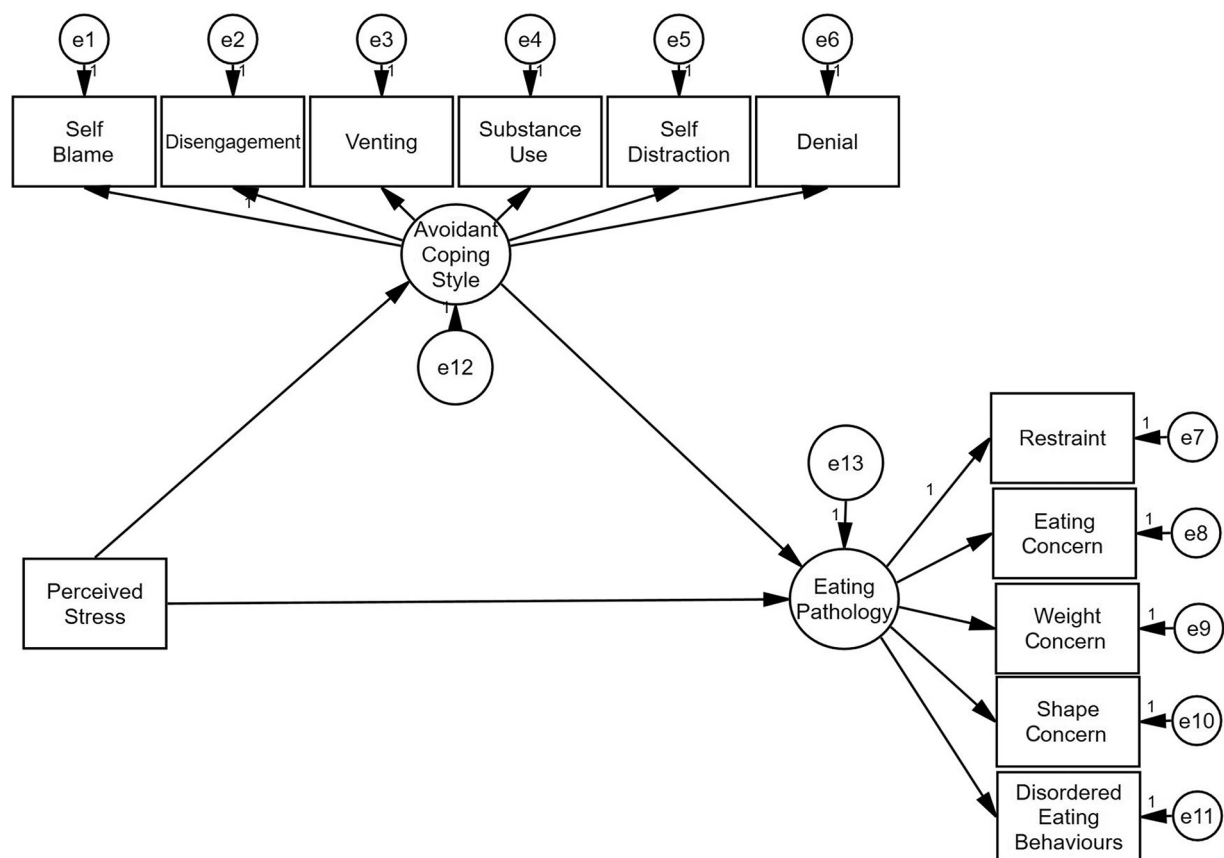


Fig. 1 Schematic representation of proposed model relationships between perceived stress, mediator avoidant coping style and eating pathology (disordered eating attitudes and behaviours). Perceived stress is an observed measured variable, and avoidant coping style and eating pathology are unobserved latent variables comprised of measurement indicators and associated error terms (e1–e13). The observed variables in the model are outcome scores from the Perceived Stress Scale (PSS), the Brief COPE and the Eating Disorder Examination Questionnaire (EDE-Q).

Results

Sample characteristics

On average, the study participants were 34.4 years of age [standard deviation (SD)=4.8 years] and had been trying to conceive for approximately 31 months (SD=24.8 months). Participant body mass index (BMI) derived from self-reported height and weight ranged from 16.33 to 45.25 kg/m², with the mean BMI being 24.78 kg/m² (SD=5.12 kg/m²). Whilst BMI was correlated positively with all eating pathology measures (all $P < 0.001$), BMI was not correlated with the independent variable perceived stress ($r = 0.07$; $P = 0.176$) or mediator avoidant coping style ($r = 0.03$; $P = 0.536$). Approximately 64% of patients were actively undergoing IVF or intracytoplasmic sperm injection fertility treatment, with the remainder being monitored for cycle tracking and/or ovulation induction treatments. Thirty-nine percent of participants were undergoing their first fertility treatment cycle, 56% were undergoing a repeat treatment cycle and 5% did not respond. Perceived level of stress (PSS) did not vary between those completing their first and repeat treatment cycles [$t(392) = -0.357$; $P = 0.722$]. Eighty-six percent of the sample consisted of participants who self-identified as Caucasian, 53% reported working full-time in paid employment and 61% reported attaining tertiary education.

Preliminary bivariate analyses

Descriptive statistics and bivariate correlation analyses associated with the the Perceived Stress Scale, the Eating Disorder Examination Questionnaire and the Brief COPE are presented in Table 1. As can be seen in Table 1, the correlations between the indicators included in the structural equation model were all statistically significant and in the expected direction. For example, higher levels of perceived stress were associated with greater levels of eating pathology on all four EDE-Q subscales and the disordered eating behaviour composite ($r = 0.11-0.36$; all $P < 0.05$). A higher level of perceived stress was likewise positively correlated with higher use of avoidant coping strategies ($r = 0.55$; $P < 0.001$). Similarly, avoidant coping style was positively correlated with all measures of the EDE-

Q subscales and the disordered eating behaviour composite ($r = 0.16-0.27$; all $P < 0.001$).

Mediating the effects of avoidant coping style on eating pathology

As can be seen in Fig. 2a, the standardized total effect of perceived stress on eating pathology was estimated at $\beta = 0.36$ ($P < 0.001$). As can be seen in Fig. 2(b), all direct effects were statistically significant ($P < 0.05$). The direct effect of perceived stress on eating pathology was estimated at $\beta = 0.21$ (95% CI 0.065–0.346; $P = 0.005$). Furthermore, the indirect effect of perceived stress on eating pathology via the mediator avoidant coping was estimated at $\beta = 0.14$ (95% CI 0.017–0.267; $P = 0.018$). As the strength of the relationship between perceived stress and eating pathology was reduced but remained significant when avoidant coping was incorporated into the model, the pattern of results was consistent with partial mediation. The close-fit indices suggested an adequately fitting model: $\chi^2(52) = 147.84$; $P < 0.001$; CFI=0.950; TLI=0.937; IFI=0.951; RMSEA=0.067; SRMR=0.048. The model R^2 was estimated at 0.150, thus 15% of the variance in maladaptive eating was accounted for by perceived stress and avoidant coping style. To determine which pathway, direct or indirect via the mediator, provided a better explanation for the variance in eating pathology, the numerical difference between the standardized direct and indirect effects was tested for statistical significance. No statistical significance was observed between the pathways ($\Delta\beta = -0.065$; 95% CI -0.318–0.189; $P = 0.593$).

Discussion

Psychological stress is an established risk factor for negative lifestyle aspects, including disordered eating behaviours (Ball and Lee, 2000). The objectives of this study were to examine the direct and indirect effects of perceived stress on eating pathology via the intermediary variable of avoidant coping style. With respect to perceived stress, the results of this study parallel the findings of previous research in community samples, supporting the perspective that higher levels of perceived stress are directly associated with higher levels of eating pathology symptoms (Ball and

Table 1 Pearson product moment correlations, means and standard deviations.

Variables	Mean	SD	PSS	REST	EC	SC	WC	DEB	COPE
PSS	25.75	7.84	1	0.11 ^a	0.31 ^b	0.36 ^b	0.32 ^b	0.18 ^b	0.55 ^b
REST	1.11	1.22		1	0.41 ^b	0.52 ^b	0.53 ^b	0.39 ^b	0.16 ^b
EC	0.47	0.79			1	0.65 ^b	0.66 ^b	0.52 ^b	0.20 ^b
SC	1.88	1.51				1	0.92 ^b	0.46 ^b	0.27 ^b
WC	1.54	1.39					1	0.45 ^b	0.26 ^b
DEB	0.47	0.76						1	0.16 ^b
COPE	26.29	5.38							1

Note: $n = 416$.

PSS, Perceived Stress Scale; REST, Eating Disorder Examination Questionnaire (EDE-Q) restraint subscale; EC, EDE-Q eating concern subscale; SC, EDE-Q shape concern subscale; WC, EDE-Q weight concern subscale; DEB, disordered eating behaviours; COPE, composite of six avoidant cope indicators.

^a Correlation is significant at the 0.05 level (two-tailed).

^b Correlation is significant at the 0.001 level (two-tailed).

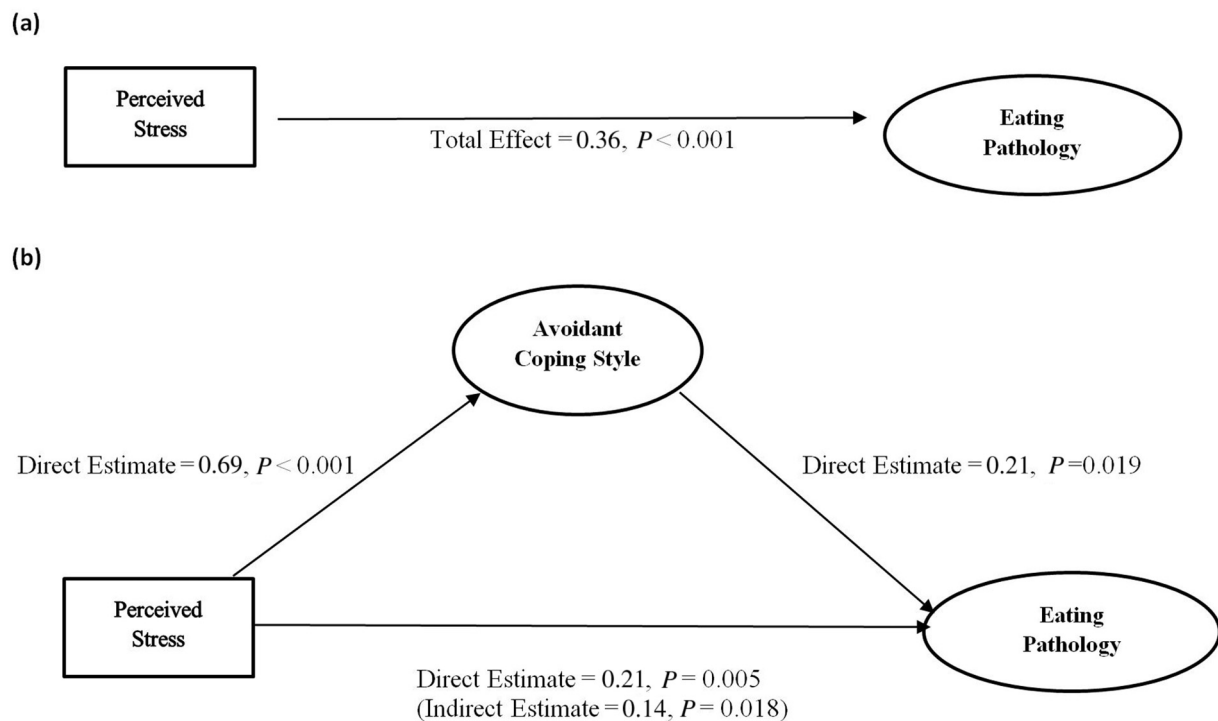


Fig. 2 (a) Base model establishing the standardized total effect between perceived stress and eating pathology ($n=416$). (b) Demonstrating path relationships between perceived stress and eating pathology once avoidant coping style has been included as an intermediary variable. Avoidant coping style and eating pathology are latent variables. Perceived stress is an observed variable. Standardized coefficients of relevant paths are shown. The value in the parentheses is the standardized coefficient for the stress to eating pathology path following the inclusion of avoidant coping style in the model (i.e. indirect effect).

Lee, 2000; Kupeli et al., 2017). However, to the authors' knowledge, the positive association between perceived stress and eating pathology reported in this study is unique in its context of women actively undergoing fertility treatment. That is, whilst previous studies in reproductive medicine have reported a higher incidence of disordered eating attitudes and behaviours amongst patients with forms of ovulatory disorders frequenting fertility clinics (Abraham et al., 1990; Coker et al., 2016; Cousins et al., 2015; Freizinger et al., 2010; Stewart et al., 1990), these studies do not specifically investigate the interconnection between measures of stress and eating pathology. Consequently, in light of the present findings, it is clinically important to assess and monitor perceived stress and eating pathology in these diagnostic groups during preconception counselling, with a view to referral for psychosocial care, particularly cognitive behavioural therapy programmes applicable to both symptoms of infertility-related stress and eating pathology (Fairburn and Beglin, 2008; Gameiro et al., 2015; Rooney and Domar, 2014). Assessing and screening patients for eating pathology is important as studies emphasize the benefit of early intervention in terms of prognostic outcomes, including a reduction in the severity of symptoms and duration of the eating disorder (Rodino et al., 2017; Rowe, 2017). Moreover, psychological interventions in patients undergoing fertility treatment have shown a positive effect on patient psychological well-being, fertility treatment retention rates and subsequent pregnancy rates, highlighting the beneficial effects of addressing patient vulnerabilities with adjunct psychological care (Domar,

2004; Domar et al., 2011; Frederiksen et al., 2015; Kraaij et al., 2010).

This study further investigated whether avoidant coping strategies mediated the relationship between perceived stress and eating pathology. Consistent with the hypothesis, avoidant coping style was shown to partially mediate the relationship between stress and eating pathology. This result suggests that avoidant coping style plays a role in eating pathology symptoms, beyond that explained purely by the direct effect of perceived stress on maladaptive eating. This mediational relationship between perceived stress, avoidant coping and eating pathology can be interpreted as consistent with an "escape theory" of eating pathology. According to this theory, perceived stress and subsequent distress arising from external life stressors may be managed through a reduced level of self-awareness and engagement in avoidance-oriented behaviours (Heatherton and Baumeister, 1991). Whilst in the short term, these avoidance strategies may be adaptive by providing emotional distance to the problem, longitudinally, they are less instrumental in resolving the distress and can impact upon psychological well-being (Holahan et al., 2005). Accordingly, clinical interventions that focus on guiding patients with alternative forms of adaptive coping skills, such as problem-focused strategies, acceptance and distress tolerance techniques, may be of greater benefit for patient well-being. This suggestion is supported empirically by others who have found that engagement in positive appraisal or cognitive-oriented coping therapies aimed at direct problem management and emotional regulation are associated with improved

patient emotional responses in fertility, including perceived burden of fertility treatment (Gameiro et al., 2015; Kraaij et al., 2010; Lancaster and Boivin, 2005; Ockhuijsen et al., 2014; Rooney and Domar, 2014; Terry and Hynes, 1998).

Understanding the differential paths of perceived stress on eating pathology is important in terms of staging targets for clinical intervention. This study found that neither the direct effects of perceived stress on eating pathology nor the indirect effect via the intermediary variable of avoidant coping style provided a superior explanation of eating pathology symptoms. Therefore, this study highlights that both perceived stress levels and avoidant coping style should be considered important targets in psychotherapeutic interventions for infertile women presenting with forms of eating pathology.

Admittedly, the relationship between stress and eating pathology is complex. In this study, only 15% of the variance in eating pathology was explained by perceived stress and avoidant coping style. Thus, it is clear that there are other unmeasured factors in our mediation model which may better account for the presence of eating pathology. For instance, it has been recognized that concomitant biological changes can occur in the body when an individual is under stress. Specifically, individual differences in levels of neuroendocrine hormones such as cortisol, insulin and ghrelin may influence appetite regulation, alterations to eating behaviours (e.g. bingeing) and food choice (Culbert et al., 2016; Hilterschild and Laessle, 2015; Newman et al., 2007; Roberts et al., 2014). Similarly, researchers have further speculated that the level of social support available can assist a woman in her capacity to cope adaptively by influencing the stress appraisal process or the emotional and behavioural responses to a stressful event (Aime et al., 2006; Cohen and Wills, 1985; Schwarzer and Knoll, 2007). Future investigations should explore the direct and stress-buffering effects of partner support on eating pathology and other negative lifestyle behaviours relevant to fertility (Kwan and Gordon, 2016; Limbert, 2010).

Limitations and strengths

Whilst this research provides a number of important insights, it is not without limitations. In this study, women had been attempting to conceive for an average of 31 months. One-off measures involved in a cross-sectional design may not fully capture the likely complex relationship of how stress and avoidant coping style act to influence eating pathology longitudinally. Therefore, future research examining coping style and eating pathology across the course of a patient's treatment journey using latent growth curve modelling would be valuable in understanding the causal and temporal aspects of these variables. Second, this study relied upon participants completing sensitive self-report measures with a potential for social desirability response bias. The anonymous completion of the study questionnaire may have served to reduce this bias. Third, whilst the response rate of 44.5% is acknowledged as a further limitation of this study, the sample size requirements for the purposes of structural equation modelling were readily met (Kline, 2011; Preacher and Hayes, 2004).

Limitations notwithstanding, the strengths of the present study include the use of a large, representative cohort drawn

from multiple assisted reproductive technology clinics, thereby reducing potential sampling bias. Second, some studies investigating the relationship between stress and eating pathology – such as those carried out in a laboratory – can lack ecological validity, failing to mimic real-life stress and coping experiences (Greeno and Wing, 1994). However, the sampling of patients who were receiving fertility treatment has permitted an investigation of authentic life experiences, with the findings not reliant on an artificial experimental design. Third, the large sample size allowed for use of structural equation modelling providing a methodological advantage over other eating pathology and stress-related fertility studies that use univariate or path analysis statistical designs. Structural equation modelling is the only data analytic strategy that allows simultaneous analysis of multiple relationships between variables measured without error, as the error has been estimated and removed (Tabachnick and Fidell, 2001). Moreover, from a theoretical perspective, it uses a confirmatory approach to data analysis by specifying the relationship among study variables *a priori*. These empirical findings provide a methodological framework for the investigation of other stress-specific maladaptive health behaviours detrimental to fertility.

Conclusions

Disordered eating attitudes and behaviours have clinical consequences for women undergoing fertility treatment. Stress and coping style have been identified as important variables impacting upon the well-being of fertility patients. The results of this study are in accordance with the existing literature in that a relationship was found between perceived stress and eating pathology, via the intermediary factor avoidant coping style. The results from this study further support the importance of both perceived stress and avoidant coping style as relevant variables to consider in preconception counselling of eating pathology symptoms in infertile patients, with recommendations for referral for adjunct psychological interventions relevant to stress management and coping. Finally, perceived stress and its health outcome response are best viewed as a process of complex intervening factors. As such, this study highlights the advantages of using structural equation modelling, with its advanced statistical capabilities, over traditional univariate analysis, and recommends continued exploration of other fertility-compromising negative health behaviours or lifestyle behaviours within this framework.

Acknowledgements

We are grateful to the women who participated in the study. We thank the nurses of Concept Fertility Centre, Fertility North and Hollywood Fertility Centre who assisted with advertising of the study and participant recruitment.

References

- Abraham, S., Mira, M., Llewellyn-Jones, D., 1990. Should ovulation be induced in women recovering from an eating disorder or who are compulsive exercisers? *Fertil. Steril.* 53, 566–568.

- Aime, A., Sabourin, S., Ratte, C., 2006. The eating disturbed spectrum in relation with coping and interpersonal functioning. *Eat. Weight Disord.* 11, 66–72.
- Aldao, A., Nolen-Hoeksema, S., Schweizer, S., 2010. Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clin. Psychol. Rev.* 30, 217–237.
- American Psychiatric Association, 2013. *Diagnostic and Statistical Manual of Mental Disorders*. 5th ed. American Psychiatric Publishing, Arlington, VA.
- Arbuckle, J.L., 2016. AMOS (Version 24.0) [Computer Program]. IBM SPSS Corp., Chicago.
- Ball, K., Lee, C., 2000. Relationships between psychological stress, coping and disordered eating: A review. *Psychol. Health* 14, 1007–1035.
- Benyamini, Y., Gefen-Bardarian, Y., Gozlan, M., Tabiv, G., Shiloh, S., Kokia, E., 2008. Coping specificity: the case of women coping with infertility. *Psychol. Health* 23, 221–241.
- Boivin, J., Griffiths, E., Venetis, C.A., 2011. Emotional distress in infertile women and failure of assisted reproductive technologies: meta-analysis of prospective psychosocial studies. *BMJ* 342, d223. <https://doi.org/10.1136/bmj.d223>.
- Carver, C.S., 1997. You want to measure coping but your protocol's too long: Consider the Brief COPE. *Int. J. Behav. Med.* 4, 92–100.
- Cohen, S., Kamarck, T., Mermelstein, R., 1983. A global measure of perceived stress. *J. Health Soc. Behav.* 24, 385–396.
- Cohen, S., Wills, T.A., 1985. Stress, social support and the buffering hypothesis. *Psychol. Bull.* 98, 310–357.
- Coker, E., Lahoud, R., Abraham, S., 2016. Polycystic Ovarian Syndrome and Eating Disorder Quality of Life: A Pilot Study. *JFIV Reprod. Med. Genet.* 4 (171). <https://doi.org/10.4172/2375-4508.1000171>.
- Cousineau, T., Domar, A.D., 2007. Psychological impact of infertility. *Best Pract. Res. Clin. Obstet. Gynaecol.* 21, 293–308.
- Cousins, A., Freizinger, M., Duffy, M.E., Gregas, M., Wolfe, B.E., 2015. Self-report of eating disorder symptoms among women with and without infertility. *JOGNN* 44, 380–388.
- Crowther, J.H., Sanftner, J., Bonifazi, D.Z., Shepherd, K.L., 2001. The role of daily hassles in binge eating. *Int. J. Eat. Disord.* 29, 449–454.
- Culbert, K.M., Racine, S.E., Klump, K.L., 2016. Hormonal factors and disturbances in eating disorders. *Curr. Psychiatry Rep.* 18, 65. <https://doi.org/10.1007/s11920-016-0701-6>.
- Davies, M.M., Bekker, M.H., Roosen, M.A., 2011. The role of coping and general psychopathology in the prediction of treatment outcome in eating disorders. *Eat. Disord.* 19, 246–258.
- Domar, A.D., 2004. Impact of psychological factors on dropout rates in insured infertility patients. *Fertil. Steril.* 81, 271–273.
- Domar, A.D., Rooney, K.L., Wiegand, B., Orav, E.J., Alper, M.M., Berger, B.M., Nikolovski, J., 2011. Impact of a group mind/body intervention on pregnancy rates in IVF patients. *Fertil. Steril.* 95, 2269–2273.
- Domar, A.D., Zuttermeister, P.C., Freidman, R., 1993. The psychological impact of infertility: a comparison with patients with other medical conditions. *J. Psychosom. Obstet. Gynaecol.* 14, 45–52.
- Ebbesen, S.M.S., Zachariae, R., Mehlsen, M.Y., Thomsen, D., Hojgaard, A., Ottosen, L., Petersen, T., Ingerslev, H.J., 2009. Stressful life events are associated with a poor in-vitro fertilization (IVF) outcome: a prospective study. *Hum. Reprod.* 24, 2173–2182.
- Endler, N.S., Parker, J.D., 1990. Multidimensional assessment of coping: A critical evaluation. *J. Pers. Soc. Psychol.* 58, 844–854. <https://doi.org/10.1037/0022-3514.58.5.844>.
- ESHRE Capri Workshop Group, 2006. Nutrition and reproduction in women. *Hum. Reprod. Update* 12, 193–207.
- Fairburn, C.G., Beglin, S.J., 2008. Eating Disorder Examination Questionnaire (EDE-Q 6.0). In: Fairburn, C.G. (Ed.), *Cognitive Behaviour Therapy and Eating Disorders*. Guildford Press, New York.
- Frederiksen, Y., Farver-Vestergaard, I., Skovgard, N.G., Ingerslev, H.J., Zachariae, R., 2015. Efficacy of psychosocial interventions for psychological and pregnancy outcomes in infertile women and men: a systematic review and meta-analysis. *BMJ Open* 5e006592. <https://doi.org/10.1136/bmjopen-2014-006592>.
- Freeman, L.M., Gil, K.M., 2004. Daily stress, coping, and dietary restraint in binge eating. *Int. J. Eat. Disord.* 36, 204–212.
- Freizinger, M., Franko, D.L., Dacey, M., Okun, B., Domar, A.D., 2010. The prevalence of eating disorders in infertile women. *Fertil. Steril.* 93, 72–78.
- Gameiro, S., Boivin, J., Dancet, E., de Klerk, C., Emery, M., Lewis-Jones, C., Thorn, P., Van den Broeck, U., Venetis, C., Verhaak, C.M., Wischman, T., Vermeulen, N., 2015. ESHRE guideline: routine psychosocial care in infertility and medically assisted reproduction – a guide for fertility staff. *Hum. Reprod.* 30, 2476–2485.
- Gameiro, S., Boivin, J., Peronace, L., Verhaak, C.M., 2012. Why do patients discontinue fertility treatment? A systematic review of reasons and predictors of discontinuation in fertility treatment. *Hum. Reprod. Update* 18, 652–669.
- Gana, K., Jakubowska, S., 2016. Relationship between infertility-related stress and emotional distress and marital satisfaction. *J. Health Psychol.* 21, 1043–1054.
- Gesink Law, D.C., Maclehose, R.F., Longnecker, M.P., 2007. Obesity and time to pregnancy. *Hum. Reprod.* 22, 414–420.
- Glanz, K., Rimer, B., Viswanath, K., 2008. *Health Behavior and Health Education: Theory, Research and Practice*. fourth edition. John Wiley & Sons, San Francisco, CA.
- Gormack, A.A., Peek, J.C., Jose, G.B., Derraik, J.G.B., Gluckman, P.D., Young, N.L., Cutfield, W.S., 2015. Many women undergoing fertility treatment make poor lifestyle choices that may affect their treatment outcome. *Hum. Reprod.* 30, 1617–1624.
- Gourounti, K., Anagnostopoulos, F., Potamianos, G., Lykeridou, K., Schmidt, L., Vaslamatzis, G., 2012. Perception of control, coping, and psychological stress of infertile women undergoing IVF. *Reprod. BioMed. Online* 24, 670–679.
- Greeno, C.G., Wing, R.R., 1994. Stress-induced eating. *Psychol. Bull.* 115, 444–464.
- Gruenewald, T.L., Kemeny, M.E., Aziz, N., Fahey, J.L., 2004. Acute threat to the social self: Shame, social self-esteem, and cortisol activity. *Psychosom. Med.* 66, 915–924.
- Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., 2010. *Multivariate Data Analysis*. 7th edn. Pearson Prentice Hall, Upper Saddle River, NJ.
- Heatherton, T.F., Baumeister, R.F., 1991. Binge eating as escape from self-awareness. *Psychol. Bull.* 110, 86–108.
- Hilterschild, E., Laessle, R., 2015. Stress-induced release of GUT peptides in young women classified as restrained and unrestrained eaters. *Eat. Weight Disord.* 20, 435–439.
- Holahan, C.J., Moos, R.H., Holahan, C.K., Brennan, P.L., Schutte, K. K., 2005. Stress generation, avoidance coping, and depressive symptoms: A 10-year model. *J. Consult. Clin. Psychol.* 73, 658–666.
- Homan, G.F., Davies, M., Norman, R., 2007. The impact of lifestyle factors on reproductive performance in the general population and those undergoing infertility treatment: a review. *Hum. Reprod. Update* 13, 209–223.
- Hu, L., Bentler, P.M., 1999. Cutoff criteria for fit indexes in covariance structure analysis. Conventional criteria versus alternatives. *Struct. Equ. Model.* 6, 1–55.
- Keyes, K.M., Hatzenbuehler, M.L., Hasin, D.S., 2011. Stressful life experiences, alcohol consumption, and alcohol use disorders: the epidemiologic evidence for four main types of stressors. *Psychopharmacology* 218, 1–17.
- Klatzkin, R.R., Gaffney, S., Cyrus, K., Bigus, E., Brownley, K.A., 2016. Stress-induced eating in women with binge-eating disorder and obesity. *Biol. Psychiatry* <https://doi.org/10.1016/j.biopsych.2016.11.002>.

- Kline, R.B., 2011. Principles and practice of structural equation modeling. Guilford, New York, NY.
- Kouvonen, A., Kivimäki, M., Virtanen, M., Pentti, J., Vahtera, J., 2005. Work stress, smoking status, and smoking intensity: an observational study of 46 190 employees. *J. Epidemiol. Community Health* 59, 63–69.
- Kraaij, V., Garnefski, N., Schroevers, M.J., Weijmer, J., Helmerhorst, F., 2010. Cognitive coping, goal adjustment, and depressive and anxiety symptoms in people undergoing infertility treatment. *J. Health Psychol.* 15, 876–886.
- Kupeli, N., Norton, S., Chilcot, J., Campbell, C., Schmidt, U.H., Troop, N.A., 2017. Affect systems, changes in body mass index, disordered eating and stress: an 18 month longitudinal study in women. *Health Psychol. Behav. Med.* 5, 214–228.
- Kwan, M.Y., Gordon, K.H., 2016. The effects of social support and stress perception on bulimic behaviors and unhealthy food consumption. *Eat. Behav.* 22, 34–39.
- Lancastle, D., Boivin, J., 2005. Dispositional optimism, trait anxiety, and coping: unique or shared effects on biological response to fertility treatment? *Health Psychol.* 24, 171–178.
- Landres, I.V., Milki, A.A., Lathi, R.B., 2010. Karyotype of miscarriages in relation to maternal weight. *Hum. Reprod.* 25, 1123–1126.
- Lazarus, R.S., Folkman, S., 1984. *Stress, Appraisal and Coping*. Springer, New York.
- Limbirt, C., 2010. Perceptions of social support and eating disorder characteristics. *Health Care Women Int.* 31, 170–178.
- Loucks, A.B., 2007. Energy availability. *Curr. Opin. Endocrinol. Diabetes Obes.* 14, 470–474.
- MacNeil, L., Esposito-Smythers, C., Mehlenbeck, R., Weismoore, J., 2012. The effects of avoidance coping and coping self-efficacy on eating disorder attitudes and behaviors: A stress-diathesis model. *Eat. Behav.* 13, 293–296.
- Marsh, H.W., Hau, K.-T., Wen, Z., 2004. In search of golden rules: Comment on hypothesis-testing approaches to setting cutoff values for fit indices and dangers in overgeneralizing Hu and Bentler's (1999) findings. *Struct. Equ. Model.* 11, 320–341.
- Miller, G.E., Chen, E., Zhou, E.S., 2007. If it goes up, must it come down? Chronic stress and the hypothalamic-pituitary-adrenocortical axis in humans. *Psychol. Bull.* 133, 25–45.
- Mircea, C.N., Lujan, M.E., Pierson, R.A., 2007. Metabolic fuel and clinical implications for female reproduction. *J. Obstet. Gynaecol. Can.* 29, 887–902.
- Newman, E., O'Connor, D.B., Conner, M., 2007. Daily hassles and eating behaviour: The role of cortisol reactivity status. *Psychoneuroendocrinology* 32, 125–132.
- Norman, R., Chura, L., Robker, R.L., 2008. Effects of obesity on assisted reproductive technology outcomes. *Fertil. Steril.* 89, 1611–1612.
- Ockhuisen, H., van den Hoogen, A., Eijkemans, M., Macklon, N., Boivin, J., 2014. The impact of a self-administered coping intervention on emotional well-being in women awaiting the outcome of IVF treatment: a randomized controlled trial. *Hum. Reprod.* 29, 1459–1470.
- Pasch, L.A., Holley, S.R., Bleil, M.E., Shehab, D., Katz, P.P., Adler, N.E., 2016. Addressing the needs of fertility treatment patients and their partners: are they informed of and do they receive mental health services? *Fertil. Steril.* 106, 209–215.
- Pearson, A.N., Heffner, M., Follette, V.M., 2010. *Acceptance & Commitment Therapy for Body Image Dissatisfaction: A Practitioner's Guide to Using Mindfulness, Acceptance & Values-Based Behavior Change Strategies*. New Harbinger Publications Inc., Oakland, California.
- Preacher, K.J., Hayes, A.F., 2004. SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behav. Res. Methods Instrum. Comput.* 36, 717–731.
- Razzoli, M., Pearson, C., Crow, S., Bartolomucci, A., 2017. Stress, overeating, and obesity: Insights from human studies and preclinical models. *Neurosci. Biobehav. Rev.* 76, 154–162.
- Roberts, C.J., Campbell, I.C., Troop, N., 2014. Increases in weight during chronic stress are partially associated with a switch in food choice towards increased carbohydrate and saturated fat intake. *Eur. Eat. Disord. Rev.* 22, 77–82.
- Rodino, I.S., Byrne, S., Sanders, K.A., 2017. Eating disorders in the context of preconception care: fertility specialists' knowledge, attitudes, and clinical practices. *Fertil. Steril.* 107, 494–501.
- Rooney, K.L., Domar, A.D., 2014. The impact of lifestyle behaviors on infertility treatment outcome. *Curr. Opin. Obstet. Gynecol.* 26, 181–185.
- Rowe, E., 2017. Early detection of eating disorders in general practice. *Aust. Fam. Physician* 46, 833–838.
- Schmidt, L., Holstein, B.E., Christensen, U., Boivin, J., 2005. Communication and coping as predictors of fertility problem stress: cohort of 816 participants who did not achieve a delivery after 12 months of fertility treatment. *Hum. Reprod.* 20, 3248–3256.
- Schneider, J.E., 2004. Energy balance and reproduction. *Physiol. Behav.* 81, 289–317.
- Schwarzer, R., Knoll, N., 2007. Functional roles of social support within the stress and coping process: A theoretical and empirical overview. *Int. J. Psychol.* 42, 243–252.
- Stewart, D.E., Robinson, G.E., Goldbloom, D.S., Wright, C., 1990. Infertility and eating disorders. *Am. J. Obstet. Gynecol.* 163, 1196–1199.
- Striegel-Moore, R.H., Bulik, C.M., 2007. Risk factors for eating disorders. *Am. Psychol.* 62, 181–198.
- Sulkowski, M.L., Dempsey, J., Dempsey, A.G., 2011. Effects of stress and coping on binge eating in female college students. *Eat. Behav.* 12, 188–191.
- Tabachnick, B.G., Fidell, L.S., 2001. *Using Multivariate Statistics*. Allyn and Bacon, Needham Heights.
- Terry, D.J., Hynes, G.J., 1998. Adjustment to a low-control situation: Reexamining the role of coping responses. *J. Pers. Soc. Psychol.* 74, 1078–1092.
- Toftager, M., Sylvest, R., Schmidt, L., Bogstad, J., Lossel, K., Praetorius, L., Zedeler, A., Bryndorf, T., Pinborg, A., 2018. Quality of life and psychosocial and physical well-being among 1,023 women during their first assisted reproductive technology treatment: secondary outcome to a randomized controlled trial comparing gonadotropin-releasing hormone (GnRH) antagonist and GnRH agonist protocols. *Fertil. Steril.* 109, 154–164.
- Troop, N.A., Holbrey, A., Trowler, R., Treasure, J.L., 1994. Ways of coping in women with eating disorders. *J. Nerv. Ment. Dis.* 182, 535–540.
- Van den Broeck, U., D'Hooghe, T., Enzlin, P., Demyttenaere, K., 2010. Predictors of psychological stress in patients starting IVF treatment: infertility-specific versus general psychological characteristics. *Hum. Reprod.* 25, 1471–1480.
- Verhaak, C.M., Smeenk, J.M.J., Evers, A.W.M., Kremer, J.A.M., Kraaijmaat, F.W., Braat, D.D.M., 2007. Women's emotional adjustment to IVF: A systematic review of 25 years of research. *Hum. Reprod. Update* 13, 27–36.

Declaration: The authors report no financial or commercial conflicts of interest.

Received 5 October 2017; refereed 11 December 2017; accepted 15 March 2018.

CHAPTER 7 - STUDY FOUR

(Peer-Reviewed Publication)

Eating Disorders in the Context of Preconception Care: Fertility Specialists' Knowledge, Attitudes, and Clinical Practices

Iolanda S. Rodino, Susan M. Byrne, Katherine A. Sanders.
Fertility and Sterility 2017; 107 (2): 494-501

DOI: 10.1016/j.fertnstert.2016.10.036

7.1 FOREWORD

Mental health literacy (MHL) is a term used to encompass knowledge, attitudes and clinical practices with respect to a specific area of mental health concern. In the context of reproductive medicine this includes the competence and confidence of fertility health care providers to detect emotional and physical risk factors during preconception care. Eating disorders represent one such area of mental health concern with direct impact upon reproductive health. Early identification and intervention are crucial given the increased risk of physical and psychological morbidity associated with eating disorders. Yet empirical evidence suggests that for women attending a fertility clinic, there remains poor rates of patient disclosure about their lifetime history of an eating disorder. This may in part be owing to patient factors, although limited doctor proficiency and confidence in their knowledge about eating pathology, including awareness of the assessment and/or screening strategies that aid in early recognition, may represent barriers in this clinical area.

The aim of *Study Four* was to examine the MHL of fertility specialists with respect to their knowledge and attitudes to eating pathology. This study provides new data with respect to knowledge and clinical practice and has relevance for patient care. The findings of this study have been published in the journal *Fertility and Sterility* 2017; 107 (2): 494-501.

Eating disorders in the context of preconception care: fertility specialists' knowledge, attitudes, and clinical practices

Iolanda S. Rodino, M.Psych.(Clin.),^{a,b} Susan M. Byrne, Ph.D.,^{b,c} and Katherine A. Sanders, Ph.D.^a

^a School of Anatomy, Physiology, and Human Biology and ^b School of Psychology, University of Western Australia; and

^c Centre for Clinical Interventions, Perth, Western Australia, Australia

Objective(s): To gauge fertility specialists' knowledge, clinical practices, and training needs in regard to eating disorders.

Design: Cross-sectional study.

Settings: Fertility clinics.

Participants: Eighty Australian and New Zealand fertility specialists who were members of the Fertility Society of Australia.

Intervention(s): None.

Main Outcome Measures(s): Responses to an anonymously completed online questionnaire.

Result(s): Approximately 54% of doctors correctly identified the body mass index relevant to anorexia nervosa, and 30% identified menstrual disturbances for anorexia, while 63.8% of doctors incorrectly nominated maladaptive weight control behaviors as a characteristic of binge eating disorder. While clinicians (83.7%) agreed it was important to screen for eating disorders during preconception assessments, 35% routinely screened for eating disorders and 8.8% indicated that their clinics had clinical practice guidelines for management of eating disorders. A minority of participants (13.8%) felt satisfied with their level of university training in eating disorders, 37.5% of doctors felt confident in their ability to recognize symptoms of an eating disorder, and 96.2% indicated a need for further education and clinical guidelines. On most items examined, knowledge and clinical practices regarding eating disorders did not differ according to doctor gender or years of clinical experience working as a fertility specialist.

Conclusion(s): Knowledge about eating disorders in the context of fertility treatment is important. This study highlights the uncertainty among fertility specialists in detecting features of eating disorders. The findings point to the importance of further education and training, including the development of clinical guidelines specific to fertility health care providers. (Fertil Steril® 2017;107:494–501. ©2016 by American Society for Reproductive Medicine.)

Key Words: Eating disorders, preconception, diagnostic criteria, fertility specialist, training

Discuss: You can discuss this article with its authors and with other ASRM members at <https://www.fertstertdialog.com/users/16110-fertility-and-sterility/posts/12941-22681>

The impact of modifiable lifestyle factors such as age, smoking, drinking, caffeine, and weight status on reproductive outcomes is widely known (1, 2). Under the rubric of preconception care, however, remains the little investigated topic of eating disorders within a fertility population (3–5). Eating disorders are serious mental illnesses related to weight and shape concerns,

problematic eating behaviors, and maladaptive weight control behaviors that occur in women of childbearing years (6, 7). Estimates from large population-based surveys give a lifetime prevalence of any eating disorder among adult women of approximately 6% (8, 9). Similarly, 5%–7.5% of women experience some form of eating disorder during pregnancy (10, 11). Existing research

findings on the occurrence of eating disorders in women undergoing fertility treatment vary according to inpatient or community-based assessment but the occurrence has been reported to be as high as 21%, particularly when patients present with forms of ovulatory disorders (3, 4, 12–14).

The current Diagnostic and Statistical Manual of Mental Disorders, fifth edition (DSM-5) (15), outlines three primary categories of eating disorders: anorexia nervosa (AN), bulimia nervosa (BN), and binge eating disorder (BED). Women with eating disorders have a high incidence of psychiatric comorbidity impacting overall patient

Received June 28, 2016; revised and accepted October 25, 2016; published online November 23, 2016.

I.S.R. has nothing to disclose. S.M.B. has nothing to disclose. K.A.S. has nothing to disclose.

Reprint requests: Ms. Iolanda S. Rodino, M.Psych.(Clin.), University of Western Australia, Perth, Western Australia, Australia 6009 (E-mail: iolanda@perthivf.com).

Fertility and Sterility® Vol. 107, No. 2, February 2017 0015-0282/\$36.00

Copyright ©2016 American Society for Reproductive Medicine, Published by Elsevier Inc.

<http://dx.doi.org/10.1016/j.fertnstert.2016.10.036>

mental health and quality of life (16, 17). Both AN and BN have varied and complex physical and neuroendocrine implications and can result in pervasive multibody organ changes involving the cardiovascular, gastrointestinal, hematological, dermatological, and skeletal systems including major dysfunctions of the endocrine system and metabolic processes relevant to fertility (18). Specifically, healthy female reproductive function is directly related to a woman's optimal body weight range and energy availability, with eating disorders influencing the activity of the hypothalamic-pituitary-ovarian axis (19, 20). Women with AN or BN are further at higher risk of adverse maternal-fetal outcomes including inadequate gestational weight gain in pregnancy, increased rates of miscarriage and cesarean section, and the delivery of newborns who are small for gestational age (7, 21). Moreover, use of ovulation induction in women who are reproductively suppressed secondary to an eating disorder increases the risk of multiple pregnancies, with added pregnancy and neonatal complications (12). Postnatally, difficulties with breast feeding, lower infant growth, unsettled infant temperament, concerns with toddler nutrition, and maternal mood disorders have also been reported in women who had an eating disorder during pregnancy (22). Consequently, from a fertility specialist perspective, knowledge and recognition of eating disorders are important to infertility patient reproductive outcomes including the physical health of the prospective child.

Despite the spectrum of physical and psychological effects of eating disorders, research suggests that eating disorders often go undetected by professionals working in the health system. Barriers to the detection of eating disorders are multifactorial but appear to centralize around four main issues: first, a commonly held societal view that it is normal for women to have discontent about their body weight and shape such that weight control behaviors are deemed normative (23); second, an inclination for patients with an eating disorder to either nondisclose, minimize symptoms, or engage in concealment of their disorder from their treating doctor (24, 25); third, a tendency for some health professionals to maintain negative attitudes and reactions towards patients with an eating disorder due to a perception that eating disorders are self-inflicted, relate to negative personality attributes, and are therefore of lesser clinical importance (26–29); and fourth, a lack of knowledge among health practitioners of the physical and psychological indications of an eating disorder due to limited tertiary training (30–34). Collectively these factors can result in poorer mental health literacy about eating disorders among health professionals, serving to reduce both diagnostic confidence and the likelihood of referral to relevant mental health networks for appropriate psychological interventions (35, 36).

Research on eating disorders in the reproductive medicine field has focused on investigating the perspectives of clinicians who primarily are generalists or who have an obstetric focus rather than a preconception specialization (32, 37, 38). Therefore the aims of this study were first to examine fertility specialists' knowledge about eating disorders, second to determine preconception clinical practices and attitudes

towards the assessment and management of eating disorders, and third to gauge fertility specialists' training needs.

MATERIALS AND METHODS

Participants

This study sought participation from male and female Australian and New Zealand medical fertility specialists who were members of the Fertility Society of Australia (FSA). Respondents were English speaking and were from all states of Australia and both the north and south islands of New Zealand.

Questionnaire Composition

The questionnaire "Fertility Specialists' Knowledge and Attitudes towards Eating Disorders" is an adapted version of a questionnaire developed by Jones et al. (34), who investigated knowledge and attitudes towards eating disorders in a cohort of psychiatrists. The Jones et al. (34) questionnaire content was determined from multiple sources including diagnostic criteria for AN and BN from the Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV) (39) and diagnostically equivalent criteria and body mass index (BMI) weight thresholds from the International Classification of Diseases Manual, 10th revision (ICD-10) (40). As BED was not assessed by Jones et al. (34), for consistency of diagnostic classifications, adjunct DSM-IV (39) research criteria for BED were incorporated into our questionnaire. The decision to use the DSM-IV criteria rather than update the questionnaire with the contemporary criteria from DSM-5 (15) was to reduce the potential confound of participant unfamiliarity with the comparatively new changes to DSM-5 eating disorder diagnostic criteria at the time of initial data collection. These DSM-5 changes include the deletion of the criteria for amenorrhea and the absence of specificity of weight thresholds, criteria both known to be of importance within the context of fertility.

Our study questionnaire focused on five main domains: [1] demographic questions; [2] doctor knowledge of diagnostic criteria relating to AN, BN, and BED; [3] preconception clinical practices for assessing patient BMI and eating disorders; [4] attitudes towards clinical practices associated with eating disorders including management and referral processes; and [5] fertility specialist training needs. Response methods used included check boxes, yes/no response, and 5-point Likert-type items ranging in scale from 1 = strongly disagree to 5 = strongly agree.

Procedure

One hundred fifty fertility specialists who were registered as medical members of the FSA were sent an initial e-mail by a collaborating fertility specialist outlining the objectives of the study, details for consent, and a direct URL to access the study questionnaire for voluntary participation. The online questionnaire took approximately 10 minutes to complete, and no identifying participant details were collected. Two further e-mail reminders about the study were sent to

participants, with online data being collected between the months of February 2014 to August 2014. Approval for completion of this study, including participant consent and study questionnaire, was granted by the Human Research Ethics Committee of the University of Western Australia (reference no. RA/4/1/6552).

Statistical Methods

Frequency tabulation and percentages were calculated for sociodemographic items, knowledge of diagnostic criteria, and preconception clinical practices regarding BMI and eating disorders. Independent-sample *t* tests were performed to evaluate fertility specialist knowledge (i.e., total correct score on diagnostic criteria) according to gender and years of clinical experience working as a fertility specialist. Years of clinical experience data were analyzed according to a binary category of either junior (i.e., less than 10 years of clinical practice; *n* = 35) or senior (exceeding 10 years of clinical practice; *n* = 45). Likert-type items gauging attitudes to clinical practices and doctor training needs on eating disorders are reported as percentage of respondents who agreed or strongly agreed to the item, with gender differences analyzed using χ^2 . Due to preliminary analyses showing multiple cells having less than expected cell counts, for the purpose of statistical reporting, we collapsed the 5-point Likert scale to a 3-point scale (i.e., strongly disagree/disagree; neither agree/disagree [neutral]; agree/strongly agree). The statistical package SPSS for Windows, version 23, was used for all statistical analyses. The significance level of .05 was used to test for statistical differences.

RESULTS

Participants

One hundred six fertility specialists initially consented to participate in this study, 54 female doctors and 52 male doctors. Twenty-six respondents discontinued after partially completing two sections of the questionnaire, leaving a valid sample of 80 respondents. A dropout analysis between responders and nonresponders showed a statistically significant effect for gender [$\chi^2(1) = 9.304; P = .002$], with more female fertility specialists exiting the online study questionnaire. Incomplete records were eliminated from further data analyses. Of questionnaire completers, 58% were male and 42% female, broadly representative of the gender distribution of actively practicing obstetric and gynecologist consultants at the time of study completion (41). A total of 81% of participants were from Australia and 19% were from New Zealand. Table 1 presents additional characteristics of participants who completed the research protocol.

Knowledge of Diagnostic Criteria (AN, BN, BED)

A total of 12 correct and five incorrect diagnostic criteria were presented for evaluation. Participant accuracy scores ranged from 1 to 12. Male fertility specialists attained a mean correct score of 7.20 (SD = 2.34), and female fertility specialists a mean correct score of 8.03 (SD = 2.63) with no difference found according to gender ($P = .140$) or years in clinical practice ($P = .982$).

TABLE 1

Demographic characteristics of respondents (total *n* = 80).

Participant characteristic	%
Age range (y) ^a	
25–35	6.2
36–45	32.5
46–55	32.5
56–65	21.2
≥ 66	7.5
Additional advanced fertility specialist training	
CREI certificate ^b	41.2
Masters in reproductive medicine	33.8
Other/no additional training	25.0
Years practicing as a fertility specialist ^a	
0–5	23.8
6–10	20.0
11–15	25.0
16–20	5.0
21–25	7.5
≥ 26	18.8
Clinical interests areas ^c	
PCOS	58.8
Male factor	37.5
Fertility preservation	36.2
Endometriosis	38.8
Pelvic surgery	26.2
Menopause	21.2

^a Sum of percentages does not always equal 100 due to rounding.

^b The Certificate of Reproductive Endocrinology and Infertility (CREI) qualification is held by trained gynecologists who already hold the qualification of Fellow of the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (FRANZCOG) and who have completed advanced training in the comprehensive management of patients with reproductive endocrine disorders and infertility.

^c Participants could indicate one or more clinical interests.

Rodino. Doctors' knowledge about eating disorders. *Fertil Steril* 2016.

Table 2 shows the percentage of fertility specialists endorsing diagnostic criteria for each eating disorder category. Approximately 54% of participants correctly identified the BMI threshold required for a diagnosis of AN (i.e., BMI below 17.5 kg/m²), whereas 38.8% of participants incorrectly endorsed a more extreme level of weight loss for AN (i.e., a BMI below 16.0 kg/m²). Of participants, 16.2% correctly identified that women with BN typically maintained their weight status above weight thresholds diagnostically associated with AN. Knowledge of menstrual disturbances associated with eating disorders revealed that 30% of participants correctly endorsed the DSM-IV criteria of an absence of three consecutive menstrual cycles for AN, while 27.5% inaccurately endorsed a more stringent criterion of absence of six consecutive menstrual cycles. With respect to maladaptive weight control behaviors, while 82.5% of participants correctly recognized “extreme maladaptive weight control behaviors” as a feature for BN, 63.8% of participants incorrectly endorsed these as relevant for a diagnosis of BED. Recognition of “marked distress” as a characteristic of BED was identified by 50% of respondents.

Preconception Clinical Practices and Attitudes to Practice

Figure 1 shows preconception practices in regards to eating disorders. Analysis revealed more female fertility specialists (82.4%) compared with male fertility specialists (58.7%)

TABLE 2

Fertility specialists' knowledge of diagnostic criteria for eating disorder categories (n = 80).

Eating disorder and diagnostic criteria	%
Anorexia nervosa	
Persistent energy intake restriction leading to weight that is maintained at least 15% below the expected BMI (or BMI is below 17.5 kg/m ²)	53.8
Persistent energy intake restriction leading to weight that is maintained at least 20% below the expected BMI (or BMI is below 16.0 kg/m ²) ^a	38.8
Binge eating (eating large amounts of food when not hungry or until uncomfortably full) ^a	17.5
Persistent behavior that interferes with weight gain, even though at a significantly low weight	75.0
Absence of at least three consecutive menstrual cycles	30.0
Absence of at least six consecutive menstrual cycles ^a	27.5
Disturbance in self-perceived weight and shape	85.0
Intense fear of gaining weight or becoming fat	76.2
Bulimia nervosa	
Recurrent episodes of binge eating at least twice a week for 3 mo	72.5
A sense of lack of control over eating during a binge episode	66.2
Persistent energy intake restriction leading to weight that is maintained at least 15% below the expected BMI (BMI is below 17.5 kg/m ²) ^a	22.5
Extreme weight control behaviors (e.g., strict dieting, self-induced vomiting, exercising, or laxative use) at least twice a week for 3 mo	82.5
Overevaluation of weight and shape	60.0
Weight is maintained above a BMI of 17.5 kg/m ²	16.2
Binge eating disorder	
A sense of lack of control over eating during a binge episode	87.5
Extreme weight-control behaviors (e.g., strict dieting, self-induced vomiting, exercising, or laxative use) at least once a week ^a	63.8
Marked distress regarding binge eating is present	50.0

Note: Diagnostic criteria for AN and BN are derived from DSM-IV and ICD-10 equivalent classification frameworks. Items for BED are based on DSM-IV research criteria. Values represent percentage (%) of respondents who endorsed the item as a diagnostic criterion.

^a Indicates participant endorsed an item that is not a correct diagnostic criteria for that specific eating disorder category.

Rodino. Doctors' knowledge about eating disorders. *Fertil Steril* 2016.

screened for the possibility of an eating disorder when a woman presented with particular symptoms of low BMI, polycystic ovary syndrome (PCOS), and/or ovulatory disorders [$\chi^2 (1) = 5.093; P = .024$], but this practice did not differ according to years of clinical experience ($P = .649$). Other clinical practices or access to clinical guidelines did not differ according to gender or years of clinical experience (all $P > .05$).

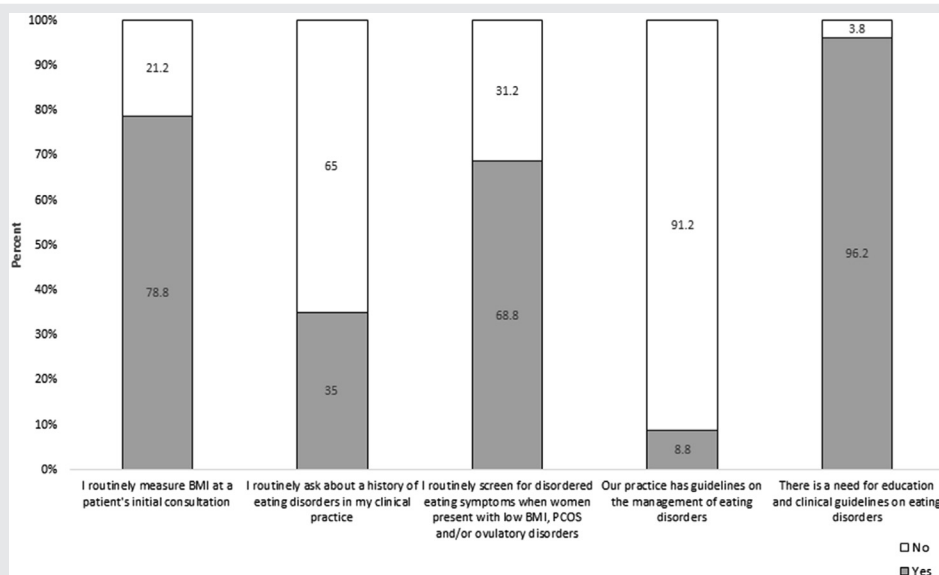
Analyses on questionnaire items gauging doctors' attitudes to clinical practices showed that 83.7% of fertility doctors agreed or strongly agreed that it was important to screen for current eating disorders during preconception assessment, with 90% of doctors agreeing or strongly agreeing that it was important to routinely enquire about exercise behaviors (Table 3). In actual practice, however, 35% of doctors routinely assessed patients for eating disorders during preconception assessment (Fig. 1). The majority of doctors (87.4%) agreed or strongly agreed that women with either very low or very high BMI should be referred to a dietitian, with 90% of participants indicating that women with eating disorders should treat their eating disorders before commencing fertility treatment. On the issue of treatment, while the majority of doctors agreed that women with an eating disorder should treat their eating disorder before starting fertility treatment (senior doctor, 91.1%, compared with junior doctor, 88.6%), 11.4% of doctors with junior clinical experience endorsed a neutral attitude ($P = .016$), although this attitude did not vary according to participant gender ($P = .151$). A minority of doctors (13.8%) agreed that assessing for eating disorders was not

their role, with 8.8% of participants agreeing that information on eating disorders was not of prime importance. On the issue of time constraints, approximately 39% of participants either agreed or strongly agreed that there was time available to assess for an eating disorder during an initial consultation, although a similar percentage of doctors held the opposing view. Overall there were no gender differences among fertility specialists in their attitudes to clinical practices relating to eating disorders (all $P > .05$); however, more female fertility specialists agreed or strongly agreed that patients presenting with BMI parameters outside of the healthy BMI weight range should be referred to a dietitian [$\chi^2 (2) = 8.447; P = .015$]. This variable did not vary according to doctors' years of clinical experience ($P = .062$).

Confidence Levels and Training Needs

Of respondents, 37.5% agreed or strongly agreed that they were confident in their ability to identify symptoms of eating disorders, and 32.5% were confident in their knowledge of referral pathways for patients with eating disorders. A minority of doctors (13.8%) were satisfied with the level of tertiary training received in this area, and 96.2% of participants felt there was a need for further education or clinical recommendations about treatment guidelines after patient disclosure of an eating disorder (Fig. 1). Male and female doctors did not differ in their attitudes to questions about their confidence in assessment, referral pathways, or training needs (all $P > .05$). Similarly, doctors did not differ on these items according to years of clinical practice (all $P > .05$).

FIGURE 1



Percentage of fertility specialists indicating use of specific clinical practice strategies, availability of clinical guidelines, and training needs relating to eating disorders (n = 80).

Rodino. Doctors' knowledge about eating disorders. *Fertil Steril* 2016.

DISCUSSION

Knowledge of Diagnostic Criteria

In this study, fertility specialists demonstrated uncertainty around weight-related diagnostic criteria, menstrual disturbances, and maladaptive weight control behaviors associated with specific eating disorders. While the majority of fertility doctors correctly viewed AN as a disturbance in self-perceived weight and shape (85%), only 53.8% of fertility doctors were cognizant of the weight threshold for clinical concern. For AN, this is body weight less than 85% of that expected for height and age or, as defined in the comparative ICD-10 classification system, a BMI threshold less than 17.5 kg/m² (40). Similarly, a minority of doctors (16.2%) recognized that women with BN characteristically have a BMI above AN weight diagnostic criteria, with the BN disorder

more typically being associated with normal or overweight weight status (i.e., BMI greater than 18.5 kg/m²) (42). From a fertility specialist perspective, knowledge about BMI thresholds of concern are not only important from the viewpoint of assessment and referral of a patient suspected of having an eating disorder but are also clinically relevant to influencing decisions about commencing fertility treatment (12).

Similar to findings by Jones et al. (34), fertility specialists' knowledge of menstrual disturbances secondary to eating disorders also revealed gaps, with 30% of doctors accurately specifying the DSM-IV criteria of absence of three consecutive cycles as being required for a confirmatory diagnosis of AN and a further 27.5% misconstruing an absence of six consecutive menstrual cycles as required for diagnosis. Even though surveillance of an eating disorder may not be

TABLE 3

Fertility specialists' attitudes to clinical practice regarding eating disorders (n = 80).

Item	SD	D	N	A	SA
It is important to screen for current eating disorders during preconception assessments	0.0	3.8	12.5	61.2	22.5
Women with eating disorders should treat their eating disorders before starting fertility treatment	0.0	5.0	5.0	56.2	33.8
It is important to routinely ask about exercise behaviors	0.0	3.8	6.2	62.5	27.5
Women who have very low or very high BMI should be referred to a dietician	1.2	3.8	7.5	56.2	31.2
Assessing patients for eating disorders is not my clinical role	12.5	53.8	20.0	13.8	0.0
There is not enough time to assess for eating disorders at initial consultations	5.0	33.8	22.5	32.5	6.2
I am confident in my ability to identify symptoms of eating disorders	1.2	32.5	28.8	35.0	2.5
Information on eating disorders is not of prime importance	13.8	58.8	18.8	8.8	0.0

Note: All ratings are on a 5-point Likert Scale (SD, strongly disagree = 1; D, disagree = 2; N, neither agree/disagree = 3; A, agree = 4; SA, strongly agree=5). Values are n (%) of participants rating each item. Percentages do not sum to 100 owing to rounding.

Rodino. Doctors' knowledge about eating disorders. *Fertil Steril* 2016.

perceived as the core business of fertility specialists, knowledge about contributors to menstrual disturbances are (18, 43). Consequently, despite amenorrhea being removed as a diagnostic construct from the contemporary DSM-5 classification system (15), its clinical utility as an exploratory marker of eating disorders in the context of reproductive medicine remains important (43).

Gaps in knowledge about maladaptive weight control behaviors associated with an eating disorder were evident. Key diagnostic criteria of extreme weight-control behaviors (e.g., self-induced vomiting, diuretics, and laxative use and/or driven exercise), while correctly selected for BN, were misconstrued as similarly being required criteria for BED. BED involves the consumption of excessively large quantities of food without accompanying compensatory weight control behaviors. Uncontrollable binge eating episodes, as experienced by BED patients, are associated with negative affect, guilt, and shame and have been linked to a reduced ability to cope with stressful situations (44, 45). Fifty percent of doctors in this study recognized the diagnostic criterion of marked distress associated with BED. As BED statistically represents the most common form of eating disorder (8), knowledge and detection of BED-related distress by medical personnel are important to ensure timely referral of distressed patients to mental health programs for psychotherapeutic care.

Attitudes towards Clinical Practices Associated with Eating Disorders

Fertility specialists maintained a positive attitude towards clinical practices associated with eating disorders. Doctors viewed information about eating disorders to be important, expressed that they had an important role to play in assessment, and supported fertility treatment suspension until a patient's eating disorder had resolved. While the majority of doctors (83.7%) in our study agreed or strongly agreed it was important to screen for current eating disorders in pre-conception assessments, only 35% routinely did this, and caution was expressed about the amount of time available to assess for eating disorders, a perspective found in other medical studies (33). Opportunities to increase knowledge about simple screening tools (e.g., the five-item SCOFF questionnaire) (46) and awareness of resources relevant to eating disorders through professional college training programs and liaison with mental health professionals expert in eating disorders are therefore essential and may circumvent concerns about time constraints.

Contrary to findings by Abraham (38) on the clinical practices of obstetricians, the assessment of BMI and exercise levels were deemed routine practice by the majority of fertility specialists and more so when patients presented with low BMI, PCOS, and ovulatory disorders. It is important, however, that doctors have an awareness that patients presenting with normal BMI parameters and who self-report in engaging in healthy behaviors such as exercise and a nutritious diet may potentially still have an undisclosed eating disorder. That is, unlike women with AN who have an observable low BMI, those with BN may represent a diagnostic challenge as

they typically present within the healthy weight range (42) and are likely to conceal their disorder unless discerning questions are asked. Consequently, attuned discussion about weight history, eating, and exercise attitudes and maladaptive weight control behaviors (e.g., extreme dietary restrictions, purging, and laxative use), irrespective of the current BMI, are more likely to be instructive in the detection of an eating disorder.

Confidence Levels and Training Needs

Research suggests that physicians have a low suspicion for eating disorders and may fail to detect eating disorders (47). Despite denial and secrecy being components of eating disorders, women are open to disclosing their symptoms in clinical settings when directly queried (48, 49). Paralleling the findings of other studies involving medical practitioners (32–34), participants in this study expressed uncertainty in their knowledge about eating disorders, with only 37.5% of fertility specialists agreeing or strongly agreeing that they were confident in their ability to identify eating disorder symptoms. Consequently, it is feasible that women with an eating disorder may go undetected while undergoing fertility treatment, which has implications for patient well-being including mental health, treatment success, and obstetric outcomes.

Our study highlights a need to address the knowledge gaps of fertility specialists on the topic of eating disorders. A minority of fertility specialists (8.8%) reported having access to a clinical protocol to guide management after patient disclosure of an eating disorder, and 96.2% of fertility specialist reported a need for further education and guidance. Currently, the typical pathways for accessing training or provision of clinical practice guidelines for fertility specialists within Australia and New Zealand are through the Royal Australian and New Zealand College of Obstetricians and Gynaecologists (RANZCOG) generally, or specifically through the RANZCOG subspecialty Certificate of Reproduction Endocrinology and Infertility (CREI) training program. While RANZCOG has produced several statements and guidelines with respect to pregnancy-related physical and mental well-being (e.g., RANZCOG statement C-Obs 03[a]; C-Obs [48]; C-Obs [49]; <https://www.ranzcog.edu.au/college-statements-guidelines.html>), no curricula or clinical consensus guidelines exist with regards to the specific gynecological aspects of eating disorders, on screening protocols or management and referral pathways, upon fertility patient disclosure of an eating disorder. Similarly, while nutrition and lifestyle factors are covered within the CREI curriculum, information pertaining to eating disorders is not specifically referenced (personal communication with College CREI examiner Associate Professor Peter Illingworth), a gap in professional training likely to be mirrored in other international reproductive medicine organizations (e.g., the American Congress of Obstetricians and Gynecologists). Research has shown that improvement in knowledge and clinical competence can be achieved by e-learning options and educational workshops (50–52) and is worthy of consideration given the serious nature of eating disorders

and their impact on reproductive physiology and outcomes. Furthermore, collaboration with professional organizations that have established clinical practice guidelines on eating disorders would be beneficial (53, 54).

Limitations and Strengths

While offering important insights into fertility specialists' knowledge and attitudes towards eating disorders, the current study is not without limitations. First, the phrasing of items within the attitudinal section of the questionnaire may have led participants to provide socially desirable responses reflective of best practice rather than of their own actual beliefs and real-life behaviors. Second, the use of a self-report online questionnaire methodology versus interview meant that participants were potentially able to access the solutions to the diagnostic criteria knowledge questions, which would have an impact on the validity of the results. Third, while participants were asked to respond according to a DSM-IV framework, it was possible that some participants may not have been specifically trained in this diagnostic framework, with the potential to influence their responses. The strength of this study lies in the participation by a representative sample of fertility specialists with diverse areas of fertility-related clinical expertise who were also members of the FSA, Australia and New Zealand's peak professional organization on reproductive medicine. Finally, as our research investigating fertility specialist knowledge and assessment of eating disorders is novel, the findings in this study give a platform to an area of fertility practice both unexplored and directly important within preconception care.

Conclusions

Eating disorders are known to influence physical, mental, and reproductive health, with serious implications for the prospective mother and child. Detection of eating disorders before fertility treatment is essential for patient physical and mental health and has direct bearing upon patient education about the clinical implications of an eating disorder and timely referral and collaboration with relevant mental health intervention services. Familiarity with assessment and/or screening strategies for women with an eating disorder is therefore important within the context of preconception care. While this study found uncertainty among fertility specialists in detecting features of eating disorders, it revealed that overall, fertility specialists expressed an interest in gaining further knowledge about eating disorders and perceived that due to the implications of eating disorders for fertility and obstetric outcomes, they had an important role to contribute to diagnosis. This study highlights the necessity for greater eating disorder education and training for fertility doctors, the incorporation of brief screening tools into preconception assessments, and a recommendation for the development of collaborative clinical practice guidelines on eating disorders by relevant professional organizations specific to fertility.

Acknowledgments: The authors sincerely thank the Australian and New Zealand fertility specialists who partici-

pated in the study and Dr. William Jones for permission granted to use and adapt his questionnaire for the purposes of our study. We particularly thank Professor Roger Hart (University of Western Australia) and Ms. Kim O'Dea (FSA Association Manager), who assisted with the initial participant e-mail recruitment process, and Mrs. Gloria Hynes (Queensland Fertility Group) and Ms. Jane Early (IVFAustralia) for promoting the study within their assisted reproductive technology organizations. We thank Associate Professor Peter Illingworth (CREI Examiner) for providing information on the CREI curriculum. We are grateful to Mr. Doug Robb (Clarity Software Pty Ltd) for implementation and maintenance of the online study questionnaire.

REFERENCES

- Homan GF, Davies M, Norman R. The impact of lifestyle factors on reproductive performance in the general population and those undergoing infertility treatment: a review. *Hum Reprod Update* 2007;13:209–23.
- ESHRE Taskforce on Ethics and Law. Lifestyle-related factors and access to medically assisted reproduction. *Hum Reprod* 2010;25:578–83.
- Freizinger M, Franko DL, Dacey M, Okun B, Domar AD. The prevalence of eating disorders in infertile women. *Fertil Steril* 2010;93:72–8.
- Cousins A, Freizinger M, Duffy ME, Gregas M, Wolfe BE. Self-report of eating disorder symptoms among women with and without infertility. *J Obstet Gynecol Neonat Nurs* 2015;44:380–8.
- Rodino IS, Byrne S, Sanders KA. Disordered eating attitudes and exercise in women undergoing fertility treatment. *Aust N Z J Obstet Gynecol* 2016;56:82–7.
- Klump KL, Bulik CM, Kaye WH, Treasure J, Tyson E. Academy for eating disorders position paper: eating disorders are serious mental illnesses. *Int J Eat Disord* 2009;42:97–103.
- Linna MS, Raevuori A, Haukka J, Suvisaari JM, Suokas JT, Gissler M. Pregnancy, obstetric, and perinatal health outcomes in eating disorders. *Am J Obstet Gynecol* 2014;211:392.e1–8.
- Hudson JI, Hiripi E, Pope HG, Kessler RC. The prevalence and correlates of eating disorders in the national comorbidity survey replication. *Biol Psychiatry* 2007;61:348–58.
- Keski-Rahkonen A, Mustelin L. Epidemiology of eating disorders in Europe: prevalence, incidence, comorbidity, course, consequences, and risk factors. *Curr Opin Psychiatry* 2016;29:340–5.
- Bulik CM, Von Holle A, Hamer R, Knopf Berg C, Torgersen L, Magnus P, et al. Patterns of remission, continuation and incidence of broadly defined eating disorders during early pregnancy in the Norwegian Mother and Child Cohort Study (MoBa). *Psych Med* 2007;37:1109–18.
- Easter A, Bye A, Taborelli E, Corfield F, Schmidt U, Treasure J, et al. Recognising the symptoms: how common are eating disorders in pregnancy? *Eur Eat Disord Rev* 2013;21:340–4.
- Abraham S, Mira M, Llewellyn-Jones D. Should ovulation induction be induced in women recovering from an eating disorder or who are compulsive exercisers? *Fertil Steril* 1990;53:566–8.
- Stewart DE, Robinson GE, Goldbloom DS, Wright C. Infertility and eating disorders. *Am J Obstet Gynecol* 1990;163:1196–9.
- Assens M, Ebdrup NH, Pinborg A, Schmidt L, Hougaard CO, Hageman I. Assisted reproductive technology treatment in women with severe eating disorders: a national cohort study. *Acta Obstet Gynecol Scand* 2015;94:1254–61.
- American Psychiatric Association. *Diagnostic and statistical manual of mental disorders*. 5th ed. Arlington, VA: American Psychiatric Association; 2013.
- Mond JM, Hay PJ, Rodgers B, Owen C, Beumont PJV. Assessing quality of life in eating disorder patients. *Qual Life Res* 2005;14:171–8.
- Javaras KN, Pope HG, Lalonde JK, Roberts JL, Nillni YI, Laird NM, et al. Co-occurrence of binge eating disorder with psychiatric and medical disorders. *J Clin Psychiatry* 2008;69:266–73.

18. Mehler PS, Andersen AE. Eating disorders: a guide to medical care and complications. 2nd ed. Baltimore, MD: John Hopkins University Press; 2010.
19. Schneider JE. Energy balance and reproduction. *Physiol Behav* 2004;81:289–317.
20. Loucks AB. Energy availability and infertility. *Curr Opin Endocrinol Diabetes Obes* 2007;14:470–4.
21. Pasternak Y, Weintraub AY, Shoham-Vardi I, Sergienko R, Guez J, Wiznitzer A, et al. Obstetric and perinatal outcomes in women with eating disorders. *J Women's Health* 2012;21:61–5.
22. Watson HJ, Torgersen L, Zerwas S, Reichborn-Kjennerud T, Knoph C, Stoltenberg C, et al. Eating disorders, pregnancy, and the postpartum period: findings from the Norwegian Mother and Child Cohort Study (MoBa). *Norsk Epidemiol* 2014;24:51–62.
23. Strahan EJ, Spencer SJ, Zanna MP. Don't take another bite: how sociocultural norms for appearance affect women's eating behaviour. *Body Image* 2007;4:331–42.
24. Mitchell-Gielegghem A, Mittelstaedt ME, Bulik CM. Eating disorders and childbearing: Concealment and consequences. *Birth* 2002;29:182–91.
25. Vandereycken W, Van Humbeeck I. Denial and concealment of eating disorders: a retrospective survey. *Eur Eat Disord Rev* 2008;16:109–14.
26. Fleming J, Szmukler GI. Attitudes of medical professionals towards patients with eating disorders. *Aust N Z J Psychiatry* 1992;26:436–43.
27. Crisafulli MA, Von Holle A, Bulik CM. Attitudes towards anorexia nervosa: the impact of framing on blame and stigma. *Int J Eat Disord* 2008;41:333–9.
28. Thompson-Brenner H, Satir DA, Franko DL, Herzog DB. Clinician reactions to patients with eating disorders: a review of the literature. *Psychiat Serv* 2012;63:73–8.
29. Bannatyne A, Stapleton P. Educating medical students about anorexia nervosa: a potential method for reducing the volitional stigma associated with the disorder. *Eat Disord* 2015;23:115–33.
30. Williams M, Leichner P. More training needed in eating disorders: a time cohort comparison study of Canadian psychiatry residents. *Eat Disord* 2006;14:323–34.
31. Currin L, Waller G, Schmidt U. Primary care physicians' knowledge of and attitudes toward the eating disorders: do they affect clinical actions. *Int J Eat Disord* 2009;42:453–8.
32. Leddy MA, Jones C, Morgan MA, Schulkin J. Eating disorders and obstetric-gynecologic care. *J Women's Health* 2009;18:1395–401.
33. Linville D, Benton A, O'Neil M, Sturm K. Medical providers' screening, training and intervention practices for eating disorders. *Eat Disord* 2010;18:110–31.
34. Jones WR, Saeidi S, Morgan JF. Knowledge and attitudes of psychiatrists towards eating disorders. *Eur Eat Disord Rev* 2013;21:84–8.
35. Jorm AF, Korten AE, Jacomb PA, Christensen H, Rodgers B, Pollitt P. "Mental health literacy": a survey of the public's ability to recognise mental health disorders and their beliefs about the effectiveness of treatment. *Med J Aust* 1997;166:182–6.
36. Mond JM. Eating disorders "mental health literacy": an introduction. *J Ment Health* 2014;23:51–4.
37. Morgan JF. Eating disorders and gynecology: knowledge and attitudes among clinicians. *Acta Obstet Gynecol Scand* 1999;78:233–9.
38. Abraham S. Obstetricians and maternal body weight and eating disorders during pregnancy. *J Psychosom Obstet Gynecol* 2001;22:159–63.
39. American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 4th ed. Washington, DC: American Psychiatric Association; 1994.
40. World Health Organisation. International statistical classification of diseases and related health problems, 10th rev. (ICD-10). Geneva: World Health Organisation; 1992.
41. Royal Australian and New Zealand College of Obstetrics and Gynaecology 2014 Activities Report, East Melbourne, Victoria, 2014. Available at: https://www.ranzcog.edu.au/RANZCOG_SITE/media/RANZCOG-MEDIA/Governance/Final-Copy-30-April-2015-2014-Activities-Report_.pdf. Accessed November 21, 2016.
42. Masheb RM, White MA. Bulimia nervosa in overweight and normal weight women. *Compr Psychiatry* 2012;53:181–6.
43. Kimmel MC, Ferguson EH, Zerwas S, Bulik CM, Meltzer-Brody S. Obstetric and gynecologic problems associated with eating disorders. *Int J Eat Disord* 2016;49:260–75.
44. Latner JD, Clyne C. The diagnostic validity of the criteria for binge eating disorder. *Int J Eat Disord* 2008;41:1–14.
45. Sulkowski ML, Dempsey J, Dempsey AG. Effects of stress and coping on binge eating in female college students. *Eat Behav* 2011;12:188–91.
46. Morgan JF, Reid F, Lacey JH. The SCOFF questionnaire: assessment of a new screening tool for eating disorders. *Br Med J* 1999;319:1467–8.
47. Johnson JG, Spitzer RL, Williams JBW. Health problems, impairment and illnesses associated with bulimia nervosa and binge eating disorder among primary care and obstetric gynecology patients. *Psychol Med* 2001;31:1455–66.
48. Becker AE, Thomas JJ, Franko DL, Herzog DB. Disclosure patterns of eating and weight concerns to clinicians, educational professionals, family, and peers. *Int J Eat Disord* 2005;38:18–23.
49. Gilbert N, Arcelus J, Cashmore R, Thompson B, Langham C, Meyer C. Should I ask about eating? Patients' disclosure of eating disorder symptoms and help-seeking behaviour. *Eur Eat Disord Rev* 2012;20:80–5.
50. Rosenvinge JH, Skarderdur F, Thune-Larsen K. Can educational programmes raise clinical competence in treating eating disorders? Results from a Norwegian trial. *Eur Eat Disord Rev* 2003;11:329–43.
51. Jorm AF, Kitchener BA, Fischer J, Cvetkovski S. Mental health first aid training by e-learning: a randomized controlled trial. *Aust N Z J Psychiat* 2010;44:1072–81.
52. Gratwick-Sarll K, Bentley C. Improving eating disorders mental health literacy: a preliminary evaluation of the "Should I say something?" workshop. *Eat Disord* 2014;22:405–19.
53. National Institute for Health and Clinical Excellence. Eating disorders: core interventions in the treatment and management of anorexia nervosa, bulimia nervosa, and related eating disorders. London, UK: British Psychological Society; 2004.
54. Hay P, Chinn D, Forbes D, Madden S, Newton R, Sugenor L, et al. Royal Australian and New Zealand College of Psychiatrists clinical practice guidelines for the treatment of eating disorders. *Aust N Z J Psychiatry* 2014;48:977–1008.

CHAPTER 8

GENERAL DISCUSSION

8.1 FOREWORD

Integrating research from the fields of reproductive medicine and eating disorders, this thesis aimed to provide a holistic perspective on issues relating to eating pathology in women seeking medical assistance for fertility problems. This chapter provides a synopsis of the research aims and key findings for each of the empirical papers presented in Chapters 4 to 7. In addition, comparisons with other studies, as well as broader study limitations and priorities for future research areas are identified. The final section of this chapter also proposes recommendations for preconception care clinical practice guidelines. These include recommendations for: (i) education and training of fertility health care providers and infertile patients on the impact and relevance of eating disorders to reproductive health, and (ii) the introduction of clinical screening practices for eating disorders in tandem with medical evaluations about weight related histories and eating behaviours.

8.2 STUDY ONE: Disordered Eating Attitudes and Exercise in Women Undergoing Fertility Treatment

8.2.1 Eating Disorders Prevalence and Disclosure Issues

There are limited empirical studies that have specifically examined the prevalence of eating disorders in women undergoing fertility treatment. Of the studies that do exist, the results coalesce around three principal findings. Firstly, women attending a fertility clinic appear to have higher rates of eating pathology, in comparison to rates reported in the general population. Secondly, higher symptoms of eating pathology occur more often in women with forms of an ovulatory disorder. Thirdly, the tendency for patients to non-disclose their current or past-history of an eating disorder to their fertility specialist. As critiqued in Chapter 2, these earlier studies have methodological constraints relating to statistical power, narrow focus of infertility diagnosis and fertility treatment regime, limiting interpretations and generalization to population lifetime rates. Moreover, as earlier studies have not controlled for BMI amongst infertility categories, it is not known whether previously reported rates of eating pathology observed relate to patient weight status or patient infertility diagnosis. *Study One* attempted to address these limitations.

With respect to the issue of prevalence, using a large Australian sample of infertile women undergoing fertility treatment, *Study One* did not reveal a greater prevalence of eating pathology amongst women attending a fertility clinic. In contrast to previously reported rates of up to 20.7% (Freizinger et al., 2010), in this study, only 6.8% of infertile women indicated having a history of an eating disorder. This estimate is consistent with the lifetime prevalence rate of 7.7% reported in an Australian community population study (Wade et al., 2006). This finding is also congruent with estimates reported in a national cohort study on 42,915 Danish women (Assens et al., 2015). Assens et al. (2015) showed that for reproductive-aged women aged up to 40 years who had accessed fertility treatment for anovulatory disorders at some stage of their life, there was no evidence of increased rates of eating pathology recorded, albeit this study's focus was on severe eating disorders.

It is possible that *Study One*'s focus on major categories of eating disorders (e.g. AN, BN and BED) prevented the participant self-reporting subclinical presentations of eating disorders, potentially underestimating the number of individuals with distressing disordered eating symptoms. Theoretically, these sub-clinical forms of eating psychopathology may have been detected by the structured clinical interview (SCID-I) methodology (First et al., 2002) used by others to diagnose the presence of a current or lifetime history of an eating disorder (e.g. Freizinger et al., 2010; Cousins et al., 2015). Research suggests that different diagnostic practices and inventories used to detect eating disorders can vary findings on prevalence rates (Hoek & van Hoeken, 2003; Keski-Rahkonen et al., 2006; Hudson et al., 2007). Thus, whilst the EDE-Q used in this study has strong sensitivity and specificity (Mond et al., 2004b), the SCID-I, a widely used semi-structured clinical interview that corresponds to DSM-IV (APA, 2000) diagnostic criteria for Axis I disorders, has diagnostic merit for the in-depth assessment and differential diagnosis of eating and mood disorders. Due to the anonymous nature of data collection and the large sample recruited in *Study One*, such clinical interviews were not feasible.

Another plausible explanation for the lower prevalence rate in this study relates to the characteristics of participants recruited, compared to previous studies. For example, when one compares the prevalence rates found in prior studies, these differences may be owing to the study's eligibility criteria (e.g. weight criteria; patients with restricted forms of diagnoses; patients undergoing certain types of treatment) (e.g. Bates et al., 1982; Allison et al., 1988; Abraham et al., 1990). By contrast, in this study, women with diverse forms of infertility who were undergoing different ART treatments and who were representative of the broader fertility clinic population (age, weight range, clinical diversity) were eligible to participate.

Consistent with other cited research in this area, *Study One* demonstrated that women with forms of ovulatory disorders and PCOS reported higher levels of eating pathology across all subscales of the EDE-Q, even after adjusting for the effects of BMI. This included higher scoring on restraint, eating, weight and shape concerns. This finding adds to the accumulating body of empirical evidence supporting the notion that women with forms of ovulatory disorders and PCOS represent clinical groups with potential disordered eating concerns. The finding further points to the importance of

inclusion of targeted patient-doctor discussions about weight history and dietary-related attitudes and weight control behaviours in preconception care assessments.

8.2.2 Presence of Obligatory Exercise in Women with Ovulatory Disorders

It is well recognized that excessive exercise without a compensatory increase in calories is a contributing factor for ovulatory disorders as it results in energy debt (De Souza & Williams, 2004; Abraham et al., 2007). Moreover, obligatory driven exercise when undertaken for the purposes of over-evaluation of weight and shape and at the expense of life events and health consequences has been linked to eating pathology in both clinical and non-clinical samples (Mond et al., 2004a; Mond et al. 2006a; Thome & Espelage, 2007, Goodwin et al., 2011; Monell et al., 2018). Hence excessive exercise can not only be a symptom of an eating disorder but a risk factor (Mond et al., 2006a; Abraham et al., 2006; Nattiv et al., 2007; Monell et al., 2018). Consequently, reasons for engaging in exercise are important to understand, with respect to their association with disordered eating attitudes and weight control behaviours (Young et al., 2017). As shown in *Study One*, infertility categories were not divergent on the quantity of physical activity undertaken. However, they were distinguished by a participant's 'attitude' to exercise. Specifically, women with forms of ovulatory disorders and PCOS reported engaging in 'obligatory,' driven exercise to control weight and shape more frequently than women with different forms of infertility diagnoses. This finding is novel to the empirical literature within infertility and serves to highlight that, despite its many well-known desirable health and mood benefits (Penedo & Dahn, 2005; Hagstomer et al., 2006), exercise may have a detrimental aspect to it. This is more so when endorsed to the extreme or when primarily undertaken secondary to an over-evaluation of weight and shape (Mond et al., 2004a; Fairburn, 2008; Monell et al., 2018).

Whilst *Study One* has strengths relating to sample size, demographic representativeness of participants due to a multi-clinic recruitment strategy and patient diagnostic diversity, two limiting aspects of *Study One* warrant discussion. First, there were a limited number of participants (i.e. 2.9%) with a low BMI (i.e. less than 18.5). Therefore, even though the weight distribution of participants in this study compares well with Freizinger et al. (2010), it reported higher BMI averages than earlier studies (e.g. Bates et al., 1982; Abraham et al., 1990). The higher BMI averages reported in *Study*

One, however, are reflective of the shift in population trends towards heavier weight status, and thus are representative of the weight concerns influencing treatment outcomes in contemporary ART patient populations (Norman et al., 2008; Pinborg et al., 2011; Moran et al., 2013). Nevertheless, to provide a more complete picture of the presence of eating disorders in women undergoing fertility treatment, future replication of this study with patients with lower BMI remains necessary. For instance, women with functional hypothalamic amenorrhea (FHA) can present with features of low BMI and amenorrhea without an identifiable anatomical cause (Meczekalski et al., 2014). Characteristically, FHA emerges secondary due to stress, chronic negative energy balance, suboptimal eating patterns (including food avoidance such as fat and carbohydrates) and excessive exercise (Berga et al., 1997; Couzinet et al., 1999; Marcus et al., 2001; Berga & Loucks, 2006). Future exploration of this low body weight infertile group in the context of active fertility treatment, eating pathology symptoms and obligatory exercise would further advance the knowledge in this area.

Second, whilst a novel finding emerged with respect to obligatory exercise, it is acknowledged that the exercise section of the EDE-Q is limited. That is, the results are based on the response to a single indicator that asked, “*Over the past 28 days how many times have you exercised in a 'driven' or 'compulsive' way as a means of controlling your weight, shape or amount of fat, or to burn off calories?*” From clinical and research standpoints, it would be important in future replication studies to include measures with established exercise factor structures (e.g. the five-factor structure of the Compulsive Exercise Test) (Taranis et al., 2011; Young et al., 2017).

In conclusion, *Study One* does not support the finding of a greater prevalence of eating pathology in women generally attending a fertility clinic. *Study One* however does provide supportive evidence that women with forms of ovulatory disorders and PCOS, compared to other infertility categories, do experience higher levels of disordered eating attitudes irrespective of their BMI. Moreover they also report engaging in driven, obligatory exercise behaviour. Given the emotional burdens associated with eating pathology and the risks to reproductive outcomes, proactive screening of infertile women for the presence of eating disorders would be of benefit.

8.3 STUDY TWO: Obesity and Psychological Wellbeing in Patients Undergoing Fertility Treatment

High BMI is an important contributor to the global burden of ill-health. Increased co-morbidities are reported for individuals who maintain a BMI in the obese weight range (WHO, 2000; Global BMI Mortality Collaboration, 2016). Research outcomes within the field of infertility suggest that when compared to healthy weight counterparts, women with obesity have poorer reproductive and obstetric health outcomes (Pasquali et al., 2003; Bellver et al., 2006; Maheshwari et al., 2007; Norman et al., 2008; Bellver et al., 2013). Similarly, obese women can experience compromised levels of mental health and quality of life due to the consequences of their weight status (Fairburn & Brownell, 2002; Grilo, 2006; Godart et. al., 2007; Hudson et al., 2007; De Wit et al., 2010). Consequently, given the potential fertility set-backs that obesity might pose, knowledge about the psychological wellbeing of obese women undertaking fertility treatment represents an important area of clinical investigation. Accordingly, *Study Two* initially aimed to determine whether obese infertile women attending a fertility clinic varied on experiences of general psychological distress and infertility specific distress when compared to infertile healthy weight and overweight counterparts. In the event of psychological differences, *Study Two* sought to determine the psychological correlates which predicted psychological distress in obese women. A final objective of *Study Two* was to explore the psychological profile of PCOS women, commonly reported to have greater psychological vulnerability, whilst taking into consideration the influence of BMI. Controlling for BMI enabled an investigation of the association between PCOS and mental health, beyond that contributed by weight status.

8.3.1 Psychological Wellbeing in Obese Infertile Women

A key finding of *Study Two* is that obesity is associated with poorer psychological dimensions relating to body shape, lower self-esteem and binge eating with a sense of loss of control, factors that distinguished obese infertile women from normal and overweight infertile women. The findings compare favourably with the psychological literature describing the putative roles of poor body image, lower self-esteem and binge eating episodes with eating disorders (Stice & Shaw, 2002; Fairburn et al., 2003a; Grilo, 2006). Importantly from a preconception care perspective, *Study Two's* findings

serve to remind fertility health care providers that even though obesity per se is not classified as a DSM-5 eating disorder (Marcus & Wildes, 2009; APA, 2013), it shares important psychological precursors to disordered eating, particularly BED, warranting careful discussions about mental health and weight management. Specifically, studies have shown that obese women who seek health care treatment are more likely to be given treatment for a problem relating to weight loss without due consideration of their underlying disordered eating attitudes. For example, Mond et al. (2007) found in a community based investigation of patients presenting to a health care setting with bulimic-type eating pathology, that 72.8% of patients were given interventions targeting weight loss and only 40.3% were provided additional treatment to address their eating pathology, having implications for ongoing patient distress and rebound weight gain.

Similarly, in this regard, the standard recommendation for obese individuals in preconception care includes a referral to healthy lifestyle programmes customarily focussing on behavioural weight loss and dieting strategies to attain pre-treatment weight targets (Anderson et al., 2010b; Mutsaerts et al., 2013; Barte et al., 2014). However, these forms of intervention programmes have been associated with limited success (Mutsaerts et al., 2013). Moreover, lifestyle programmes may be insufficient to meet the needs of infertile women experiencing both obesity and distressing BED psychopathology, unless the cognitive components and emotions at the core of their BED are addressed (Fairburn & Brownell, 2002; Grilo, 2006; Ramacciotti et al., 2007; Fairburn, 2008). This is particularly relevant to those patients where an emphasis on over-evaluation of weight and shape, dichotomous thinking about dietary rules and perceptions about weight stigma, may contribute to the maintenance or exacerbation of their eating disorder (Fairburn et al., 2003a; Fairburn, 2008; Lethbridge et al., 2011; Pearl et al., 2014; Puhl & Suh, 2015). Consequently from a clinical perspective, interventions that address the broader challenges associated with weight loss endeavours and rebound binge eating in an individual who is susceptible to underlying eating pathology, are important to consider. For instance cognitive-behavioural therapy and interpersonal psychotherapy are efficacious treatments for the management of binge eating, yielding significant long term reductions (≥ 2 years) in binge eating, when compared to behavioural weight loss treatment interventions alone (Wilson et al. 2010). Cognitive behavioural and interpersonal therapy interventions include strategies that address underlying rules about eating and

exercise, assess distorted cognitions about weight and shape concerns, and assess interpersonal coping-strategies as triggers to rebound binge eating (Fairburn & Cooper, 1993; Grilo, 2006; Fairburn et al., 2003a, Fairburn, 2008; Ramacciotti et al., 2008; Murphy et al., 2010; Byrne et al., 2011; Lethbridge et al., 2011; Conceicao et al., 2018).

Contrary to expectations, *Study Two* did not confirm that obese infertile women undertaking fertility treatment, significantly varied on common measures of psychological distress (depression, anxiety, stress, positive and negative affect and perfectionism) or infertility specific distress when compared to their non-obese counterparts. There are several possibilities for the lack of a main effect for obesity on these variables. First, as described in *Study Two*, the acceptance into a fertility programme to receive medical assistance to achieve the goal of family formation may have created mood lifting benefits, with weight status no longer being interpreted as the focus of infertility concern. The mood improving effects of acceptance into fertility treatment however, can only be substantiated by a comparison of mood in those women denied fertility treatment on the grounds of their obesity, information unknown in *Study Two*. Consequently, the investigation of patients accessing fertility treatment may not be representative of those infertile obese and PCOS women who were not accepted for fertility treatment or of patients who had given up treatment. Future exploratory studies designed to specifically examine the psychological status of obese individuals not accepted for fertility treatment due to weight eligibility criteria or who have ceased ART treatment, would be informative.

A second explanation that can account for *Study Two's* findings relates to the question under investigation. The assumption that women with obesity have greater distress may be too general in its application and fails to consider individual life circumstances. For instance, empirical research reveals that obesity may not be inherently psychologically distressing for all women, with distress only being greatest in women seeking weight loss treatment (Fitzgibbon et al., 1993). As this study did not gauge information relating to participation in weight loss programmes, additional information on this issue cannot be explored. *Study Two* however did reveal that the life circumstance of time trying to conceive has bearing on the question of obesity and mood outcome. In line with this, *Study Two* demonstrated weight status was positively correlated with increased length of time trying to conceive ($p < .001$) with obese-PCOS women taking the longest time to conceive ($M= 59.9$ months, $SD = 42.2$ months).

Moreover, longer time to conceive was associated with higher levels of depression, negative affect, infertility specific distress and lower self-esteem (all $p < .05$). Whether infertile patients undergoing fertility treatment understand the connection between their own current weight status, time trying to conceive and impact on mood, requires future exploration.

8.3.2 Psychological Risk Factors for Obese Infertile Women

One clear objective in preconception care is the identification of risk factors for physical and mental health. Predictor variables are factors that can play a causal role in the development, magnitude and/or maintenance of a disorder (Schmidt, 2002). Whilst models predicting psychological distress for general groups of infertile patients have been evaluated (Verhaak et al., 2005; Van Den Broeck, et al. 2010), prediction models for psychological distress specific to obese infertile women are lacking. This study provided the opportunity to evaluate previously isolated predictors of mood as they relate to weight status, providing information on psychological correlates that can be considered in the development of tailored interventions. *Study Two* showed that for obese infertile women, lower self-esteem, negative affect, higher perfectionism and shape concerns were amongst the strongest predictors of distress and thus as targets of intervention are important mental health variables to observe. Relatedly, as a grouping of significant psychological variables they represent documented risk factors outlined in the transdiagnostic theory of eating disorders (Fairburn et al., 2003a).

The transdiagnostic model proposes that shared clinical features such as those highlighted in *Study Two* represent core and maintaining factors to eating pathology. For instance, low self-esteem and negative affect may play a role in the evolution and maintenance of eating pathology particularly binge eating and sense of loss of control (Polivy & Herman, 2002; Fairburn et al., 2003a; Grilo, 2006; Shea & Pritchard, 2007; Berg et al., 2014). Similarly, lower self-esteem when combined with higher levels of perfectionism, represent commonly reported indices of disordered eating even in non-clinical samples (Fairburn et al., 2003a; Sassaroli & Ruggiero, 2005). Therefore evidenced-based cognitive-behavioural strategies in line with the transdiagnostic model of eating disorders would be a useful clinical intervention framework to consider in the clinical care of the obese woman (Fairburn & Fairburn et al., 2003a; Fairburn, 2008; Murphy et al., 2010).

8.3.3 Psychological Health in Women with PCOS

Diverse studies on women with PCOS have identified the presence of mental health concerns (Elsenbruch et al. 2003; Hahn et al., 2005; Trent et al., 2005; Himelein & Thatcher, 2006; Hollinrake et al. 2007; Jones et al., 2008; Kerchner et al. 2009; Bhattacharya & Jha, 2010; Deeks et al., 2011). These findings however have been determined from community based populations. Moreover, these studies have often ignored the potentially confounding effect of BMI, making it difficult to interpret whether mood relates to weight status or PCOS diagnosis.

Study Two found no differences between obese and non-obese PCOS women with respect to state measures of depression, stress, positive and negative affect, perfectionism and an infertility specific index of distress (all $p > .05$). These findings suggest that at least in this sample of infertile women, once the confound of BMI has been adjusted for, the presence of elevated mental health concerns typically reported in previous community based studies and attributed to a diagnosis of PCOS, is diminished. Alternatively, this finding may also be interpreted that when undertaking fertility treatment, women are psychologically homogeneous with respect to the stresses and emotional challenges of the life event of infertility, irrespective of their diagnostic status.

Of note, after adjustment for BMI, women with PCOS did report higher levels of anxiety and shape concerns (a proxy marker for body image). With respect to anxiety, this finding is in line with Lee et al. (2017) who reported that women with PCOS, independent of weight status but who had concurrent symptoms of anxiety, were at increased risk of eating pathology symptoms. As anxiety does contribute to eating behaviours and broader psychological distress, it is an important mental health issue worthy of clinical consideration for women with PCOS undergoing fertility treatment (Pallister & Waller, 2008; Garipey et al., 2010; Cooney & Dokras, 2017). Future studies elucidating the underlying cognitive and physiological mechanisms in anxiety-driven eating pathology in PCOS women undergoing ART treatment can contribute to more informed thinking about clinical care.

Whilst having some body image concerns are considered normative, body dissatisfaction is a lifespan risk factor for psychological distress (Tiggemann, 2004). Moreover, body image disturbance is viewed as critical in the formation and maintenance of eating disorders and considered a risk factor for dieting and negative affect (Stice, 2002; Stice and Shaw, 2002). *Study Two's* finding of shape

concerns in women with PCOS is important as longitudinally body image dissatisfaction when combined with negative mood can lead to the endorsement of unhealthy eating and weight control practices. Given the relevance of body image dissatisfaction to eating pathology, and as *Study Two* only used the EDE-Q shape concern subscale as the proxy marker of body image dissatisfaction, more nuanced understanding of the many facets of body image and dissatisfaction as they relate to PCOS remain important future research targets to explore.

To summarize, the main findings revealed in *Study Two* demonstrate that obese, infertile women undergoing fertility treatment do not exhibit significant differences from normal weight and overweight infertile women on levels of depression, anxiety, stress, positive and negative affect, clinical perfectionism and infertility specific distress. They do however vary on psychological parameters associated with or placing them at risk for the distress associated with BED, underscoring the need to monitor clinical features of disordered eating in obese, infertile women. That is, whilst obesity at a manifest level may appear as features of poor dietary patterns and sedentary behaviours, for a subset of obese women, psychological factors such as shape concern, binge eating and lower self-esteem, factors driven by negative affect and perfectionistic tendencies, warrant monitoring. Moreover, for women with PCOS, clinical interventions tailored to address anxiety and body shape concerns are clinical imperatives, as are the psychological experiences relating to obesity and time trying to conceive (Gesink Law et al., 2007). Importantly, as psychotherapeutic interventions can mitigate the effects of eating pathology and related psychological distress, the results of *Study Two* highlight the importance of mental health appraisals, as integral components within preconception care.

8.4 STUDY THREE: Stress has a Direct and Indirect Effect on Eating Pathology in Infertile Women: Avoidant Coping Style as a Mediator

From the perspective of stress and coping theory (Lazarus & Folkman, 1984), how a person perceives and endeavours to cope with the stress of a life-event, has relevance to the manifestation of negative psychological and behavioural outcomes. Whilst diverse coping strategies exist, various forms of avoidant coping strategies are routinely aligned with negative health and psychological

outcomes. To the contrary active and problem-focussed coping endeavours directed towards addressing a stressor, tend to result in better health outcomes (Lazarus & Folkman, 1984; Aldao et al., 2010). In the context of infertility, perceived stress and avoidant coping strategies are variables widely examined, with demonstrated implications for ART treatment outcomes, treatment drop-out rates, relationships and psychological wellbeing (Hynes et al., 1992; Domar, 2004; Schmidt et al., 2005a; Van den Broeck et al., 2010; Gameiro et al., 2012). Studies, however, empirically investigating the behavioural manifestations of stress and coping within the infertility context, are less well known. Clinically and central to this thesis, the association between perceived stress, avoidant coping style and eating pathology are therefore important to investigate. This is owing to the accumulating evidence of the presence of disordered eating behaviours with forms of ovulatory disorders and PCOS (see Chapter 2 – Section 2.1 and Chapter 4 for an overview) and evidence establishing stress and avoidant cope style as risk factors for eating psychopathology (Troop et al., 1994; Ball & Lee 2000; Pendleton et al., 2001; Crowther et al., 2001; Freeman & Gil, 2004; Davies et al., 2011; Sulkowski et al., 2011).

Accordingly, the primary objective of *Study Three* was to investigate the direct influence of perceived stress on eating pathology in women undergoing fertility treatment and to determine whether avoidant coping style had a mediatory influence in this relationship. In addition, *Study Three* sought to simultaneously investigate two competing hypotheses (i.e. pathways of the influence of stress on eating) and to examine whether the pathways of influence on eating pathology differed.

Study Three demonstrated that a higher level of perceived stress was directly associated with a higher level of eating pathology. This finding whilst congruent with outcomes in other studies based on community and university populations (e.g. Crowther et al., 2001; Epel et al., 2001; O'Connor et al., 2008) is empirically novel within the context of the reproductive medicine literature. Conceptually, within preconception care, this finding highlights the importance of gauging the influence of perceived stress in infertile women, as a potential antecedent to negative health behaviours. This includes the manifestation of disordered eating attitudes and behaviours known to influence infertility and female mental health (NICE guidelines, 2004; Klump et al., 2009; Kimmel et al., 2016).

Lazarus and Folkman (1984) posit that strategies chosen to manage a stressful situation can affect the relationship between stress and physical and mental health outcomes. Focussing on the avoidant strategies endorsed by infertile women undergoing fertility treatment, *Study Three* further showed a direct association between avoidant coping style and eating pathology, suggestive that a greater endorsement of avoidant-oriented strategies is associated with a higher level of eating pathology. Moreover, *Study Three* revealed a significant intermediary effect of avoidant coping style in the relationship between perceived stress and eating pathology. Specifically, the mechanism by which perceived stress impacts on eating pathology is partially explained by use of avoidant coping strategies. These findings are in line with other studies and reinforce the idea that women exposed to stress and who endorse maladaptive coping styles have increasing levels of eating pathology (e.g. Pendleton et al., 2001; Freeman & Gil, 2004; Davies et al., 2011). Of relevance to theories on energy balance and reproduction such changes can potentially have adverse consequences for reproductive health, i.e. ovulatory disorders and relatedly, mental health (Schneider, 2004; Hudson et al., 2007; Unluturk et al., 2016; Schweiger et al., 2018).

The use of a mediational model is important as it can be used to provide formative evidence to identify key targets for preconception counselling and pathways by which those targets operate (Hagger et al., 2016). Using a competing hypothesis approach, *Study Three* demonstrated that neither the direct effects of perceived stress on eating pathology nor indirect effect via the intermediary variable of ‘avoidant coping style’ provided a better explanation of eating pathology symptoms. Therefore, from a targeted interventions perspective, strategies oriented to assist with stress management, re-appraisal of avoidant coping and the practice of alternative positive coping skills are crucial and should be considered as foci of clinical interventions for infertile patients presenting with forms of maladaptive eating behaviours. This perspective is supported by researchers within the infertility domain who agree that psychological interventions that dually address stress management strategies and coping skills are effective in facilitating psychological wellbeing in the infertile patient (Domar et al., 2000; Cousineau & Domar, 2007; Domar et al., 2011).

One limitation of *Study Three* is the total amount of variance in eating pathology accounted for by stress and avoidant coping style, indicating that other unmeasured variables played a role in the

manifestation of eating pathology. These could include social support networks, physiological drivers to appetite, personality constructs and ethnicity (Gluck, 2006; Schwarzer & Knoll, 2007; Carver & Connor-Smith, 2010; Dallman, 2010; Greil et al., 2010; Lynch et al., 2014). A broader understanding of the processes that account for the link between perceived stress and eating pathology therefore is likely to have important clinical implications for development and refinement of psychological treatments.

A second limitation of this study relates to design. A diagnosis of infertility has been characterized as stressful (Domar et al., 1993), however, the experience of infertility can attenuate or magnify over the course of a treatment cycle and over time. Similarly, coping styles and mood outcomes are dynamic and may change in response to particular elements of an event appraised as stressful (Lazarus & Folkman, 1984; Boivin & Lancaster, 2010). Observing the effects of infertility, coping style and associated maladaptive behavioural outcomes thus requires prospective, longitudinal designs rather than cross-sectional designs. Therefore, whilst this study describes findings for perceived stress and eating pathology approximating a month (28 days being the time reference for the EDE-Q and 'last month' for the PSS), it does not provide information about the trajectories of perceived stress, coping style and eating pathology processes over longer durations. This point has relevance given the protracted nature of fertility treatment. For example, as reported in this study, women on average reported attempting to conceive for approximately 31 months ($SD = 25$ months), endeavours which were longer if the participant was characterized as being obese PCOS (*Study Two*; $M = 59.9$ months, $SD = 42.2$). Future research directed towards a longitudinal investigation designed to track infertile patients' stress levels, coping strategies and resultant eating behaviours mapped according to their individualized fertility treatment journey, would be valuable.

To conclude, psychological stress is an established risk factor for negative lifestyle behaviours including disordered eating behaviours (Ball & Lee, 2000; Clark et al. 2016; Klatzkin et al., 2016). A body of literature suggests that disordered eating patterns are present in women undergoing fertility treatment. The findings of *Study Three* have shown that both perceived stress and endorsement of avoidant coping style are associated with eating pathology and should be given due consideration in preconception psychotherapy programmes. Moreover, given the influence of lifestyle factors on

ovulatory function and fertility treatment outcomes (Anderson et al., 2010a; Gormack et al., 2015) recommendations for future investigations including the exploration of the impact of other maladaptive lifestyle behaviours (e.g. smoking and alcohol use) both short-term and longitudinally, have merit.

8.5 STUDY FOUR: Eating Disorders in the Context of Preconception Care: Fertility Specialists' Knowledge, Attitudes, and Clinical Practices

Diagnostics skills and patient management are the cornerstones of good medical practice and can be influenced by mental health literacy (MHL). The phrase MHL (Jorm et al., 1997) relates to knowledge and beliefs about mental disorders which aid in their recognition, management or prevention. For a fertility health care provider confronted with a patient who has an eating disorder, several barriers may be encountered preventing good clinical practice. These factors in part include low rates of patient self-disclosure of their eating disorder and limited doctor MHL about eating disorders. Limited MHL can result in doctors feeling less equipped to confidently deal with an eating disorder (Linville et al., 2010; Thompson-Brenner et al., 2012; Mond, 2014). Furthermore, a clinical focus on current BMI as a proxy marker of health, rather than the assessment of patient eating, weight and exercise histories, may serve to diminish detection of problematic disordered eating attitudes and weight control behaviours in women presenting for fertility treatment.

Given the absence of studies examining the clinical competencies and training needs of fertility specialists working with eating disorders, the overarching aim of *Study Four* was to gauge the MHL of practicing Australian and New Zealand fertility specialists, an unexplored perspective in the reproductive medicine field. Notably, the study has clinical relevance as early and accurate detection of an eating disorder can steer treatment decisions and enable timely patient referral to adjunct intervention programmes (Abraham et al., 1990; Jorm et al., 1997; Kelly et al. 2007; Kersten et al., 2015).

One of the central findings of *Study Four* related to diagnostic knowledge. The results demonstrated limitations in doctor knowledge about diagnostic criteria relating to AN, BN and BED. Specific shortfalls with respect to differential diagnosis relating to amenorrhoea, weight limits and

behavioural manifestations of BN compared to BED were observed. This implies that fertility specialists may have a low diagnostic scrutiny for eating disorders and may fail to detect eating disorders having implications for patient care. This finding whilst original for Australian and New Zealand fertility specialists is consistent with reports on physicians practicing in other clinical areas (Abraham, 2001; Johnson et al., 2001; Clarke & Polemini-Walker, 2004; Jones et al., 2013).

The second group of findings in *Study Four* pertained to attitudinal issues. As shown in Chapter 7, two third of doctors (66.3%) perceived that assessing for eating disorders was part of their clinical role with only few fertility specialists (8.8%) indicating that information on eating disorders was not of prime importance. Moreover, the majority of doctors (90%) agreed or strongly agreed with the statement that, “*Women with an eating disorder should treat their eating disorder prior to starting fertility treatment,*” signifying clinical importance. These positive attitudes are encouraging and contrary to the findings of other studies in the literature where pejorative and stigmatizing views are reportedly held (Fleming & Szmukler, 1992; Thompson-Brenner et al., 2012; Bannatyne & Stapleton, 2015). Clinical environments in which weight-related stigmatizing attitudes prevail and associated mental health issues are not given due priority are detrimental to patient wellbeing and increase the likelihood of discontinuation of medical treatment (Domar, 2004; Puhl & Heuer, 2010; Gameiro et al., 2012; Puhl & Suh, 2015).

A third group of findings related to clinical practice. Research findings have shown that women with an eating disorder may not openly disclose to their treating doctor their history of an eating disorder although may do so if questioned (Becker et al., 2005; Gilbert et al., 2012). Non-disclosure of a current or past history of an eating disorder has been empirically demonstrated in the reproductive medicine literature (Stewart et al., 1990; Freizinger et al., 2010; Rodino et al., 2016a). Consequently, despite positive sentiments being held about eating disorders in the context of infertility, many eating disordered patients are likely to remain undetected unless routine screening protocols are in place. This was reflected in *Study Four*. Specifically, even though 83.7% of fertility doctors agreed with the importance of screening for eating disorders during preconception assessment, just over a third of doctors (35%) routinely did so. Consequently, how doctors translate their positive

attitudes towards eating disorders into active practice remains a challenge and focus for future research.

To be skilled in MHL, confidence, relevant resources and professional training are essential. A key finding from *Study Four* was that fertility specialists (96.2%) expressed a need for more training on the topic of eating disorders. Moreover, just over a third felt confident in their capacity to identify an eating disorder (37.5%) and a minority (8.8%) reported having access to dedicated clinical guidelines to follow upon patient disclosure of an eating disorder. These findings are similar to other studies in this area, where limited confidence and training can serve to undermine clinical interest and priority about eating disorders (Clarke & Polimeni-Walker, 2004; Currin et al., 2009; Linville et al., 2010; Thompson-Brenner et al., 2012; Bannatyne & Stapleton, 2015). Collectively, these findings highlight the need for further training to suit the specific needs of fertility specialists including knowledge about screening protocols, vigilance about physiological and psychological symptoms and awareness of referral pathways for integrated care.

Whilst revealing original findings, *Study Four* is not without limitations, particularly relating to the data collection and survey responses. First, although details of the study were directly emailed to members of the Fertility Society of Australia (FSA), no notification mechanism was in place to confirm that emails were opened by the email recipient, potentially having an impact on accuracy of response rates. Second, the potential for social response bias on attitude and practice questions was present, although web survey methodology involving anonymous completion of a questionnaire is likely to reduce this effect (Joinson, 1999). Third, this study is limited in its scope since it is devoid of the views of other relevant fertility health care providers including non-members of the FSA, fertility nurses and counsellors. Fertility clinic nurses and counsellors have lengthier patient consultations and therefore have an important role to play in early detection of eating disorders. Future studies focussing on the knowledge, attitudes and clinical practice strategies of these professionals would broaden the findings in this area.

In summary, fertility specialists in their role as women's health experts have a pivotal part to play in the assessment and early detection of eating disorders. Knowledge, attitudes and clinical practice protocols are key factors in the timely detection of eating disorders. Collaborative endeavours

between principal training stakeholders in reproductive medicine, in developing training and clinical practice guidelines for fertility specialists and allied health staff would be valuable.

8.6 Clinical Implications and Recommendations for Preconception Care

It is evident that eating disorders within the context of reproductive medicine are important to consider within preconception care. It is envisioned that improved clinical competencies of fertility specialists around eating disorders will subsequently improve access to mental health services for infertile patients who present with comorbid symptoms of an eating disorder. Based on the research outcomes reported in the eating disorders literature, the contemporary guidelines on clinical excellence in eating pathology (e.g. National Institute of Clinical Excellence, [NICE], 2004; Royal Australian and New Zealand College of Psychiatrists [RANZCP], 2014) and the specific findings of this thesis, the following empirically informed recommendations are suggested.

8.6.1 Sound Knowledge Base and Training

Despite the reported prevalence and symptoms of eating pathology in women undergoing fertility treatment, empirical research suggests that health care professionals have limited knowledge and training in this clinical area. Consequently, doctors may not feel competent to practice in this area or lack the breadth of diagnostic knowledge and/or simple screening tools to achieve the task of symptom detection. As fertility treatment is physically, emotionally and financially taxing, improved knowledge about disordered eating attitudes and weight control behaviours are warranted to ensure clinical decisions and interventions are justified. Given the increased need for training about eating disorders reported by fertility doctors and the limited training available within the Australian and New Zealand postgraduate curriculum, specialized training in this clinical area should be paramount.

Recommendation 1: Increased Mental Health Literacy: awareness programmes could be developed to educate fertility specialists about the importance of disordered eating and exercise behaviours on reproductive outcomes. This could include training in the identification of physical symptoms, awareness of psychological sequelae of eating disorders and establishment of clinical practice guidelines for appropriate referral to mental health professionals. In Australia and New Zealand this

would best be achieved by collaboration amongst professional stakeholder groups (e.g. the FSA, the RANZCOG and the RANZCP) as they have a role to play in terms of professional development and competencies expected of their practitioners.

8.6.2 Routine Screening

Studies in MHL have suggested that early detection through routine screening practices can lead to improved patient outcomes (Hill et al., 2010; Gilbert et al., 2012). Given the hidden nature of some eating disorders and the hesitance of patients to spontaneously reveal their current symptoms or lifetime history of an eating disorder, it is important that fertility specialists proactively screen and assess for eating pathology. Widespread misunderstanding of the symptoms, limited awareness of the severity of the eating pathology and the stigma associated with eating disorders has meant cases of eating disorders go unrecognised (Johnson et al., 2001; Mitchell-Gielegheem et al., 2002; Becker et al., 2005; Crisafulli et al., 2008; Bannatyne & Stapleton, 2015; Ali et al., 2017).

Recommendation 2: In addition to being cognizant of the DSM-5 criteria for eating disorders (American Psychiatric Association, 2013), readily available and simplified tools should be incorporated into daily ART clinic practice. The SCOFF (Morgan et al., 1999) is one example of a screening tool suitable for endorsement in clinical practice. The SCOFF consists of an acronym of key probe areas of assessment related to eating pathology (SCOFF: Sick, Control, One stone, Fat, Food). *Appendix D* outlines questions and scoring used in the SCOFF questionnaire (Morgan et al., 1999). Although not a categorical diagnostic tool, the SCOFF has good sensitivity and has specificity for detecting cases of eating pathology (Mond et al., 2008; Hill et al., 2010). Moreover, as a screening measure, it has been used in diverse clinical settings, is simple to administer, to interpret and compares well with other measures used to assess eating pathology (Mond et al., 2008).

8.6.3 Clinical Interpretations of BMI

Empirical research within the infertility field has focussed on BMI as a proxy marker of physical health. However, difficulties with the overt interpretation of this measure are evident since BMI cannot distinguish fat mass from lean tissue. Thus, it is possible for an individual to have a BMI in the healthy weight range whilst simultaneously maintaining an unhealthy lifestyle. Moreover, the

medical and psychological consequences of eating disorders may not be discernible by way of patient BMI. As discussed in Section 1.3.2 of this thesis, this is because BMI does not inform of the maladaptive behaviours that patients endorse to achieve their BMI status, nor does it reveal the patients' subjective and distressing cognitive evaluations about weight and shape and experience of loss of control, established markers of eating disorder risk (Stice et al., 2000; Stice, 2002; Fairburn, 2008). Moreover, even non-emaciated individuals may experience metabolic and systemic organic damage secondary to weight cycling and bulimic symptoms (Mehler & Andersen, 2010). Thus, for women undergoing fertility treatment, conversations about wellbeing and healthy lifestyle behaviours are pertinent across all BMI categories. Consequently, operationalizing key questions essential for exploring symptoms of eating pathology across the BMI spectrum would be valuable.

Recommendation 3: Pre-treatment evaluation of an eating disorder irrespective of infertility category and BMI. In tandem with routine screening protocols, the National Institute for Health and Clinical Excellence (NICE, 2004) guidelines advocate that health professionals empathically enquire about behavioural manifestations of eating pathology including overeating and unhealthy weight control practices such as skipping meals, over-exercising or use of laxatives or appetite suppressants. Fertility specialists should be prepared to ask questions about weight history and weight cycling. Failure to achieve appropriate weight goals required for fertility treatment may also indicate a warning sign of an undetected eating disorder. Additional follow-up with examination of physical symptoms of an eating disorder (e.g. bradycardia, gastrointestinal disturbances, constipation, dental and skin changes) and of laboratory investigations can be useful in detecting eating disorders (Mehler & Andersen, 2010). Furthermore, from a general psychological perspective, gauging patients' anxiety about anticipated weight and shapes changes secondary to ART treatment may highlight areas of eating pathology concern, as can inquiring about a patient's perception of their 'ideal' weight and description of how this is attained.

8.6.4 Patient Psycho-Education about Diet and Exercise

Women contemplating a pregnancy with the assistance of an ART clinic are highly motivated to achieve a healthy successful pregnancy. Lifestyle factors, such as diet and exercise, represent

common topics in preconception counselling (Homan et al., 2007; Rooney & Domar, 2014; Mutsaerts et al., 2013; Gormack et al., 2015). As discussed in Chapter 1, women may engage in lifestyle behaviours that may have unintended consequences which serve to disrupt their ovulatory functioning (Abraham, 2003; Loucks & Thuma, 2003; De Souza & Williams, 2004; Abraham et al., 2007; Anderson et al., 2010a). Dieting and exercise are variables that have been linked to the development and maintenance of eating pathology in vulnerable individuals (Stice et al., 2001; Abraham, 2003; Fairburn et al., 2003a; Mond et al., 2004a; Abraham et al., 2007). Moreover, for obese women, unhealthy patterns of weight control behaviours (e.g. rapid weight loss) can contribute to rebound weight gain when compared to measured regimes of physical activity (Savage & Birch, 2010). Therefore, many of the perceived benefits of diet and exercise may be outweighed by the physiological harm when undertaken to extreme or when undertaken by an individual who is fixated on issues of weight and shape.

Recommendation 4: Improved dissemination of preconception healthy lifestyle information, (i.e. psychoeducation about the perils of excessive ‘healthy’/restrained eating and ‘driven’ exercise on weight status and energy debt), particularly in relation to menstrual dysfunction are important (Abraham, 2003; Abraham et al., 2007). Providing infertile women with comprehensive information about nutritional and exercise strategies, whilst at the same time carefully minimizing the risk for eating pathology, is important. Moreover, treatments that encompass cognitive behavioural and interpersonal therapy strategies for managing binge eating psychopathology and that assist with regulation of emotions, rather than behavioural weight loss strategies alone (Mond et al., 2007; Wilson et al., 2010), may prove advantageous for infertile patients struggling with patterns of disordered eating attitudes and behaviours.

8.6.5 Stress Management and Evidenced Based Interventions

In response to the potentially stressful nature of an ART programme, women may react with the endorsement of maladaptive lifestyle health behaviours. What attenuates these experiences can in part be determined by the stress management strategies and coping style used by that person.

Recommendation 5: For infertile patients assessed to be experiencing stress, encouraging the use of cognitive behavioural strategies, and positive re-appraisal techniques or problem focussed coping strategies as found in evidenced based interventions, are relevant to endorse as important adjuncts to preconception care programmes (Fairburn et al., 2003a; Cousineau & Domar, 2007; Kraaij et al., 2010; Domar et al., 2011; Ockhuijsen et al., 2014).

8.6.6 Collaboration and Referral to Specialist Multi-Disciplinary Eating Disorder Programmes

Infertility counsellors are ideally placed to conceptualize the complex interactions between biopsychosocial factors related to fertility concerns. However, not all mental health professionals have been trained in techniques specific to eating disorders. Whilst mild symptoms may remit with psycho-education, severe and enduring symptoms of an eating disorder can require the long-term management of specialist multi-disciplinary eating disorder services. This highlights the importance of establishing referral networks specialized in the field of eating pathology. In line with good clinical practice, fertility specialists can make patients aware that well established evidenced based interventions exist and direct them accordingly. Optimally, evidence-based treatment delivered by multidisciplinary health professionals with expertise in the care of patients with eating disorders is recommended.

Recommendation 6: Establishment of a referral pathway to expert multidisciplinary teams with specialist knowledge in disordered eating attitudes and behaviours. This requires rapport and empathic communication with patients, so as to prevent perceptions of stigma and weight bias and to increase adherence to care recommendations. Moreover, this requires a collaborative stance by the fertility specialist on potential delays to the commencement of ART treatment, secondary to the appraisal of the physical and psychological health needs of a person with an eating disorder.

8.7 Strengths and Limitations

This thesis represents one of a limited number of studies investigating the experiences of eating disorders in infertile patients undergoing fertility treatment. Of these earlier studies, design constraints are limiting factors. Therefore, some of the strengths of this thesis include sample size, diverse categories of infertile patients and completeness of psychological database. These provided

statistical power enabling advanced statistical analysis involving structural equation modelling, statistical control of confounds and robust interpretations of study objectives. Structural equation modelling, which takes into account the influence of measurement error (McCoach et al., 2007; Kline, 2011), is more statistically rigorous than the univariate analyses, multiple regression or path analyses that have generally been used in areas of psychosocial infertility research.

This thesis also provided unique information on psychological measures. The Fertility Problems Inventory (FPI), a specific measure of infertility related distress, has not previously been assessed with respect to weight status. Moreover, whilst the Eating Disorder Examination-Questionnaire (EDE-Q) has been utilized in infertility research, the volume and completeness of data obtained in this thesis, at least at the time of thesis submission, is unmatched.

Controlling for BMI is an additional strength of this research. Given the well-established relationship between weight status and psychological variables, adjusting for this confound enabled clearer interpretations about the presence of eating pathology according to infertility diagnoses in *Studies One* and *Two*. Finally, to date, no line of research has provided both a patient centred and fertility health provider perspective to this topic. This thesis therefore extends knowledge about eating disorders both in the empirical fields of reproductive medicine and psychology, dually highlighting areas of patient concern and clinical considerations for fertility health providers of preconception care.

Despite the strengths, various methodological limitations of this thesis should be acknowledged. First, whilst the use of self-report data on one hand represents a strength enabling the collection of large quantities of sensitive data, it may also be deemed a limitation owing to the concerns about social desirability response bias, representativeness of the study sample and accuracy of data. In regard to social desirability, the anonymous nature of data collection affords some protection about intentional portrayal of positive impression. With respect to sample representativeness, the size of the sample, diversity of infertility categories and multi-clinic recruitment strategy lends confidence to the generalizability of the findings. Moreover, as reported in *Study Two*, a comparison of participant characteristics in this study's sample with another published Australian infertility cohort revealed participant characteristics to be representative on key variables such as age and BMI distribution (Moran et al., 2013). Nevertheless, it is acknowledged that

participants who declined to participate in the study may have been different in some relevant aspect to the participants who participated, however as no details were recorded an analysis of non-responders could not be undertaken. For instance, it is possible that only women more psychologically robust were motivated and able to complete the lengthy, multidimensional battery of questionnaires used in Project One. Thus, response burden may have played a role in influencing the final sample for Project One. Consequently, sample bias cannot be categorically ruled out. In part to address sample bias, future studies involving anonymous questionnaire completion could include within the survey, a specific section for non-responders that encourages the submission of non-identifiable demographic information and that gauges factors for non-participation. This strategy would enable basic statistical comparisons between survey responders and non-responders to be completed.

With respect to data accuracy, having access to fertility clinic records and use of diagnostic interviewing techniques would clearly have been advantageous. However, the time to retrieve clinic data records from three IVF clinics and the time required to undertake structured clinical interviews were logistically impracticable. Furthermore, the scheduling of a structured clinical interview may have additionally served to decrease patient participation owing to existing time burdens associated with multiple appointments already linked to a patient's fertility treatment protocol.

Finally, this thesis consists of two projects characterized by cross-sectional designs, precluding definitive conclusions about the directionality of relationships observed. Longitudinal studies might help elucidate the causal role of psychological and physiological variables in the development and maintenance of eating disorders.

8.8 Directions for Future Research

This thesis highlights several areas of research that could be addressed in future studies on infertility and eating pathology, particularly when investigated under the rubric of longitudinal designs. Broadly these include investigations of: (i) weight bias, (ii) assessment of physiological indices, (iii) fluctuating nature of stress and coping mechanisms, and (iv) social support.

Weight bias is *“defined as the inclination to form unreasonable judgments based on a person's weight. Stigma is the social sign that is carried by a person who is a victim of prejudice and*

weight bias” (Washington, 2011, p.1). Obese individuals are reported to experience weight bias across diverse life domains including medical. The lived experience of weight bias and stigma are known to be associated with poor mental health outcomes and increased risk for disordered eating (Puhl et al., 2007; Puhl & Heuer, 2010; Puhl & Suh, 2015; Vartanian & Porter, 2016; Wu & Berry, 2018). Little is known about the stigma associated with weight bias within an infertility clinic context and how these may influence the perpetuation of eating pathology. Future studies exploring how patients perceive fertility health care provider comments about weight status and whether perceived weight bias and stigma influence mood, eating pathology and help-seeking behaviours, would be important to investigate. This research is particularly relevant where weight status determines eligibility for ART treatment (Maheshwari, 2010; Legro, 2016).

Whilst this thesis has focussed on the psychological parameters of eating pathology, assessment of co-morbid physiological indices associated with eating pathology would be novel. Specifically, individual differences in levels of neuroendocrine hormones such as cortisol, insulin, leptin and ghrelin have been implicated with appetite regulation, alterations to eating behaviours (e.g. bingeing), food choice (Newman et al., 2007; Roberts et al., 2014; Hilterscheid & Laessle, 2015; Culbert et al., 2016) and relatedly, down-regulation of the HPO axis (Gordon, 2010; Evans & Anderson, 2012). Replication of the psychological components of this research with concurrent assessment of neuroendocrine biomarkers of stress and appetite regulation across an ART treatment cycle would further advance the knowledge in this area.

There is considerable clinical evidence that perceived social support is an important factor for physical and mental wellbeing including how well a woman adjusts to infertility (Cohen & Willis, 1985; Schmidt et al., 2005b; Cohen & Janicki-Deverts, 2009; Martins et al., 2011). It has been speculated that social support can assist a woman in her capacity to cope adaptively by influencing the stress appraisal process or the emotional and behavioural responses to a stressful event (Cohen & Willis, 1985; Thoits, 1995; Aime et al., 2006; Schwarzer & Knoll, 2007). Researchers have also shown an association between low perceived levels of support, higher levels of interpersonal distress and disordered eating attitudes and behaviours, particularly in women with clinical and sub-clinical levels of eating disorders (Freeman & Gil, 2004; Limbert, 2010; Bodell et al., 2011; Kwan & Gordon,

2016). Thus, exploring the role that intimate partner and family support play in relation to the endorsement of unhealthy eating, excessive exercise and other maladaptive health behaviours, represents an important direction for future research (Arcelus et al., 2012).

8.9 Concluding Remarks

Eating disorders through their impact on nutritional status, energy balance, physical and psychological wellbeing represent an understudied area of clinical relevance to infertility. In times of nutritional scarcity or chronic excesses, an individual's reproductive capacity can be compromised resulting in disturbances. This particularly manifests in infertile women with forms of ovulatory disorders and PCOS, where symptoms of eating pathology have been reported to occur. As revealed in *Study One*, the findings of this thesis confirm the presence of elevated symptoms of disordered eating in infertile women with forms of ovulatory disorders and PCOS adding to the body of knowledge in this area. The finding of obligatory exercise in infertile women with ovulatory disorders and PCOS further demonstrates an eating pathology risk factor previously unexplored in treatment seeking, infertile women.

Evidence suggests that psychological burdens are present in women undergoing fertility treatment but whether this distress relates to weight status and eating pathology prompted the research motive for *Study Two*. This study revealed that lower self-esteem, shape concerns and binge eating accompanied by a sense of loss of control are a triad of mental health constructs warranting exploration in obese infertile women. Whilst these findings coincide with the broader eating disorder literature, they are novel within the context of infertility and are of clinical importance in encouraging clinicians to be mindful of indicators of an eating disorder. Importantly from a preconception perspective the findings emphasize the need to tailor psychotherapeutic care beyond routine behavioural weight loss strategies.

Aetiology and maintenance of symptoms of eating pathology are multifactorial. As a clinical endeavour, mediation analysis is important as it can be used to provide formative evidence to identify specific targets and priorities for clinical intervention. The findings of *Study Three* underscore the importance of both perceived stress and avoidant coping style as psychological variables for

consideration in preconception stress management programmes. Moreover, the theoretically driven statistical model outlined in this thesis is one worthy of replication with other forms of maladaptive lifestyle behaviours relevant to infertility.

Early detection and timely referral for appropriate care leads to improved physical and psychological outcomes for women with an eating disorder. As evidenced in this thesis and prior research, low rates of patient disclosure of a life-time history of an eating disorder are pervasive thus warranting routine screening in preconception clinical practices. Fundamental to this practice of screening are clinical knowledge and confidence. As demonstrated in *Study Four*, gaps in fertility specialist's confidence, knowledge and clinical practices relating to eating disorders were evident. Yet contrary to some earlier studies in MHL amongst physicians working in different medical fields, fertility specialists affirmed the importance of eating disorders, perceived assessment and detection of eating disorders as part of their role and strongly endorsed the need for professional development in this clinical area. In response, recommendations for practice guidelines were proposed relating to training for fertility health care providers, routine screening practices, patient psycho-education and support for a multidisciplinary approach to treatment. It is envisioned that with increased specialist training in MHL, clinical competencies and confidence in addressing the mental health needs of infertile patients with eating disorders will be enhanced.

In summary, healthy female reproduction is the endpoint of integrated biological, behavioural and psychological pathways, many of which can be disrupted by symptoms of eating pathology. The research presented in this thesis provides valuable insight into the topic of eating disorders in infertile women seeking fertility treatment. It advances upon earlier studies in this area through improvements to methodological design and provides novel empirical findings for information related to eating pathology, reproductive medicine and psychology. It is hoped that this thesis successfully draws attention to a more nuanced understanding of BMI, helps identify infertility groups at greater risk of disordered eating attitudes and behaviours and highlights psychological correlates of concern. Finally, this thesis endeavours to heighten fertility health care providers' knowledge about eating pathology with the view to improved patient care. This includes establishing clearer clinical practice guidelines for the management of the infertile woman with eating pathology undertaking fertility treatment.

REFERENCES

- ABRAHAM, S. 2001. Obstetricians and maternal body weight and eating disorders during pregnancy. *Journal of Psychosomatic Obstetrics & Gynaecology*, 22, 159-163.
- ABRAHAM, S., MIRA, M. & LLEWELLYN-JONES, D. 1990. Should ovulation be induced in women recovering from an eating disorder or who are compulsive exercisers? *Fertility and Sterility*, 53, 566-568.
- ABRAHAM, S. F. 2003. Dieting, body weight, body image and self-esteem in young women: doctors' dilemmas. *Medical Journal of Australia*, 178, 607-611.
- ABRAHAM, S. F., BOYD, C., LUSCOMBE, G., HART, S. & RUSSELL, J. 2007. When energy in does not equal energy out: Disordered energy control. *Eating Behaviours*, 8, 350-356.
- ABRAHAM, S. F., BROWN, T., BOYD, C., LUSCOMBE, G. & RUSSELL, J. 2006. Quality of life: eating disorders. *Australian and New Zealand Journal of Psychiatry*, 40, 150-155.
- ADAM, T. C. & EPEL, E. S. 2007. Stress, eating and the reward system. *Physiology & Behavior*, 91, 449-458.
- ADAMSON, G. D. & BAKER, V. L. 2003. Subfertility: causes, treatment and outcome. *Best Practice & Research Clinical Obstetrics & Gynaecology*, 17, 169-185.
- AIME, A., SABOURIN, S. & RATTE, C., 2006. The eating disturbed spectrum in relation with coping and interpersonal functioning. *Eating and Weight Disorders*, 11, 66-72.
- AINSWORTH, B. E., HASKELL, W. L., WHITT, M. C., IRWIN, M.L., SWARTZ, A. M., STRATH, S. J., O'BRIEN, W. L., BASSETT, D. R., SCHMITZ, K. H., EMPLAINCOURT, P.O., JACOBS, D. R. & LEON, A. S. 2000. Compendium of physical activities: an update of activity codes and MET intensities. *Medicine and Science in Sports and Exercise*, 32, S498-S504.
- ALDAO, A., NOLEN-HOEKSEMA, S. & SCHWEIZER, S. 2010. Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review*, 30, 217-237.
- ALGARS, M., HUANG, L., VON HOLLE, A. F., PEAT, C. M., THORNTON, L. M., LICHTENSTEIN, P. & BULIK, C. M. 2014. Binge eating and menstrual dysfunction. *Journal of Psychosomatic Research*, 76, 19-22.
- ALI, K., FARRER, L., FASSNACHT, D. B., GULLIVER, A., BAUER, S. & GRIFFITHS, K. M. 2017. Perceived barriers and facilitators towards help-seeking for eating disorders: A systematic review. *International Journal of Eating Disorders*, 50, 9-21.
- ALLISON, S., KALUCY, R., GILCHRIST, P. & JONES, W. 1988. Weight preoccupation among infertile women. *International Journal of Eating Disorders*, 7, 743-748.
- AMERICAN PSYCHIATRIC ASSOCIATION. 1987. *Diagnostic and Statistical Manual of Mental Disorders - Revised (DSM-III-R)*, 3rd edn. American Psychiatric Association, Washington DC.

- AMERICAN PSYCHIATRIC ASSOCIATION. 1994. *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)*, 4th edn. American Psychiatric Association, Washington DC.
- AMERICAN PSYCHIATRIC ASSOCIATION. 2000. *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR) – Text Revision*, 4th edn. American Psychiatric Association, Washington DC.
- AMERICAN PSYCHIATRIC ASSOCIATION. 2013. *Diagnostic and Statistical Manual of Mental Disorders (DSM-5)*, 5th edn. American Psychiatric Publishing, Arlington, VA.
- ANDERSEN, A. E. & RYAN, G. L. 2009. Eating disorders in the obstetric and gynecologic patient population. *Obstetrics & Gynecology*, 114, 1353-1367.
- ANDERSON, K., NISENBLAT, V. & NORMAN, R. 2010a. Lifestyle factors in people seeking infertility treatment – a review. *Australian and New Zealand Journal of Obstetrics and Gynaecology*, 50, 8-20.
- ANDERSON, K., NORMAN, R. J. & MIDDLETON, P. 2010b. Preconception lifestyle advice for people with subfertility. *Cochrane Database System Review*, 4, doi: 10.1002/14651858.CD008189.pub2.
- ANDREWS, M. A., SCHLIEP, K. C., WACTAWSKI-WENDE, J., STANFORD, J. B., ZAREK, S. M., RADIN, R. G., SJAARDA, L. A., PERKINS, N. J., KALWERISKY, R. A. & HAMMOUD, A. O. 2015. Dietary factors and luteal phase deficiency in healthy eumenorrheic women. *Human Reproduction*, 30, 1942-1951.
- ANDRICO, S., GAMBERA, A., SPECCHIA, C., PELLEGRINI, C., FALSETTI, L. & SARTORI, E. 2002. Leptin in functional hypothalamic amenorrhoea. *Human Reproduction*, 17, 2043-2048.
- ANNIS, N. M., CASH, T. F. & HRABOSKY, J. I. 2004. Body image and psychosocial differences among stable average weight, currently overweight, and formerly overweight women: the role of stigmatizing experiences. *Body Image*, 1, 155-167.
- ANTONY, M. M., BIELING, P. J., COX, B. J., ENNS, M. W. & SWINSON, R. P. 1998. Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. *Psychological Assessment*, 10, 176-181.
- ARBUCKLE, J. L. 2016. *Amos* (version 24.0) [Computer Program]. IBM SPSS Corp., Chicago.
- ARCELUS, J., MITCHELL, A. J., WALES, J. & NIELSEN, S. 2011. Mortality rates in patients with anorexia nervosa and other eating disorders: a meta-analysis of 36 studies. *Archives of General Psychiatry*, 68, 724-731.
- ARCELUS, J., YATES, A. & WHITELEY, R. 2012. Romantic relationships, clinical and sub-clinical eating disorders: A review of the literature. *Sexual and Relationship Therapy*, 27, 147-161.
- ASSENS, M., EBDRUP, N. H., PINBORG, A., SCHMIDT, L., HOUGAARD, C. O. & HAGEMAN, I. 2015. Assisted reproductive technology treatment in women with severe eating disorders: a national cohort study. *Acta Obstetrica et Gynecologica Scandinavica*, 94, 1254-1261.

- AUSTRALIAN BUREAU OF STATISTICS. 2012. *Overweight and Obesity: Australian Health Survey: First results, 2011-12* (cat. no. 4364.0.55.001). ABS, Canberra Australia.
- AUSTRALIAN BUREAU OF STATISTICS. 2012. *Sports and Physical Recreation: A Statistical Overview. Australia Health Survey: First results, 2011-12* (4364.0.55.001). ABS, Canberra, Australia.
- AUSTRALIAN BUREAU OF STATISTICS. 2015. *Overweight and Obesity: National Health Survey: First results, 2014-2015* (cat. no. 4364.0.55.001). ABS, Canberra Australia.
- AZZIZ, R. 2016. Introduction: Determinants of polycystic ovary syndrome. *Fertility and Sterility*, 106, 4-5.
- BALASCH, J. 2010. Aging and infertility: an overview. *Gynecology and Endocrinology*, 26, 855-860.
- BALEN, A. 2004. The pathophysiology of polycystic ovary syndrome: trying to understand PCOS and its endocrinology. *Best Practice & Research Clinical Obstetrics & Gynaecology*, 18, 685-706.
- BALL, K. & LEE, C. 2000. Relationships between psychological stress, coping and disordered eating: A review. *Psychology and Health*, 14, 1007-1035.
- BANNATYNE, A. & STAPLETON, P. 2015. Educating medical students about anorexia nervosa: A potential method for reducing the volitional stigma associated with the disorder. *Eating Disorders*, 23, 115-133.
- BARBIERI, R. 2002. Management of infertility caused by ovulatory dysfunction. *American College of Obstetrics and Gynecology Practice Bulletin*, 34, 347-358.
- BARDONE-CONE, A. M., WONDERLICH, S. A., FROST, R. O., BULIK, C. M., MITCHELL, J. E., UPPALA, S. & SIMONICH, H. 2007. Perfectionism and eating disorders: Current status and future directions. *Clinical Psychology Review*, 27, 384-405.
- BARKER, D. J. 2007. The origins of the developmental origins theory. *Journal of Internal Medicine*, 261, 412-417.
- BARKER, D. J., GODFREY, K. M., GLUCKMAN, P. D., HARDING, J. E., OWENS, J. A. & ROBINSON, J. S. 1993. Fetal nutrition and cardiovascular disease in adult life. *The Lancet*, 341, 938-941.
- BARKER, D. J. & OSMOND, C. 1986. Infant mortality, childhood nutrition, and ischaemic heart disease in England and Wales. *The Lancet*, 327, 1077-1081.
- BARNARD, L., FERRIDAY, D., GUENTHER, N., STRAUSS, B., BALEN, A.H. & DYE, L. 2007. Quality of life and psychological wellbeing in polycystic ovary syndrome. *Human Reproduction*, 22, 2279-2286.
- BARRY, J. A., KUCZMIERCZYK, A. R. & HARDIMAN, P. J. Anxiety and depression in polycystic ovary syndrome: a systematic review and meta-analysis. *Human Reproduction*, 2011, 2442-2451.

- BARTE, J. C., VELDWIJK, J., TEIXEIRA, P. J., SACKS, F. M. & BEMELMANS, W. J. 2014. Differences in weight loss across different BMI classes: a meta-analysis of the effects of interventions with diet and exercise. *International Journal of Behavioral Medicine*, 21, 784-793.
- BARTHOLOMEW, J. B., MORRISON, D. & CICOLO, J. T. 2005. Effects of acute exercise on mood and well-being in patients with major depressive disorder. *Medicine and Science in Sports and Exercise*, 37, 2032-7.
- BARUCH, Y. & HOLTAM, B. C. 2008. Survey response rate levels and trends in organizational research. *Human Relations*, 61, 1139-1160.
- BATES, G. W., BATES, S. R. & WHITWORTH, N. S. 1982. Reproductive failure in women who practice weight control. *Fertility and Sterility*, 37, 373-378.
- BAZARGANIPOUR, F., ZIAEI, S., MONTAZERI, A., FOROOZANFARD, F., KAZEMNEJAD, A. & FAGHIHZADEH, S. 2013. Body image satisfaction and self-esteem status among the patients with polycystic ovary syndrome. *Iranian Journal of Reproductive Medicine*, 11, 829-836.
- BECK, A. T., STEER, R. A. & BROWN, G. K. 1996. *Beck Depression Inventory-II*, Psychological Corporation, San Antonio, Texas.
- BECKER, A. E., THOMAS, J. J., FRANKO, D. L. & HERZOG, D. B. 2005. Disclosure patterns of eating and weight concerns to clinicians, educational professionals, family, and peers. *International Journal of Eating Disorders*, 38, 18-23.
- BELLVER, J., PELLICER, A., GARCIA-VELASCO, J. A., BALLESTEROS, A., REMOHI, J. & MESEGUER, M. 2013. Obesity reduces uterine receptivity: clinical experiences from 9,587 first cycles of ovum donation with normal weight donors. *Fertility and Sterility*, 100, 1050-1058.
- BELLVER, J., BUSSO, C., PELLICER, A., REMOHÍ, J. & SIMÓN, C. 2006. Obesity and assisted reproductive technology outcomes. *Reproductive Biomedicine Online*, 12, 562-568.
- BENYAMINI, Y., GEFEN-BARDARIAN, Y., GOZLAN, M., TABIV, G., SHILOH, S. & KOKIA, E. 2008. Coping specificity: The case of women coping with infertility treatments. *Psychology and Health*, 23, 221-241.
- BERG, K. C., PETERSON, C. B., CROSBY, R. D., CAO, L., CROW, S. J., ENGEL, S. G. & WONDERLICH, S. A. 2014. Relationship between daily affect and overeating-only, loss of control eating-only, and binge eating episodes in obese adults. *Psychiatry Research*, 215, 185-191.
- BERG, K. C., PETERSON, C. B., FRAZIER, P. & CROW, S. J. 2012. Psychometric evaluation of the Eating Disorder Examination and Eating Disorder Examination-Questionnaire: a systematic review of the literature. *International Journal of Eating Disorders*, 45, 428-438.

- BERGA, S. L. 2008. Stress and reproduction: a tale of false dichotomy? *Endocrinology*, 149, 867-868.
- BERGA, S. L., DANIELS, T. L. & GILES, D. E. 1997. Women with functional hypothalamic amenorrhea but not other forms of anovulation display amplified cortisol concentrations. *Fertility and Sterility*, 67, 1024-1030.
- BERGA, S. L. & LOUCKS, T. L. 2006. Use of cognitive behavior therapy for functional hypothalamic amenorrhea. *Annals of the New York Academy of Sciences*, 1092, 114-129.
- BHATTACHARYA, S. M. & JHA, A. 2010. Prevalence and risk of depressive disorders in women with polycystic ovary syndrome (PCOS). *Fertility and Sterility*, 94, 357-359.
- BLECHERT, J., ANSORGE, U., BECKMANN, S. & TUSCHEN-CAFFIER, B. 2011. The undue influence of shape and weight on self-evaluation in anorexia nervosa, bulimia nervosa and restrained eaters: a combined ERP and behavioral study. *Psychological Medicine*, 41, 185-194.
- BLINDER, B. J., CUMELLA, E. J. & SANATHARA, V. A. 2006. Psychiatric comorbidities of female inpatients with eating disorders. *Psychosomatic Medicine*, 68, 454-462.
- BODELL, L. P., SMITH, A. R., HOLM-DENOMA, J. M., GORDON, K. H. & JOINER, T. E. 2011. The impact of perceived social support and negative life events on bulimic symptoms. *Eating Behaviors*, 12, 44-48.
- BOIVIN, J., BUNTING, L., COLLINS, J. A. & NYGREN, K. G. 2007. International estimates of infertility prevalence and treatment-seeking: potential need and demand for infertility medical care. *Human Reproduction*, 22, 1506-1512.
- BOIVIN, J., DOMAR, A. D., SHAPIRO, D. B., WISCHMANN, T. H., FAUSER, B. C. & VERHAAK, C. 2012. Tackling burden in ART: an integrated approach for medical staff. *Human Reproduction*, 27, 941-950.
- BOIVIN, J., GRIFFITHS, E. & VENETIS, C. 2011. Emotional distress in infertile women and failure of assisted reproductive technologies: meta-analysis of prospective psychosocial studies. *BMJ*, 342, doi:10.1136/bmj.d223.
- BOIVIN, J. & LANCASTLE, D. 2010. Medical waiting periods: imminence, emotions and coping. *Women's Health*, 6, 59-69.
- BRANNAN, M.E. & PETRIE, T.A. 2001. Psychological well-being and the body dissatisfaction-bulimic symptomatology relationship: an examination of moderators. *Eating Behaviors*, 12, 233-241.
- BRECHAN, I. & KVALEM, I.L. 2014. Relationship between body dissatisfaction and disordered eating: mediating role of self-esteem and depression. *Eating Behaviors*, doi:10.1016/j.eatbeh.2014.12.008. Epub 2014 Dec 11.
- BRONSON, F. & MANNING, J. M. 1991. The energetic regulation of ovulation: a realistic role for body fat. *Biology of Reproduction*, 44, 945-950.

- BROUGHTON, D. E. & MOLEY, K. H. 2017. Obesity and female infertility: potential mediators of obesity's impact. *Fertility and Sterility*, 107, 840-847.
- BYRNE, S. M., FURSLAND, A., ALLEN, K. L. & WATSON, H. 2011. The effectiveness of enhanced cognitive behavioural therapy. *Behaviour Research and Therapy*, 49, 219-226.
- BULIK, C., VON HOLLE, A., HAMER, R., KNOPH BERG, C., TORGERSEN, L., MAGNUS, P., STOLTENBERG, C., SIEGA-RIZ, A. M., SULLIVAN, P. & REICHBORN-KJENNERUD, T. 2007. Patterns of remission, continuation, and incidence of broadly defined eating disorders during pregnancy in the Norwegian Mother and Child Cohort Study (MoBa). *Psychological Medicine*, 37, 1109-1118.
- CAFRI, G., YAMAMIYA, Y., BRANNICK, M. & THOMPSON, J. K. 2005. The influence of sociocultural factors on body image: A meta-analysis. *Clinical Psychology: Science and Practice*, 12, 421-433.
- CALLE, E. E., RODRIGUEZ, C., WALKER-THURMOND, K. & THUN, M. J. 2003. Overweight, obesity, and mortality from cancer in a prospectively studied cohort of US adults. *New England Journal of Medicine*, 348, 1625-1638.
- CAPRIO, M., FABBRINI, E., ISIDORI, A. M., AVERSA, A. & FABBRI, A. 2001. Leptin in reproduction. *Trends in Endocrinology & Metabolism*, 12, 65-72.
- CARVER, C. S. 1997. You want to measure coping but your protocol's too long: Consider the Brief COPE. *International Journal of Behavioral Medicine*, 4, 92-100.
- CARVER, C. S. & CONNOR-SMITH, J. 2010. Personality and coping. *Annual Review of Psychology*, 61, 679-704.
- CARVER, C. S., SCHEIER, M. F. & WEINTRAUB, J. K. 1989. Assessing coping strategies: a theoretically based approach. *Journal of Personality and Social Psychology*, 56, 267-283.
- CEFALO, R. C. & MOOS, M.-K. 1995. *Preconceptional Health Care: A Practical Guide*. Mosby-Year Book Inc., St Louis.
- CHACHAMOVICH, J. R., CHACHAMOVICH, E., EZER, H., FLECK, M. P., KNAUTH, D. & PASSOS, E. P. 2010. Investigating quality of life and health-related quality of life in infertility: a systematic review. *Journal of Psychosomatic Obstetrics & Gynecology*, 31, 101-110.
- CHAN, J. L. & MANTZOROS, C. S. 2005. Role of leptin in energy-deprivation states: normal human physiology and clinical implications for hypothalamic amenorrhoea and anorexia nervosa. *The Lancet*, 366, 74-85.
- CHANG, E. C. & SANNA, L. J. 2012. Evidence for the validity of the Clinical Perfectionism Questionnaire in a nonclinical population: More than just negative affectivity. *Journal of Personality Assessment*, 94, 102-108.

- CHAVARRO, J. E., RICH-EDWARDS, J. W., ROSNER, B. A. & WILLETT, W. C. 2007. Diet and lifestyle in the prevention of ovulatory disorder infertility. *Obstetrics & Gynecology*, 110, 1050-1058.
- CHUANG, J.-C. & ZIGMAN, J. M. 2010. Ghrelin's roles in stress, mood, and anxiety regulation. *International Journal of Peptides*, dx.doi.org/10.1155/2010/460549.
- CLARK, M. M., JENKINS, S. M., HAGEN, P. T., RILEY, B. A., ERIKSEN, C. A., HEATH, A. L., VICKERS DOUGLAS, K. S., WERNEBURG, B. L., LOPEZ-JIMENEZ, F. & SOOD, A., BENZO, R. P. & OLSEN, K. D. 2016. High stress and negative health behaviors: a five-year wellness center member cohort study. *Journal of Occupational and Environmental Medicine*, 58, 868-873.
- CLARKE, D.E., POLIMENI-WALKER, I. 2004. Treating individuals with eating disorders in family practice: a needs assessment. *Eating Disorders*, 12, 293-301.
- COHEN, S. & JANICKI-DEVERTS, D. 2009. Can we improve our physical health by altering our social networks? *Perspectives on Psychological Science*, 4, 375-378.
- COHEN, S., KAMARCK, T. & MERMELSTEIN, R. 1983. A global measure of perceived stress. *Journal of Health and Social Behavior*, 24, 385-396.
- COHEN, S. & WILLS, T. A. 1985. Stress, social support, and the buffering hypothesis. *Psychological Bulletin*, 98, 310-357.
- COKER, E., LAHOUD, R. & ABRAHAM, S. 2016. Polycystic Ovarian Syndrome and Eating Disorder Quality of Life: A Pilot Study. *Journal of Fertilization: In Vitro – IVF Worldwide, Reproductive Medicine and Genetics*, 4, 171. <https://doi.org/10.4172/2375-4508.1000171>.
- COLOMBO, O., PINELLI, G., COMELLI, M., MARCHETTI, P., SIERI, S., BRIGHENTI, F., NAPPI, R. E. & TAGLIABUE, A. 2009. Dietary intakes in infertile women a pilot study. *Nutrition Journal*, 8, 53, doi: 10.1186/1475-2891-8-53.
- COMNINOS, A. N., JAYASENA, C. N. & DHILLO, W. S. 2014. The relationship between gut and adipose hormones, and reproduction. *Human Reproduction Update*, 20, 153-174.
- CONCEICAO, E. M., DE LOURDES, M., PINTO-BASTOS, A., VAZ, A. R., BRANDAO, I., RAMALHO, S. 2018. Problematic behaviours and psychotherapy in patients undergoing bariatric surgery: The mediating role of loss of control eating. *International Journal of Eating Disorders*, doi: 10.1002/eat.22862.
- COONEY, L. G. & DOKRAS, A. 2017. Depression and anxiety in polycystic ovary syndrome: Etiology and treatment. *Current Psychiatry Reports*, 19, 83 doi: 10.1007/s11920-017-0834-2.
- COSTARELLI, V. & PATSAI, A. 2012. Academic examination stress increases disordered eating symptomatology in female university students. *Eating and Weight Disorders*, 17, e164-e169.
- COUSINEAU, T. M. & DOMAR, A. D. 2007. Psychological impact of infertility. *Best Practice & Research Clinical Obstetrics & Gynaecology*, 21, 293-308.

- COUSINS, A., FREIZINGER, M., DUFFY, M. E., GREGAS, M. & WOLFE, B. E. 2015. Self-report of eating disorder symptoms among women with and without infertility. *Journal of Obstetric, Gynecologic, & Neonatal Nursing*, 44, 380-388.
- COUZINET, B., YOUNG, J., BRAILLY, S., LE BOUC, Y., CHANSON, P. & SCHAISON, G. 1999. Functional hypothalamic amenorrhoea: a partial and reversible gonadotrophin deficiency of nutritional origin. *Clinical Endocrinology*, 50, 229-235.
- COYNE, J. C. & RACIOPPO, M. W. 2000. Never the Twain shall meet? Closing the gap between coping research and clinical intervention research. *American Psychologist*, 55, 655-664.
- CUSSONS, A. J., STUCKEY, B. G. A., WALSH, J. P., BURKE, V. & NORMAN, R. J. 2005. Polycystic ovarian syndrome: marked differences between endocrinologists and gynaecologists in diagnosis and management. *Clinical Endocrinology*, 62, 289-295.
- CRAIG, C. L., MARSHALL, A. L., SJORSTROM, M., BAUMAN, A. E., BOOTH, M. L., AINSWORTH, B. E., PRATT, M., EKELUND, U., YNGVE, A. & SALLIS, J. F. 2003. International physical activity questionnaire: 12-country reliability and validity. *Medicine and Science in Sports and Exercise*, 35, 1381-1395.
- CRAWFORD, J. R. & HENRY, J. D. 2004. The Positive and Negative Affect Schedule (PANAS): Construct validity, measurement properties and normative data in a large non-clinical sample. *British Journal of Clinical Psychology*, 43, 245-265.
- CRISAFULLI, M. A., VON HOLLE, A. & BULIK, C. M. 2008. Attitudes towards anorexia nervosa: The impact of framing on blame and stigma. *International Journal of Eating Disorders*, 41, 333-339.
- CROWTHER, J. H., SANFTNER, J., BONIFAZI, D. Z. & SHEPHERD, K. L. 2001. The role of daily hassles in binge eating. *International Journal of Eating Disorders*, 29, 449-454.
- CUI, H., LOPEZ, M., RAHMOUNTI, K. 2017. The cellular and molecular bases of leptin and ghrelin resistance in obesity. *Nature Reviews Endocrinology*, 13, 338-351.
- CULBERT, K. M., RACINE, S. E. & KLUMP, K. L. 2016. Hormonal factors and disturbances in eating disorders. *Current Psychiatry Reports*, 18, 65. <https://doi.org/10.1007/s11920-016-0701-6>.
- CURRIN, L., WALLER, G. & SCHMIDT, U. 2009. Primary care physicians' knowledge of and attitudes toward the eating disorders: Do they affect clinical actions? *International Journal of Eating Disorders*, 42, 453-458.
- DAGFINN, A., SEN, A., PRASAD, M., NORAT, T., JANSZKY, I., TONSTAD, S., ROMUNDSTAD, P., VATTEEN, L. J. 2016. BMI and all cause mortality: systematic review and non-linear dose-response meta-analysis of 230 cohort studies with 3.74 million deaths among 30.3 million participants. *BMJ*, 353:i2156

- DAKANALIS, A., CLERICI, M., BARTOLI, F., CASLINI, M., CROCAMO, C., RIVA, G. & CARRÀ, G. 2017. Risk and maintenance factors for young women's DSM-5 eating disorders. *Archives of Women's Mental Health*, 20, 721-731.
- DALLMAN, M. F. 2010. Stress-induced obesity and the emotional nervous system. *Trends in Endocrinology & Metabolism*, 21, 159-165.
- DALLMAN, M. F., PECORARO, N. C. & LA FLEUR, S. E. 2005. Chronic stress and comfort foods: self-medication and abdominal obesity. *Brain, Behavior, and Immunity*, 19, 275-280.
- DANILUK, J. C. 2001. Reconstructing their lives: A longitudinal, qualitative analysis of the transition to biological childlessness for infertile couples. *Journal of Counseling & Development*, 79, 439-449.
- DAVIES, M. M., BEKKER, M. H. & ROOSEN, M. A. 2011. The role of coping and general psychopathology in the prediction of treatment outcome in eating disorders. *Eating Disorders*, 19, 246-258.
- DE MAN LAPIDOTH, J., GHADERI, A. & NORRING, C. 2006. Eating disorders and disordered eating among patients seeking non-surgical weight-loss treatment in Sweden. *Eating Behaviors*, 7, 15-26.
- DE SOUZA, M.J. 2003. Menstrual disturbances in athletes: a focus on luteal phase defects. *Medicine and Science in Sports and Exercise*, 35, 1553-1563.
- DE SOUZA, M. J. & WILLIAMS, N. I. 2004. Physiological aspects and clinical sequelae of energy deficiency and hypoestrogenism in exercising women. *Human Reproduction Update*, 10, 433-448.
- DE WIT, L., LUPPINO, F., VAN STRATEN, A., PENNINX, B., ZITMAN, F. & CUIJPERS, P. 2010. Depression and obesity: a meta-analysis of community-based studies. *Psychiatry Research*, 178, 230-235.
- DEAN, S. V., LASSI, Z. S., IMAM, A. M. & BHUTTA, Z. A. 2014. Preconception care: nutritional risks and interventions. *Reproductive Health*, 11, S3, <https://doi/10.1186/1742-4755-11-S3-S3>.
- DECHANET, C., ANAHORY, T., MATHIEU DAUDE, J., QUANTIN, X., REYFTMANN, L., HAMAMAH, S., HEDON, B. & DECHAUD, H. 2011. Effects of cigarette smoking on reproduction. *Human Reproduction Update*, 17, 76-95.
- DEEKS, A., GIBSON-HELM, M., PAUL, E. & TEEDE, H. 2011. Is having polycystic ovary syndrome a predictor of poor psychological function including anxiety and depression? *Human Reproduction*, 26, 1399-1407.
- DEEKS, A. A., GIBSON-HELM, M. E. & TEEDE, H. J. 2010. Anxiety and depression in polycystic ovary syndrome: a comprehensive investigation. *Fertility and Sterility*, 93, 2421-2423.

- DELITALA, A. P., CAPOBIANCO, G., DELITALA, G., CHERCHI, P. L. & DESSOLE, S. 2017. Polycystic ovary syndrome, adipose tissue and metabolic syndrome. *Archives of Gynecology and Obstetrics*, 296, 405-419.
- DI ANGELANTONIO, E., BHUPATHIRAJU, S. N., WORMSER, D., GAO, P., KAPTOGE, S., DE GONZALEZ, A. B., CAIRNS, B. J., HUXLEY, R., JACKSON, C. L. & JOSHY, G. 2016. Body-mass index and all-cause mortality: individual-participant-data meta-analysis of 239 prospective studies in four continents. *Lancet*, 388, 776-786.
- DICKERSON, S. S. & KEMENY, M. E. 2004. Acute stressors and cortisol responses: a theoretical integration and synthesis of laboratory research. *Psychological Bulletin*, 130, 355-391.
- DIMEO, F., BAUER, M., VARAHRAM, I., PROEST, G. & HALTER, U. 2001. Benefits from aerobic exercise in patients with major depression: a pilot. *British Journal of Sports Medicine*, 35, 114-117.
- DOMAR, A. D. 2004. Impact of psychological factors on dropout rates in insured infertility patients. *Fertility and Sterility*, 81, 271-273.
- DOMAR, A. D., CLAPP, D., SLAWSBY, E., KESSEL, B., ORAV, J. & FREIZINGER, M. 2000. The impact of group psychological interventions on distress in infertile women. *Health Psychology*, 19, 568-575.
- DOMAR, A. D., ROONEY, K. L., WIEGAND, B., ORAV, E. J., ALPER, M. M., BERGER, B. M. & NIKOLOVSKI, J. 2011. Impact of a group mind/body intervention on pregnancy rates in IVF patients. *Fertility and Sterility*, 95, 2269-2273.
- DOMAR, A. D., ZUTTERMEISTER, P. & FRIEDMAN, R. 1993. The psychological impact of infertility: a comparison with patients with other medical conditions. *Journal of Psychosomatic Obstetrics and Gynaecology*, 14, 45-52.
- DOWNEY, C. A. & CHANG, E. C. 2007. Perfectionism and symptoms of eating disturbances in female college students: Considering the role of negative affect and body dissatisfaction. *Eating Behaviors*, 8, 497-503.
- EASTER, A., BYE, A., TABORELLI, E., CORFIELD, F., SCHMIDT, U., TREASURE, J. & MICALI, N. 2013. Recognising the symptoms: how common are eating disorders in pregnancy? *European Eating Disorders Review*, 21, 340-344.
- EBBESEN, S. M. S., ZACHARIAE, R., MEHLSSEN, M. Y., THOMSEN, D., HØJGAARD, A., OTTOSEN, L., PETERSEN, T. & INGERSLEV, H. J. 2009. Stressful life events are associated with a poor in-vitro fertilization (IVF) outcome: a prospective study. *Human Reproduction*, 24, 2173-2182.
- EDELMANN, R. J., CONNOLLY, K. J. & BARTLETT, H. 1994. Coping strategies and psychological adjustment of couples presenting for IVF. *Journal of Psychosomatic Research*, 38, 355-364.

- EGAN, S. J., SHAFRAN, R., LEE, M., FAIRBURN, C. G., COOPER, Z., DOLL, H. A., PALMER, R. L. & WATSON, H. J. 2016. The reliability and validity of the clinical perfectionism questionnaire in eating disorder and community samples. *Behavioural and Cognitive Psychotherapy*, 44, 79-91.
- EGAN, S. J., WADE, T. D. & SHAFRAN, R. 2011. Perfectionism as a transdiagnostic process: a clinical review. *Clinical Psychology Review*, 31, 203-212.
- EGGERT, J., THEOBALD, H. & ENGFELDT, P. 2004. Effects of alcohol consumption on female fertility during an 18-year period. *Fertility and Sterility*, 81, 379-383.
- ELLISON, P. T. 1990. Human ovarian function and reproductive ecology: new hypotheses. *American Anthropologist*, 92, 933-952.
- ELSENBRUCH, S., HAHN, S., KOWALSKY, D., ÖFFNER, A. H., SCHEDLOWSKI, M., MANN, K. & JANSSEN, O. E. 2003. Quality of life, psychosocial well-being, and sexual satisfaction in women with polycystic ovary syndrome. *Journal of Clinical Endocrinology & Metabolism*, 88, 5801-5807.
- ENDLER, N. S. & PARKER, J. 1990a. *Coping Inventory for Stressful Situations (CISS)*. Multi-Health Systems. Inc, Toronto, Canada.
- ENDLER, N. S. & PARKER, J. D. 1990b. Multidimensional assessment of coping: a critical evaluation. *Journal of Personality and Social Psychology*, 58, 844-854.
- EPEL, E., LAPIDUS, R., MCEWEN, B. & BROWNELL, K. 2001. Stress may add bite to appetite in women: a laboratory study of stress-induced cortisol and eating behavior. *Psychoneuroendocrinology*, 26, 37-49.
- ERRISURIZ, V. L., PASCH, K. E. & PERRY, C. L. 2016. Perceived stress and dietary choices: The moderating role of stress management. *Eating Behaviors*, 22, 211-216.
- ESHRE CAPRI WORKSHOP GROUP, 2006. Nutrition and reproduction in women. *Human Reproduction Update*, 12, 193-207.
- ESHRE CAPRI WORKSHOP GROUP, 2012. Health and fertility in World Health Organization group 2 anovulatory women. *Human Reproduction Update*, 18, 586-599.
- ESHRE TASKFORCE ON ETHICS AND LAW, 2010. Lifestyle-related factors and access to medically assisted reproduction. *Human Reproduction*, 25, 578-583.
- EVANS, J. & ANDERSON, G. 2012. Balancing ovulation and anovulation: integration of the reproductive and energy balance axes by neuropeptides. *Human Reproduction Update*, 18, 313-332.
- EVERS, J. L. 2002. Female subfertility. *Lancet*, 360, 151-159.
- FAIRBURN, C. G. 2008. *Cognitive Behavior Therapy and Eating Disorders*. Guilford Press, New York.
- FAIRBURN, C. G. & BEGLIN, S. J. 1994. Assessment of eating disorders: interview or self-report questionnaire? *International Journal Eating Disorders*, 16, 363-370.

- FAIRBURN, C. G. & BEGLIN, S. J. 2008. Eating Disorder Examination Questionnaire (EDE-Q 6.0). In Fairburn, C.G. (Ed.), *Cognitive Therapy and Eating Disorders*. Guilford Press, New York, pp. 309-313.
- FAIRBURN, C. & BROWNELL, K. 2002. *Eating Disorders and Obesity: A Comprehensive Handbook*, 2nd edn. Guilford Press, New York.
- FAIRBURN, C. G., COOPER, Z. 1993. The Eating Disorder Examination (12th edn). In C.G. Fairburn, C. G. and Wilson, G. T. (Eds.), *Binge Eating: Nature, Assessment and Treatment*. Guilford Press, New York, pp. 317-360.
- FAIRBURN, C. G., COOPER, Z. & SHAFRAN, R. 2003a. Cognitive behaviour therapy for eating disorders: a “transdiagnostic” theory and treatment. *Behaviour Research and Therapy*, 41, 509-528.
- FAIRBURN, C. G., COOPER, Z. & SHAFRAN, R. 2003b. *The Clinical Perfectionism Questionnaire*. Unpublished manuscript, Department of Psychiatry, University of Oxford, UK.
- FEDORCSAK, P., DALE, P.O., STORENG, R., ERTZEID, G., BJERCKE, S., OLDEREID, N., OMLAND, A.K., ABYHOLM, T. & TANBO, T. 2004. Impact of overweight and underweight on assisted reproduction treatment. *Human Reproduction*, 19, 2523-2528.
- FINUCANE, M. M., STEVEN, G. A., COWAN, M. J., DANAEI, G., LIN, J.K., PACIOREK, C.J., SINGH, G. M., GUITERREZ, H.R., LU, Y., BAHALIM, A. N., FARZADFAR, F., RILEY, L. M. & EZZATI, M. 2011. National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination survey and epidemiological studies with 960 country-years and 9.1 million participants. *Lancet*, 377, 557-567.
- FIRST, M. B., SPITZER, R. L., GIBBON, M., WILLIAMS, J. B. W. 2002. *Structured clinical interview for the DSM-IV-TR axis I disorders, research version, non-patient edition (SCID-I/NP)*. Biometrics Research, New York State Psychiatric Institute, New York.
- FITZGIBBON, M. L. & KIRSCHENBAUM, D. S. 1991. Distressed binge eaters as a distinct subgroup among obese individuals. *Addictive Behaviors*, 16, 441-451.
- FITZGIBBON, M. L., STOLLEY, M.R., KIRSCHENBAUM, D.S. 1993. Obese people who seek treatment have different characteristics than those who do not seek treatment. *Health Psychology*, 12, 342-345.
- FLEMING, J. & SZMUKLER, G. I. 1992. Attitudes of medical professionals towards patients with eating disorders. *Australian and New Zealand Journal of Psychiatry*, 26, 436-443.
- FRANK, G. K. 2013. Altered brain reward circuits in eating disorders: chicken or egg? *Current Psychiatry Reports*, 15, 396. doi:10.1007/s11920-013-0396-x
- FRANKO, D. L., BLAIS, M. A., BECKER, A. E., DELINSKY, S. S., GREENWOOD, D. N., FLORES, A. T., EKEBLAD, E. R., EDDY, K. T. & HERZOG, D. B. 2001. Pregnancy complications and neonatal outcomes in women with eating disorders. *American Journal of Psychiatry*, 158, 1461-1466.

- FRANKS, S. & BERGA, S. L. 2012. Does PCOS have developmental origins? *Fertility and Sterility*, 97, 2-6.
- FREDERIKSEN, Y., FARVER-VESTERGAARD, I., SKOVGÅRD, N. G., INGERSLEV, H. J. & ZACHARIAE, R. 2015. Efficacy of psychosocial interventions for psychological and pregnancy outcomes in infertile women and men: a systematic review and meta-analysis. *BMJ Open*, 5, e006592. doi: 10.1136/bmjopen-2014-006592
- FREEMAN, L. M. Y. & GIL, K. M. 2004. Daily stress, coping, and dietary restraint in binge eating. *International Journal of Eating Disorders*, 36, 204-212.
- FREIZINGER, M., FRANKO, D. L., DACEY, M., OKUN, B. & DOMAR, A. D. 2010. The prevalence of eating disorders in infertile women. *Fertility and Sterility*, 93, 72-78.
- FRIEDER, A., DUNLOP, A. L., CULPEPPER, L. & BERNSTEIN, P. S. 2008. The clinical content of preconception care: women with psychiatric conditions. *American Journal of Obstetrics & Gynecology*, 199, S328-S332.
- FRISCH, R. E. & MCARTHUR, J. W. 1974. Menstrual cycles: fatness as a determinant of minimum weight for height necessary for their maintenance or onset. *Science*, 185, 949-951.
- GAMEIRO, S., BOIVIN, J., DANCET, E., DE KLERK, C., EMERY, M., LEWIS-JONES, C., THORN, P., VAN DEN BROECK, U., VENETIS, C. & VERHAAK, C. M. 2015. ESHRE guideline: routine psychosocial care in infertility and medically assisted reproduction - a guide for fertility staff. *Human Reproduction*, 30, 2476-2485.
- GAMEIRO, S., BOIVIN, J., PERONACE, L. & VERHAAK, C. M. 2012. Why do patients discontinue fertility treatment? A systematic review of reasons and predictors of discontinuation in fertility treatment. *Human Reproduction Update*, 18, 652-669.
- GANNA, K. & JAKUBOWSKA, S. 2016. Relationship between infertility-related stress and emotional distress and marital satisfaction. *Journal of Health Psychology*, 21, 1043-1054.
- GANEM, P. A., DE HEER, H. & MORERA, O. F. 2009. Does body dissatisfaction predict mental health outcomes in a sample of predominantly Hispanic college students? *Personality and Individual Differences*, 46, 557-561.
- GARIEPY, G., NITKA, D. & SCHMITZ, N. 2010. The association between obesity and anxiety disorders in the population: a systematic review and meta-analysis. *International Journal of Obesity (London)*, 34, 407-419.
- GARNER, D. M. 2004. *EDI-3, Eating Disorder Inventory-3: Professional Manual*. Psychological Assessment Resources, Incorporated, Florida.
- GELIEBTER, A., YAHAV, E. K., GLUCK, M. E. & HASHIM, S. A. 2004. Gastric capacity, test meal intake, and appetitive hormones in binge eating disorder. *Physiology & Behavior*, 81, 735-740.
- GERMAIN, N., FAUCONNIER, A., KLEIN, J.-P., WARGNY, A., KHALFALLAH, Y., PAPASTATHI-BOUREAU, C., ESTOUR, B. & GALUSCA, B. 2017. Pulsatile

- gonadotropin-releasing hormone therapy in persistent amenorrheic weight-recovered anorexia nervosa patients. *Fertility and Sterility*, 107, 502-509.
- GESINK LAW, D.C., MACLEHOSE, R. F. & LONGNECKER, M. P. 2007. Obesity and time to pregnancy. *Human Reproduction*, 22, 414-420.
- GILBERT, N., ARCELUS, J., CASHMORE, R., THOMPSON, B., LANGHAM, C. & MEYER, C. 2012. Should I ask about eating? Patients' disclosure of eating disorder symptoms and help-seeking behaviour. *European Eating Disorders Review*, 20, 80-85.
- GIVIZIEZ, C. R., SANCHEZ, E. G., APPROBATO, M. S., MAIA, M. C., FLEURY, E. A. B. & SASAKI, R. S. 2016. Obesity and anovulatory infertility: a review. *JBRA Assisted Reproduction*, 20, 240-245.
- GLANZ, K., RIMER, B. & VISWANATH, K. 2008. *Health Behavior and Health Education: Theory, Research, and Practice*. John Wiley & Sons, San Francisco, CA.
- GLOBAL BMI MORTALITY COLLABORATION. 2016. Body-mass index and all-cause mortality: individual-participant-data meta-analysis of 239 prospective studies in four continents. *Lancet*, 20, 776-786.
- GLUCK, M. E. 2006. Stress response and binge eating. *Appetite*, 46, 26-30.
- GLUCKMAN, P. D., HANSON, M. A., COOPER, C. & THORNBURG, K. L. 2008. Effect of in utero and early-life conditions on adult health and disease. *New England Journal of Medicine*, 359, 61-73.
- GNOTH, C., GODEHARDT, E., FRANK-HERRMANN, P., FRIOL, K., TIGGES, J. & FREUNDL, G. 2005. Definition and prevalence of subfertility and infertility. *Human Reproduction*, 20, 1144-1147.
- GODART, N., PERDEREAU, F., REIN, Z., BERTHOZ, S., WALLIER, J., JEAMMET, P. & FLAMENT, M. 2007. Comorbidity studies of eating disorders and mood disorders. Critical review of the literature. *Journal of Affective Disorders*, 97, 37-49.
- GOLDFIELD, G. S., ADAMO, K. B., RUTHERFORD, J. & LEGG, C. 2008. Stress and the relative reinforcing value of food in female binge eaters. *Physiology & Behavior*, 93, 579-587.
- GOODWIN, H., HAYCRAFT, E., TARANIS, L. & MEYER, C. 2011. Psychometric evaluation of the compulsive exercise test (CET) in an adolescent population: links with eating psychopathology. *European Eating Disorders Review*, 19, 269-279.
- GORDON, C. M. 2010. Functional hypothalamic amenorrhea. *New England Journal of Medicine*, 363, 365-371.
- GORMACK, A. A., PEEK, J. C., DERRAIK, J. G., GLUCKMAN, P. D., YOUNG, N. L. & CUTFIELD, W. S. 2015. Many women undergoing fertility treatment make poor lifestyle choices that may affect treatment outcome. *Human Reproduction*, 30, 1617-1624.

- GOUROUNTI, K., ANAGNOSTOPOULOS, F., POTAMIANOS, G., LYKERIDOU, K., SCHMIDT, L. & VASLAMATZIS, G. 2012. Perception of control, coping and psychological stress of infertile women undergoing IVF. *Reproductive Biomedicine Online*, 24, 670-679.
- GRATWICK-SARLL, K. & BENTLEY, C. 2014. Improving eating disorders mental health literacy: a preliminary evaluation of the “Should I say something?” workshop. *Eating Disorders*, 22, 405-419.
- GREEN, B. B., WEISS, N. S. & DALING, J. R. 1988. Risk of ovulatory infertility in relation to body weight. *Fertility and Sterility*, 50, 721-726.
- GREENO, C. G. & WING, R. R. 1994. Stress-induced eating. *Psychological Bulletin*, 115, 444-464.
- GREIL, A. L., SLAUSON-BLEVINS, K. & MCQUILLAN, J. 2010. The experience of infertility: a review of recent literature. *Sociology of Health & Illness*, 32, 140-162.
- GRILO, C. 2006. *Eating and Weight Disorders*. Psychology Press, Hove and New York.
- GRILO, C. M., WHITE, M. A., BARNES, R. D. & MASHEB, R. M. 2013. Psychiatric disorder comorbidity and correlates in an ethnically diverse sample of obese patients with binge eating disorder in primary care settings. *Comprehensive Psychiatry*, 54, 209-216.
- GRODSTEIN, F., GOLDMAN, M. B. & CRAMER, D. W. 1994. Body mass index and ovulatory infertility. *Epidemiology*, 5, 247-250.
- GROGAN, S., 2006. Body image and health: contemporary perspectives. *Journal of Health Psychology*, 11, 523-530.
- GRUENEWALD, T. L., KEMENY, M. E., AZIZ, N. & FAHEY, J. L. 2004. Acute threat to the social self: Shame, social self-esteem, and cortisol activity. *Psychosomatic Medicine*, 66, 915-924.
- GUH, D. P., ZHANG, W., BANSBACK, N., AMARSI, Z., BIRMINGHAM, C. L. & ANIS, A. H. 2009. The incidence of co-morbidities related to obesity and overweight: a systematic review and meta-analysis. *BMC Public Health*, 9, 88. doi: 10.1186/1471-2458-9-88.
- HABBEMA, J. D. F., COLLINS, J., LERIDON, H., EVERS, J. L., LUNENFELD, B. & TEVELDE, E. R. 2004. Towards less confusing terminology in reproductive medicine: a proposal. *Human Reproduction*, 19, 1497-1501.
- HABHAB, S., SHELDON, J. P. & LOEB, R. C. 2009. The relationship between stress, dietary restraint, and food preferences in women. *Appetite*, 52, 437-444.
- HAGGER, M. S., CHAN, D. K., PROTOGEROU, C. & CHATZISARANTIS, N. L. 2016. Using meta-analytic path analysis to test theoretical predictions in health behavior: An illustration based on meta-analyses of the theory of planned behavior. *Preventive Medicine*, 89, 154-161.
- HAGSTRÖMER, M., OJA, P. & SJÖSTRÖM, M. 2006. The International Physical Activity Questionnaire (IPAQ): a study of concurrent and construct validity. *Public Health Nutrition*, 9, 755-762.
- HAHN, S., JANSSEN, O. E., TAN, S., PLEGER, K., MANN, K., SCHEDLOWSKI, M., KIMMIG, R., BENSON, S., BALAMITSA, E. & ELSENBRUCH, S. 2005. Clinical and psychological

- correlates of quality-of-life in polycystic ovary syndrome. *European Journal of Endocrinology*, 153, 853-860.
- HAINES, J. & NEUMARK-SZTAINER, D. 2006. Prevention of obesity and eating disorders: a consideration of shared risk factors. *Health Education Research*, 21, 770-782.
- HAIR, J. F., BLACK, W. C., BABIN, B.J., & ANDERSON, R. E. 2010. *Multivariate Data Analysis: A Global Perspective*, 7th edn. Pearson Prentice Hall, Upper Saddle River, NJ.
- HAKIMI, O. & CAMERON, L.-C. 2017. Effect of exercise on ovulation: A systematic review. *Sports Medicine*, 47, 1555-1567.
- HAMMARBERG, K., COLLINS, V., HOLDEN, C., YOUNG, K. & MCLACHLAN, R. 2017. Men's knowledge, attitudes and behaviours relating to fertility. *Human Reproduction Update*, 23, 458-480.
- HARRIS, K., FITZFERALD, O., PAUL, RC., MACALDOWIE, A., LEE, E & CHAMBERS, GM. 2016. *Assisted Reproductive Technology in Australia and New Zealand 2014*. National Perinatal Epidemiology and Statistics Unit, the University of New South Wales. Sydney, NSW.
- HASSAN, M. A. & KILLICK, S. R. 2004. Negative lifestyle is associated with a significant reduction in fecundity. *Fertility and Sterility*, 81, 384-392.
- HAY, P., CHINN, D., FORBES, D., MADDEN, S., NEWTON, R., SUGENOR, L., TOUYZ, S. & WARD, W. 2014. Royal Australian and New Zealand College of Psychiatrists clinical practice guidelines for the treatment of eating disorders. *Australian & New Zealand Journal of Psychiatry*, 48, 977-1008.
- HAY, P., GIROSI, F. & MOND, J. 2015. Prevalence and sociodemographic correlates of DSM-5 eating disorders in the Australian population. *Journal of Eating Disorders*, 3, 19. doi: 10.1186/s40337-015-0056-0
- HAY, P., MITCHISON, D., COLLADO, A. E. L., GONZÁLEZ-CHICA, D. A., STOCKS, N. & TOUYZ, S. 2017. Burden and health-related quality of life of eating disorders, including Avoidant/Restrictive Food Intake Disorder (ARFID), in the Australian population. *Journal of Eating Disorders*, 5, 21, doi: 10.1186/s40337-017-0149-z
- HEATHERTON, T. F. & BAUMEISTER, R. F. 1991. Binge eating as escape from self-awareness. *Psychological Bulletin*, 110, 86-108.
- HEBEBRAND, J., MULLER, T., HOLTKAMP, K. & HERPERTZ-DAHLMANN, B. 2007. The role of leptin in anorexia nervosa: clinical implications. *Molecular Psychiatry*, 12, 23-35.
- HERMAN, C. & POLIVY, J. 1980. Restrained Eating. In A. J. Stunkard (Ed.), *Obesity*. WB Saunders, Philadelphia, pp. 208-225.
- HILBERT, A., CLAUS, V., TUSCHEN-CAFFIER, B. & HARTMANN, A. S. 2011. Psychophysiological responses to idiosyncratic stress in Bulimia Nervosa and Binge Eating Disorder. *Physiology & Behavior*, 104, 770-777.

- HILL, L. S., REID, F., MORGAN, J. F. & LACEY, J. H. 2010. SCOFF, the development of an eating disorder screening questionnaire. *International Journal of Eating Disorders*, 43, 344-351.
- HILTERSCHIED, E. & LAESSLE, R. 2015. Stress-induced release of GUT peptides in young women classified as restrained or unrestrained eaters. *Eating and Weight Disorders*, 20, 435-439.
- HIMELEIN, M. J. & THATCHER, S. S. 2006. Depression and body image among women with polycystic ovary syndrome. *Journal of Health Psychology*, 11, 613-625.
- HOEK, H. W. & VAN HOEKEN, D. 2003. Review of the prevalence and incidence of eating disorders. *International Journal of Eating Disorders*, 34, 383-396.
- HOLAHAN, C. J. & MOOS, R. H. 1991. Life stressors, personal and social resources, and depression: A 4-year structural model. *Journal of Abnormal Psychology*, 100, 31-38.
- HOLAHAN, C. J., MOOS, R. H., HOLAHAN, C. K., BRENNAN, P. L. & SCHUTTE, K. K. 2005. Stress generation, avoidance coping, and depressive symptoms: a 10-year model. *Journal of Consulting and Clinical Psychology*, 73, 658-666.
- HOLLINRAKE, E., ABREU, A., MAIFELD, M., VAN VOORHIS, B. J. & DOKRAS, A. 2007. Increased risk of depressive disorders in women with polycystic ovary syndrome. *Fertility and Sterility*, 87, 1369-1376.
- HOLMES, M., FULLER-TYSZKIEWICZ, M., SKOUTERIS, H. & BROADBENT, J. 2015. Understanding the link between body image and binge eating: a model comparison approach. *Eating and Weight Disorders*, 20, 81-89.
- HOMAN, G., DAVIES, M. & NORMAN, R. 2007. The impact of lifestyle factors on reproductive performance in the general population and those undergoing infertility treatment: a review. *Human Reproduction Update*, 13, 209-223.
- HOMBURG, R. 2009. Androgen circle of polycystic ovary syndrome. *Human Reproduction*, 24, 1548-1555.
- HSU, L. G. 1989. The gender gap in eating disorders: Why are the eating disorders more common among women? *Clinical Psychology Review*, 9, 393-407.
- HU, L. T. & Bentler, P. M. 1999. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*, 6, 1-55.
- HUBERTY, C. J., PETOSKY, M.D. 2000. Multivariate analysis of variance and covariance. In Tinsley, H., Brown, S. (Eds.). *Handbook of Applied Multivariate Statistics and Mathematical Modeling*. Academic Press, New York.
- HUDSON, J. I., HIRIPI, E., POPE, H. G. & KESSLER, R. C. 2007. The prevalence and correlates of eating disorders in the National Comorbidity Survey Replication. *Biological Psychiatry*, 61, 348-358.
- HUDSON, J. I., LALONDE, J. K., BERRY, J. M., PINDYCK, L. J., BULIK, C. M., CROW, S. J., MCELROY, S. L., LAIRD, N. M., TSUANG, M. T. & WALSH, B. T. 2006. Binge-eating

- disorder as a distinct familial phenotype in obese individuals. *Archives of General Psychiatry*, 63, 313-319.
- HYNES, G. J., CALLAN, V. J., TERRY, D. J. & GALLOIS, C. 1992. The psychological well-being of infertile women after a failed IVF attempt: The effects of coping. *British Journal of Medical Psychology*, 65, 269-278.
- ICE, G. H. & JAMES, G. D. 2007. Conducting a field study of stress: general principles. In *Measuring Stress in Humans: A Practical Guide for the Field*. Cambridge University Press, New York, pp 1-3.
- INHORN, M. C. & PATRIZIO, P. 2015. Infertility around the globe: new thinking on gender, reproductive technologies and global movements in the 21st century. *Human Reproduction Update*, 21, 411- 426.
- IPAQ RESEARCH COMMITTEE. 2005. *Guidelines for data processing and analysis of the International Physical Activity Questionnaire (IPAQ) – Short and Long Forms*. Scoring Protocol: https://sites.google.com/site/theipaq/questionnaire_links. Accessed 20th January 2018.
- JACOBI, C., FITTIG, E., BRYSON, S., WILFLEY, D., KRAEMER, H. & TAYLOR, C. B. 2011. Who is really at risk? Identifying risk factors for subthreshold and full syndrome eating disorders in a high-risk sample. *Psychological Medicine*, 41, 1939-1949.
- JAHANFAR, S., EDEN, J. & NGUYENT, T. 1995. Bulimia nervosa and polycystic ovary syndrome. *Gynecological Endocrinology*, 9, 113-117.
- JAIN, A., POLOTSKY, A. J., ROCHESTER, D., BERGA, S. L., LOUCKS, T., ZEITLIAN, G., GIBBS, K., POLOTSKY, H. N., FENG, S. & ISAAC, B. 2007. Pulsatile luteinizing hormone amplitude and progesterone metabolite excretion are reduced in obese women. *The Journal of Clinical Endocrinology & Metabolism*, 92, 2468-2473.
- JANNSEN, O. E., HAHN, S., TAN, S., BENSON, S. & ELSENBURCH, S. 2008. Mood and sexual function in polycystic ovary syndrome. *Seminars in Reproductive Medicine*, 26, 45-52.
- JAVARAS, K. N., POPE JR, H. G., LALONDE, J. K., ROBERTS, J. L., NILLNI, Y. I., LAIRD, N. M., BLUK, C. M., CROW, S. J., MCELROY, S. L. & WALSH, B. T. 2008. Co-occurrence of binge eating disorder with psychiatric and medical disorders. *Journal of Clinical Psychiatry*, 69, 266-273.
- JENKINS, P. E., HOSTE, R. R., MEYER, C. & BLISSETT, J. M. 2011. Eating disorders and quality of life: A review of the literature. *Clinical Psychology Review*, 31, 113-121.
- JOHNSON, J. G., SPITZER, R.I. & WILLIAMS, J. B.W. 2001. Health problems, impairment and illnesses associated with bulimia nervosa and binge eating disorder among primary care and obstetric gynaecology patients. *Psychological Medicine*, 31, 1455-1466.
- JOHNSON, M. H. & EVERITT, B. J. 2000. *Essential Reproduction*. 5th edn. Blackwell Science, Malden, MA.

- JOINSON, A. 1999. Social desirability, anonymity, and internet-based questionnaires. *Behavior Research Method, Instruments, & Computers*, 31, 433-438.
- JONES, G., HALL, J., BALEN, A. & LEDGER, W. 2008. Health-related quality of life measurement in women with polycystic ovary syndrome: a systematic review. *Human Reproduction Update*, 14, 15-25.
- JONES, W. R., SAEIDI, S. & MORGAN, J. F. 2013. Knowledge and attitudes of psychiatrists towards eating disorders. *European Eating Disorders Review*, 21, 84-88.
- JORM, A. F., KITCHENER, B. A., FISCHER, J. & CVETKOVSKI, S. 2010. Mental health first aid training by e-learning: a randomized controlled trial. *Australian and New Zealand Journal of Psychiatry*, 44, 1072-1081.
- JORM, A. F., KORTEN, A., JACOMB, P., CHRISTENSEN, H., RODGERS, B. & POLLITT, P. 1997. Mental health literacy: a survey of the public's ability to recognise mental disorders and their beliefs about the effectiveness of treatment. *Medical Journal Australia*, 166, 182-186.
- KÄRKKÄINEN, U., MUSTELIN, L., RAEVUORI, A., KAPRIO, J. & KESKI-RAHKONEN, A. 2018. Do disordered eating behaviours have long-term health-related consequences? *European Eating Disorders Review*, 26, 22-28.
- KASSEL, J. D., STROUD, L. R. & PARONIS, C. A. 2003. Smoking, stress, and negative affect: correlation, causation, and context across stages of smoking. *Psychological Bulletin*, 129, 270-304.
- KATZ, D. J., TELOKEN, P. & SHOSHANY, O. 2017. Male infertility - The other side of the equation. *Australian Family Physician*, 46, 641-646.
- KEEL, P. K., DORER, D. J., FRANKO, D. L., JACKSON, S. C. & HERZOG, D. B. 2005. Postremission predictors of relapse in women with eating disorders. *American Journal of Psychiatry*, 162, 2263-2268.
- KELLY, C. M., JORM, A. F. & WRIGHT, A. 2007. Improving mental health literacy as a strategy to facilitate early intervention for mental disorders. *Medical Journal of Australia*, 187, S26-S30.
- KERCHNER, A., LESTER, W., STUART, S. P. & DOKRAS, A. 2009. Risk of depression and other mental health disorders in women with polycystic ovary syndrome: a longitudinal study. *Fertility and Sterility*, 91, 207-212.
- KERSTEN, F., HERMENS, R., BRAAT, D., HOEK, A., MOL, B., GODDIJN, M. & NELEN, W. 2015. Overtreatment in couples with unexplained infertility. *Human Reproduction*, 30, 71-80.
- KESKI-RAHKONEN, A., SIHVOLA, E., RAEVUORI, A., KAUKORANTA, J., BULIK, C. M., HOEK, H. W., RISSANEN, A. & KAPRIO, J. 2006. Reliability of self-reported eating disorders: optimizing population screening. *International Journal of Eating Disorders*, 39, 754-762.

- KESKI-RAHKONEN, A. & MUSTELIN, L. 2016. Epidemiology of eating disorders in Europe: prevalence, incidence, comorbidity, course, consequences, and risk factors. *Current Opinion in Psychiatry*, 29, 340-345.
- KEYES, K. M., HATZENBUEHLER, M. L. & HASIN, D. S. 2011. Stressful life experiences, alcohol consumption, and alcohol use disorders: the epidemiologic evidence for four main types of stressors. *Psychopharmacology*, 218, 1-17.
- KIMMEL, M., FERGUSON, E. H., ZERWAS, S., BULIK, C. M. & MELTZER-BRODY, S. 2016. Obstetric and gynecologic problems associated with eating disorders. *International Journal of Eating Disorders*, 49, 260-275.
- KIVIRUUSU, O., KONTTINEN, H., HUURRE, T., ARO, H., MARTTUNEN, M. & HAUKKALA, A. 2016. Self-esteem and body mass index from adolescence to mid-adulthood. A 26-year follow-up. *International Journal of Behavioral Medicine*, 23, 355-363.
- KLATZKIN, R. R., GAFFNEY, S., CYRUS, K., BIGUS, E. & BROWNLEY, K. A. 2016. Stress-induced eating in women with binge-eating disorder and obesity. *Biological Psychology*, <http://doi.org/10.1016/j.biopsycho.2016.11.002>.
- KLINE, R. B., 2011. *Principles and Practice of Structural Equation Modeling*. 3rd ed. Guilford Press, New York. NY.
- KLOK, M., JAKOBSDOTTIR, S. & DRENT, M. 2007. The role of leptin and ghrelin in the regulation of food intake and body weight in humans: a review. *Obesity Reviews*, 8, 21-34.
- KLUMP, K. L., BULIK, C. M., KAYE, W. H., TREASURE, J. & TYSON, E. 2009. Academy for eating disorders position paper: eating disorders are serious mental illnesses. *International Journal of Eating Disorders*, 42, 97-103.
- KONING, A., MUTSAERTS, M., KUCHENBECHER, W., BROEKMANS, F., LAND, J., MOL, B. & HOEK, A. 2011. Complications and outcome of assisted reproduction technologies in overweight and obese women. *Human Reproduction*, 27, 457-467.
- KOUVONEN, A., KIVIMÄKI, M., VIRTANEN, M., PENTTI, J. & VAHTERA, J. 2005. Work stress, smoking status, and smoking intensity: an observational study of 46 190 employees. *Journal of Epidemiology & Community Health*, 59, 63-69.
- KOWALCEK, I., WIHSTUTZ, N., BUHROW, G. & DIEDRICH, K. 2001. Subjective well-being in infertile couples. *Journal of Psychosomatic Obstetrics & Gynecology*, 22, 143-148.
- KRAAIJ, V., GARNEFSKI, N., SCHROEVERS, M. J., WEIJMER, J. & HELMERHORST, F. 2010. Cognitive coping, goal adjustment, and depressive and anxiety symptoms in people undergoing infertility treatment: a prospective study. *Journal of Health Psychology*, 15, 876-886.
- KRAUSZ, C. 2011. Male infertility: pathogenesis and clinical diagnosis. *Best Practice & Research Clinical Endocrinology & Metabolism*, 25, 271-285.

- KUPELI, N., NORTON, S., CHILCOT, J., CAMPBELL, I. C., SCHMIDT, U. & TROOP, N. 2017. Affect systems, changes in body mass index, disordered eating and stress: an 18-month longitudinal study in women. *Health Psychology and Behavioral Medicine*, 5, 214-228.
- KWAN, M. Y. & GORDON, K. H. 2016. The effects of social support and stress perception on bulimic behavior and unhealthy food consumption. *Eating Behaviors*, 22, 34-39.
- LAMPIC, C., SVANVERG, A. S., KARLSTROM, P., TYDEN, T. 2006. Fertility awareness, intentions concerning childbearing, and attitudes towards parenthood, among female and male academics. *Human Reproduction*, 21, 558-564.
- LANCASTLE, D. & BOIVIN, J. 2005. Dispositional optimism, trait anxiety, and coping: unique or shared effects on biological response to fertility treatment? *Health Psychology*, 24, 171-178.
- LANDE, Y., SEIDMAN, D. S., MAMAN, E., BAUM, M. & HOURVITZ, A. 2015. Why do couples discontinue unlimited free IVF treatments? *Gynecological Endocrinology*, 31, 233-236.
- LANDRES, I. V., MILKI, A. A. & LATHI, R. B. 2010. Karyotype of miscarriages in relation to maternal weight. *Human Reproduction*, 25, 1123-1126.
- LARSEN, U. 2005. Research on infertility: which definition should we use? *Fertility and Sterility*, 83, 846-852.
- LASSI, Z. S., IMAM, A. M., DEAN, S. V. & BHUTTA, Z. A. 2014. Preconception care: caffeine, smoking, alcohol, drugs and other environmental chemical/radiation exposure. *Reproductive Health*, 11, S6. doi: 10.1186/1742-4755-11-S3-S6
- LATNER, J. D. & CLYNE, C. 2008. The diagnostic validity of the criteria for binge eating disorder. *International Journal of Eating Disorders*, 41, 1-14.
- LATNER, J. D., DURSO, L. E. & MOND, J.M., 2013. Health and health related quality of life among treatment seeking overweight and obese adults: association with internalized weight bias. *Journal of Eating Disorders*, 1, 3. doi: 10.1186/2050-2974-1-3.
- LAVENDER, J. M., DE YOUNG, K. P. & ANDERSON, D. A. 2010. Eating Disorder Examination Questionnaire (EDE-Q): norms for undergraduate men. *Eating Behaviors*, 11, 119-121.
- LAWSON, D. W. 2011. Life history theory and human reproductive behaviour. In Swami, V. (Ed), *Evolutionary Psychology: A Critical Introduction*. Wiley-Blackwell, Oxford, pp 183-214.
- LAZARUS, R. & FOLKMAN, S. 1984. *Stress, Appraisal and Coping*. Springer, New York.
- LAZARUS, R. S. 1966. *Psychological Stress and the Coping Process*. McGraw-Hill, New York, NY.
- LEDDY, M. A., JONES, C., MORGAN, M. A., SCHULKIN, J. 2009. Eating disorders and obstetric-gynecologic care. *Journal of Women's Health*, 18, 1395-1401.
- LEE, I., COONEY, L. G., SAINI, S., SMITH, M. E., SAMMEL, M. D., ALLISON, K. C. & DOKRAS, A. 2017. Increased risk of disordered eating in polycystic ovary syndrome. *Fertility and Sterility*, 107, 796-802.
- LEGRO, R. S. 2016. Mr. Fertility Authority, tear down that weight wall! *Human Reproduction*, 31, 2662-2664.

- LEMOINE, M.-E. & RAVITSKY, V. 2013. Toward a public health approach to infertility: The ethical dimensions of infertility prevention. *Public Health Ethics*, 6, 287-301.
- LETHBRIDGE, J., WATSON, H.J., EGAN, S. J., STREET, H. & NATHAN, P. R. 2011. The role of perfectionism, dichotomous thinking, shape and weight evaluation, and conditional goal setting in eating disorders. *Eating Behaviors*, 12, 200-206.
- LIAO, J., MUNIZ-TERRERA, G., SCHOLE, S., HAO, Y. & CHEN, Y-M. 2018. Lifestyle index for mortality prediction using multiple ageing cohorts in the USA, UK, and Europe. *Science Reports*, 8, 6644. doi: 10.1038/s41598-018-24778-1.
- LILLIS, J., LEVIN, M.E., HAYES, S.C. 2011. Exploring the relationship between body mass index and health related quality of life: a pilot study of the impact of weight self-stigma and experiential avoidance. *Journal of Health Psychology*, 16, 722-727.
- LIM, S. S., DAVIES, M., NORMAN, R. & MORAN, L. 2012. Overweight, obesity and central obesity in women with polycystic ovary syndrome: a systematic review and meta-analysis. *Human Reproduction Update*, 18, 618-637.
- LIMBERT, C. 2010. Perceptions of social support and eating disorder characteristics. *Health Care for Women International*, 31, 170-178.
- LINNA, M. S., RAEVUORI, A., HAUKKA, J., SUVISAARI, J. M., SUOKAS, J. T. & GISSLER, M. 2013. Reproductive health outcomes in eating disorders. *International Journal of Eating Disorders*, 46, 826-833.
- LINNA, M. S., RAEVUORI, A., HAUKKA, J., SUVISAARI, J. M., SUOKAS, J. T. & GISSLER, M. 2014. Pregnancy, obstetric, and perinatal health outcomes in eating disorders. *American Journal of Obstetrics & Gynecology*, 211, 392.e1-e8.
- LINNE, Y. 2004. Effects of obesity on women's reproduction and complications during pregnancy. *Obesity Reviews*, 5, 137-143.
- LINVILLE, D., BENTON, A., O'NEIL, M. & STURM, K. 2010. Medical providers' screening, training and intervention practices for eating disorders. *Eating Disorders*, 18, 110-131.
- LITT, M. D., TENNEN, H., AFFLECK, G. & KLOCK, S. 1992. Coping and Cognitive factors in adaptation to in vitro fertilization failure. *Journal of Behavioral Medicine*, 15, 171-187.
- LO COCO, G., SALERNO, L., BRUNO, V., CALTABIANO, M. L. & RICCIARDELLI, L. A. 2014. Binge eating partially mediates the relationship between body-image dissatisfaction and psychological distress in obese treatment seeking individuals. *Eating Behaviors*, 15, 45-48.
- LOH, K., ZHANG, L., BRANDON, A., WANG, Q., BEGG, D., QI, Y., FU, M., KULKARNI, R., TEO, J. & BALDOCK, P. 2017. Insulin controls food intake and energy balance via NPY neurons. *Molecular Metabolism*, 6, 574-584.
- LOUCKS, A. B. 2003. Energy availability, not body fatness, regulates reproductive function in women. *Exercise and Sport Sciences Reviews*, 31, 144-148.

- LOUCKS, A. B. 2004. Energy balance and body composition in sports and exercise. *Journal of Sports Sciences*, 22, 1-14.
- LOUCKS, A. B. 2007a. Energy availability and infertility. *Current Opinion in Endocrinology, Diabetes and Obesity*, 14, 470-474.
- LOUCKS, A. B. 2007b. Low energy availability in the marathon and other endurance sports. *Sports Medicine*, 37, 348-352.
- LOUCKS, A. B. & THUMA, J. R. 2003. Luteinizing hormone pulsatility is disrupted at a threshold of energy availability in regularly menstruating women. *The Journal of Clinical Endocrinology and Metabolism*, 88, 297-311.
- LOVIBOND, P. F. & LOVIBOND, S. H. 1995. The structure of negative emotional states: Comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behaviour Research and Therapy*, 33, 335-343.
- LUCE, K. H., CROWTHER, J. H. & POLE, M. 2008. Eating Disorder Examination Questionnaire (EDE-Q): norms for undergraduate women. *International Journal of Eating Disorders*, 41, 273-276.
- LUPPINO, F. S., DE WIT, L. M., BOUVY, P. F., STIJNEN, T., CUIJPERS, P., PENNINX, B. W. & ZITMAN, F. G. 2010. Overweight, obesity, and depression: a systematic review and meta-analysis of longitudinal studies. *Archives of General Psychiatry*, 67, 220-229.
- LYKERIDOU, K., GOUROUNTI, K., DELTSIDOU, A., LOUTRADIS, D. & VASLAMATZIS, G. 2009. The impact of infertility diagnosis on psychological status of women undergoing fertility treatment. *Journal of Reproductive and Infant Psychology*, 27, 223-237.
- LYNCH, C., SUNDARAM, R., MAISOG, J., SWEENEY, A. & BUCK LOUIS, G. 2014. Preconception stress increases the risk of infertility: results from a couple-based prospective cohort study—the LIFE study. *Human Reproduction*, 29, 1067-1075.
- MACHT, M. 2008. How emotions affect eating: a five-way model. *Appetite*, 50, 1-11.
- MACNEIL L., ESPOSITO-SMYTHERS, C., MEHLENBECK, R. & WEISMOORE, J. 2012. The effects of avoidance coping and coping self-efficacy on eating disorder attitudes and behaviors: A stress-diathesis model. *Eating Behaviors*, 13, 293-296.
- MAHESHWARI, A. 2010. Overweight and obesity in infertility: cost and consequences. *Human Reproduction Update*, 16, 229-230.
- MAHESHWARI, A., STOFBERG, L. & BHATTACHARYA, S. 2007. Effect of overweight and obesity on assisted reproductive technology - a systematic review. *Human Reproduction Update*, 13, 433-444.
- MANSSON, M., HOLTE, J., LANDIN-WILHELMSSEN, K., DAHLGREN, E., JOHANSSON, A. & LANDEN, M. Women with polycystic ovary syndrome are often depressed or anxious – a case control study. *Psychoneuroendocrinology*, 33, 1132-1138.

- MANTZOROS, C. S. 2000. Role of leptin in reproduction. *Annals of the New York Academy of Sciences*, 900, 174-183.
- MANTZOROS, C. S., DUNAIF, A. & FLIER, J. S. 1997. Leptin concentrations in the polycystic ovary syndrome. *The Journal of Clinical Endocrinology & Metabolism*, 82, 1687-1691.
- MARCUS, M. D. & WILDES, J. E. 2009. Obesity: Is it a mental disorder. *International Journal of Eating Disorders*, 42, 739-753.
- MARCUS, M. D., LOUCKS, T. L. & BERGA, S. L. 2001. Psychological correlates of functional hypothalamic amenorrhea. *Fertility and Sterility*, 76, 310-316.
- MARKEY, C. N. 2004. Culture and the development of eating disorders: A tripartite model. *Eating Disorders*, 12, 139-156.
- MARSH, H. W., HAU, K.-T. & WEN, Z. 2004. In search of golden rules: Comment on hypothesis-testing approaches to setting cutoff values for fit indexes and dangers in overgeneralizing Hu and Bentler's (1999) findings. *Structural Equation Modeling*, 11, 320-341.
- MARTINS, M. V., PETERSON, B. D., ALMEIDA, V. M. & COSTA, M. E. 2011. Direct and indirect effects of perceived social support on women's infertility-related stress. *Human Reproduction*, 26, 2113-2121.
- MASCARENHAS, M. N., FLAXMAN, S. R., BOERMA, T., VANDERPOEL, S. & STEVENS, G. A. 2012. National, regional, and global trends in infertility prevalence since 1990: a systematic analysis of 277 health surveys. *PLoS Medicine*, 9, e1001356.
- MASHEB, R.M. & WHITE, M.A., 2012. Bulimia nervosa in overweight and normal weight women. *Comprehensive Psychiatry*, 53, 181-186.
- MATTAR, L., HUAS, C., DUCLOS, J., APFEL, A. & GODART, N. 2011. Relationship between malnutrition and depression or anxiety in Anorexia Nervosa: a critical review of the literature. *Journal of Affective Disorders*, 132, 311-318.
- MCCLUSKEY, S., EVANS, C., LACEY, J. H., PEARCE, J. M. & JACOBS, H. 1991. Polycystic ovary syndrome and bulimia. *Fertility and Sterility*, 55, 287-291.
- MCCOACH, D. B., BLACK, A. C. & O'CONNELL, A. A. 2007. Errors of inference in structural equation modeling. *Psychology in the Schools*, 44, 461-470.
- MECZEKALSKI, B., KATULSKI, K., CZYZYK, A., PODFIGURNA-STOPA, A. & MACIEJEWSKA-JESKE, M. 2014. Functional hypothalamic amenorrhea and its influence on women's health. *Journal of Endocrinological Investigation*, 37, 1049-1056.
- MEHLER, P. S. & ANDERSEN, A. E. 2010. *Eating Disorders: A Guide to Medical Care and Complications*, 2nd edn. John Hopkins University Press, Baltimore.
- MEYERS, L.S., GAMST, G. & GUARINO, A.J. 2006. Applied multivariate research: Design and interpretation. Sage Publications, Thousand Oaks, CA.
- MICALI, N., SIMONOFF, E. & TREASURE, J. 2007. Risk of major adverse perinatal outcomes in women with eating disorders. *British Journal of Psychiatry*, 190, 255-259.

- MILLER, G. E., CHEN, E. & ZHOU, E. S. 2007. If it goes up, must it come down? Chronic stress and the hypothalamic-pituitary-adrenocortical axis in humans. *Psychological Bulletin*, 133, 25-45.
- MIRCEA, C. N., LUJAN, M. E. & PIERSON, R. A. 2007. Metabolic fuel and clinical implications for female reproduction. *Journal of Obstetrics and Gynaecology Canada*, 29, 887-902.
- MITCHELL-GIELEGHEM, A., MITTLESTAEDT, M.E. & BULIK, C. M. 2002. Eating disorders and childbearing: concealment and consequences. *Birth*, 29, 182-191.
- MITCHISON, D., HAY, P., SLEWA-YOUNAN, S. & MOND, J. 2014. The changing demographic profile of eating disorder behaviors in the community. *BMC Public Health*, 14, 943, doi: 10.1186/1471-2458-14-943.
- MOND, J.M. 2014. Eating disorders “mental health literacy”: an introduction. *Journal of Mental Health*, 23, 51-54.
- MOND, J. M. & HAY, P. J. 2007. Functional impairment associated with bulimic behaviors in a community sample of men and women. *International Journal of Eating Disorders*, 40, 391-398.
- MOND, J. M., HAY, P. J., RODGERS, B. & OWEN, C. 2006a. An update on the definition of "excessive exercise" in eating disorders research. *International Journal of Eating Disorders*, 39, 147-153.
- MOND, J. M., HAY, P. J., RODGERS, B. & OWEN, C. 2006b. Eating Disorder Examination Questionnaire (EDE-Q): norms for young adult women. *Behaviour Research and Therapy*, 44, 53-62.
- MOND, J. M., HAY, P. J., RODGERS, B. & OWEN, C. 2007. Health service utilization for eating disorders: Findings from a community-based study. *International Journal of Eating Disorders*, 40, 399-408.
- MOND, J. M., HAY, P. J., RODGERS, B., OWEN, C. & BEUMONT, P. J. 2004a. Relationships between exercise behaviour, eating-disordered behaviour and quality of life in a community sample of women: when is exercise ‘excessive’? *European Eating Disorders Review*, 12, 265-272.
- MOND, J. M., HAY, P. J., RODGERS, B., OWEN, C. & BEUMONT, P. J. 2004b. Validity of the Eating Disorder Examination (EDE-Q) in screening for eating disorders in community samples. *Behavior Research and Therapy*, 42, 551-567.
- MOND, J. M., MYERS, T. C., CROSBY, R. D., HAY, P. J., RODGERS, B., MORGAN, J. F., LACEY, J. H. & MITCHELL, J. E. 2008. Screening for eating disorders in primary care: EDE-Q versus SCOFF. *Behaviour Research and Therapy*, 46, 612-622.
- MOND, J. M., HAY, P. J., RODGERS, B., OWEN, C. & BEUMONT, P. J. V. 2005. Assessing quality of life in eating disorder patients. *Quality of Life Research*, 14, 171-178.

- MONELL, E., LEVALLIUS, J., MATILLA, E. F., & BIRGEGARD, A. 2018. Running on empty – a nationwide large-scale examination of compulsive exercise in eating disorders. *Journal of Eating Disorders*, 6:11 <https://doi.org/10.1186/s40337-018-0197-z>.
- MONTELEONE, P., DI LIETO, A., TORTORELLA, A., LONGOBARDI, N. & MAJ, M. 2000. Circulating leptin in patients with anorexia nervosa, bulimia nervosa or binge-eating disorder: relationship to body weight, eating patterns, psychopathology and endocrine changes. *Psychiatry Research*, 94, 121-129.
- MOOS, R. H. & HOLAHAN, C. J. 2003. Dispositional and contextual perspectives on coping: Toward an integrative framework. *Journal of Clinical Psychology*, 59, 1387-1403.
- MORAN, L., RANASINHA, S., ZOUNGAS, S., MCNAUGHTON, S.A., BROWN, W.J. & TEEDE, H.J., 2013. The contribution of diet, physical activity and sedentary behaviour to body mass index in women with and without polycystic ovary syndrome. *Human Reproduction*, 28, 2276-2283.
- MORAN, L., NOAKES, M., CLIFTON, P., WITTERT, G., TOMLINSON, L., GALLETLY, C., LUSCOMBE, N. & NORMAN, R. 2004. Ghrelin and measures of satiety are altered in polycystic ovary syndrome but not differentially affected by diet composition. *The Journal of Clinical Endocrinology & Metabolism*, 89, 3337-3344.
- MORGAN, J. 1999. Eating disorders and gynecology, knowledge and attitudes among clinicians. *Acta Obstetrica et Gynecologica Scandinavica*, 78, 233-239.
- MORGAN, J. F., REID, F. & LACEY, J. H. 1999. The SCOFF questionnaire: assessment of a new screening tool for eating disorders. *British Medical Journal*, 319, 1467-1468.
- MOSCHOS, S., CHAN, J. L. & MANTZOROS, C. S. 2002. Leptin and reproduction: a review. *Fertility and Sterility*, 77, 433-444.
- MOURA-RAMOS, M., GAMEIRO, S., CANAVARRO, M.C. & SOARES, I. 2012. Assessing infertility stress: re-examining the factor structure of the Fertility Problem Inventory. *Human Reproduction*, 27, 496-505.
- MUELLER, C., FIELD, T., YANDO, R., HARDING, J., GONZALEZ, K. P., LASKO, D. & BENDELL, D. 1995. Under-eating and over-eating concerns among adolescents. *Journal of Child Psychology and Psychiatry*, 36, 1019-1025.
- MULLER, A., CLAES, L., WILDERJANS, T. F. & DE ZWAAN, M. 2014, Temperament subtypes in treatment seeking obese individuals: a latent profile analysis. *European Eating Disorder Review*, 22, 260-266.
- MUMFORD, S. L., MICHELS, K. A., SALARIA, N., VALANZASCA, P. & BELIZÁN, J. M. 2014. Preconception care: it's never too early. *BioMed Central*, 11:73. doi: 10.1186/1742-4755-11-73.
- MURPHY, R., STRAEBLER, S., COOPER, Z. & FAIRBURN, C. G. 2010. Cognitive behaviour therapy for eating disorders. *The Psychiatric Clinics of North American*, 33, 611-627.

- MUTSAERTS, M.A.Q., KUCHENBECKER, W.K.H., MOL, B.W., LAND, J.A. & HOEK, A. 2013. Dropout is a problem in lifestyle intervention programs for overweight and obese infertile women: a systematic review. *Human Reproduction*, 28, 979-986.
- NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE, 2004. *Eating Disorders: Core Interventions in the Treatment and Management of Anorexia Nervosa, Bulimia Nervosa and Related Eating Disorders*, British Psychological Society, London, UK.
- NATTIV, A., LOUCKS, A. B., MANORE, M. M., SANBORN, C. F., SUNDGOT-BORGEN, J., WARREN, M. P., & AMERICAN COLLEGE OF SPORTS MEDICINE. 2007. American College of Sports Medicine position stand. The female athlete triad. *Medicine and Science in Sports and Exercise*, 39, 1867-1882.
- NEEL, J. V. 1962. Diabetes mellitus: a “thrifty” genotype rendered detrimental by “progress”? *American Journal of Human Genetics*, 14, 353-362.
- NEUMARK-SZTAINER, D. R., WALL, M. M., HAINES, J. I., STORY, M. T., SHERWOOD, N. E. & VAN DEN BERG, P. A. 2007. Shared risk and protective factors for overweight and disordered eating in adolescents. *American Journal of Preventive Medicine*, 33, 359-369.
- NEWMAN, E., O’CONNOR, D. B. & CONNER, M. 2007. Daily hassles and eating behaviour: the role of cortisol reactivity status. *Psychoneuroendocrinology*, 32, 125-132.
- NEWTON, C. R., SHERRARD, W. & GLAVAC, I. 1999. The Fertility Problem Inventory: measuring perceived infertility-related stress. *Fertility and Sterility*, 72, 54-62.
- NORMAN, R. & CLARK, A. 1998. Obesity and reproductive disorders: a review. *Reproduction, Fertility and Development*, 10, 55-63.
- NORMAN, R. J., CHURA, L. R. & ROBKER, R. L. 2008. Effects of obesity on assisted reproductive technology outcomes. *Fertility and Sterility*, 89, 1611-1612.
- NORRIS, M. L., ROBINSON, A., OBEID, N., HARRISON, M., SPETTIGUE, W. & HENDERSON, K. 2014. Exploring avoidant/restrictive food intake disorder in eating disordered patients: A descriptive study. *International Journal of Eating Disorders*, 47, 495-499.
- O’ CONNOR, D. B., JONES, F., CONNER, M., MCMILLIAN, B. & FERGUSON, E. 2008. Effects of daily hassles and eating style on eating behaviour. *Health Psychology*, 27, S20-S31.
- OCKHUIJSEN, H., VAN DEN HOOGEN, A., EIJKEMANS, M., MACKLON, N. & BOIVIN, J. 2014. The impact of a self-administered coping intervention on emotional well-being in women awaiting the outcome of IVF treatment: a randomized controlled trial. *Human Reproduction*, 29, 1459-1470.
- OLIVER, G. & WARDLE, J. 1999. Perceived effects of stress on food choice. *Physiology & Behavior*, 66, 511-515.
- OSTROVSKY, N. W., SWENCIONIS, C., WYLIE-ROSETT, J. & ISASI, C. R. 2013. Social anxiety and disordered overeating: an association among overweight and obese individuals. *Eating Behaviors*, 14, 145-148.

- PAANS, N. P., BOT, M., VAN STRIEN, T., BROUWER, I. A., VISSER, M. & PENNINX, B. W. 2018. Eating styles in major depressive disorder: Results from a large-scale study. *Journal of Psychiatric Research*, 97, 38-46.
- PALLISTER, E. & WALLER, G. 2008. Anxiety in the eating disorders: understanding the overlap. *Clinical Psychology Review*, 28, 366-386.
- PARK, C. L. & IACOCCA, M. O. 2014. A stress and coping perspective on health behaviors: theoretical and methodological considerations. *Anxiety, Stress & Coping*, 27, 123-137.
- PARKER, G. A. & SMITH, J. M. 1990. Optimality theory in evolutionary biology. *Nature*, 348, 27-33.
- PASCH, L. A., HOLLEY, S. R., BLEIL, M. E., SHEHAB, D., KATZ, P. P. & ADLER, N. E. 2016. Addressing the needs of fertility treatment patients and their partners: are they informed of and do they receive mental health services? *Fertility and Sterility*, 106, 209-215.
- PASCO, J. A., NICHOLSON, G. C., BRENNAN, S. L. & KOTOWICZ, M. A. 2012. Prevalence of obesity and the relationship between the body mass index and body fat: cross-sectional, population-based data. *PloS One*, 7, e29580.
- PASQUALI, R. & GAMBINERI, A. 2006. Polycystic ovary syndrome: a multifaceted disease from adolescence to adult age. *Annals of the New York Academy of Sciences*, 1092, 158-174.
- PASQUALI, R., PELUSI, C., GENGHINI, S., CACCIARI, M. & GAMBINERI, A. 2003. Obesity and reproductive disorders in women. *Human Reproduction Update*, 9, 359-372.
- PASTERNAK, Y., WEINTRAUB, A.Y., SHOHAM-VARDI, I., SERGIENKO, R., GUEZ, J., WIZNITZER, A., SHALEV, H. & SHEINER, E. 2012. Obstetric and perinatal outcomes in women with eating disorders. *Journal of Women's Health*, 21, 61-65.
- PAXTON, S. J., NEUMARK-SZTAINER, D., HANNAN, P. J. & EISENBERG, M. E. 2006. Body dissatisfaction prospectively predicts depressive mood and low self-esteem in adolescent girls and boys. *Journal of Clinical Child and Adolescent Psychology*, 35, 539-549.
- PEARL, R. L., WHITE, M.A. & GRILO, C.M. 2014. Overevaluation of weight and shape as a mediator between self-esteem and weight bias internalization among patients with binge eating disorder. *Eating Behaviors*, 15, 259-261.
- PEARSON, A.N., HEFFNER, M., FOLLETTE, V.M. 2010. *Acceptance and Commitment Therapy for Body Image Dissatisfaction: A Practitioner's Guide to Using Mindfulness, Acceptance, and Values-Based Behavior Change Strategies*. New Harbinger Publications Inc., Oakland, California.
- PEDRO, A. & ANDIPATIN, M. 2014. A qualitative exploration of South African women's psychological and emotional experiences of infertility. *Open Journal of Preventive Medicine*, 4, 327.

- PENDLETON, V. R., WILLEMS, E., SWANK, P., POSTON, W. S. C., GOODRICK, G. K., REEVES, R. S. & FOREYT, J. P. 2001. Negative stress and the outcome of treatment for binge eating. *Eating Disorders*, 9, 351-360.
- PENEDO, F. J. & DAHN, J. R. 2005. Exercise and well-being: a review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry*, 18, 189-193.
- PETERSON, B., PIRRITANO, M., CHRISTENSEN, U., BOIVIN, J., BLOCK, J. & SCHMIDT, L. 2009. The longitudinal impact of partner coping in couples following 5 years of unsuccessful fertility treatments. *Human Reproduction*, 24, 1656-1664.
- PHILLIPOU, A., CASTLE, D. J. & ROSSELL, S. L. 2018. Anorexia nervosa: Eating disorder or body image disorder? *Australian and New Zealand Journal of Psychiatry*, 52, 13-14.
- PINBORG, A., GAARSLEV, C., HOUGAARD, C., ANDERSEN, A. N., ANDERSEN, P., BOIVIN, J. & SCHMIDT, L. 2011. Influence of female bodyweight on IVF outcome: a longitudinal multicentre cohort study of 487 infertile couples. *Reproductive Biomedicine Online*, 23, 490-499.
- PIRKE, K., DOGS, M., FICHTER, M. & TUSCHL, R. 1988. Gonadotrophins, oestradiol and progesterone during the menstrual cycle in bulimia nervosa. *Clinical Endocrinology*, 29, 265-270.
- PIRKE, K. M., SCHWEIGER, U., STROWITZKI, T., TUSCHL, R. J., LAESSLE, R. G., BROOCKS, A., HUBER, B. & MIDDENDORF, R. 1989. Dieting causes menstrual irregularities in normal weight young women through impairment of episodic luteinizing hormone secretion. *Fertility and Sterility*, 51, 263-268.
- POLIVY, J. & HERMAN, C. P. 2002. Causes of eating disorders. *Annual Review of Psychology*, 53, 187-213.
- POSNER, S. F., JOHNSON, K., PARKER, C., ATRASH, H. & BIERMANN, J. 2006. The national summit on preconception care: a summary of concepts and recommendations. *Maternal and Child Health Journal*, 10, 199-207.
- POYASTRO PINHEIRO, A., THORNTON, L. M., PLOTONICOV, K. H., TOZZI, F., KLUMP, K. L., BERRETTINI, W. H., BRANDT, H., CRAWFORD, S., CROW, S. & FICHTER, M. M., GOLDMAN, D., HALMI, K. A., JOHNSON, C., KAPLAN, A. S., KEEL, P., LA VIA, M., MITCHELL, J., ROTONDO, A., STROBERM M., TREASURE, J., WOODSIDE, D. B., VON HOLLE, A., HAMER, R., KAYE, W. H. & BULIK, C. M. 2007. Patterns of menstrual disturbance in eating disorders. *International Journal of Eating Disorders*, 40, 424-434.
- PRACTICE COMMITTEE OF THE AMERICAN SOCIETY FOR REPRODUCTIVE MEDCINE, 2015. Obesity and reproduction: a committee opinion. *Fertility and Sterility*, 104, 1116-1126.
- PREACHER, K. J. & HAYES, A. F. 2004. SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers*, 36, 717-731.

- PUHL, R. & SUH, Y. 2015. Stigma and eating and weight disorders. *Current Psychiatry Reports*, 17, 552. doi: 10.1007/s11920-015-0552-6
- PUHL, R. M. & HEUER, C. A. 2010. Obesity stigma: important considerations for public health. *American Journal of Public Health*, 100, 1019-1028.
- PUHL, R. M., MOSS-RACUSIN, C. A., SCHWARTZ, M. B. & BROWNELL, K. D. 2007. Weight stigmatization and bias reduction: perspectives of overweight and obese adults. *Health Education Research*, 23, 347-358.
- RAMACCIOTTI, C. E., COLI, E., BONDI, E., BURGALASSI, A., MASSIMETTI, G. & DELL'OSSO, L. 2008. Shared psychopathology in obese subjects with and without binge-eating disorder. *International Journal of Eating Disorders*, 41, 643-649.
- RAZZOLI, M., PEARSON, C., CROW, S. & BARTOLOMUCCI, A. 2017. Stress, overeating, and obesity: Insights from human studies and preclinical models. *Neuroscience & Biobehavioral Reviews*, 76, 154-162.
- REAS, D. L., GRILO, C. M. & MASHEB, R. M. 2006. Reliability of the Eating Disorder Examination-Questionnaire in patients with binge eating disorder. *Behaviour Research and Therapy*, 44, 43-51.
- RØ, Ø., REAS, D. L. & STEDAL, K. 2015. Eating Disorder Examination Questionnaire (EDE-Q) in Norwegian adults: Discrimination between female controls and eating disorder patients. *European Eating Disorders Review*, 23, 408-412.
- ROBERTS, C. J., CAMPBELL, I. C. & TROOP, N. 2014. Increases in weight during chronic stress are partially associated with a switch in food choice towards increased carbohydrate and saturated fat intake. *European Eating Disorders Review*, 22, 77-82.
- RODINO, I. S., BYRNE, S. & SANDERS, K. A. 2016a. Disordered eating attitudes and exercise in women undergoing fertility treatment. *Australian and New Zealand Journal of Obstetrics and Gynaecology*, 56, 82-87.
- RODINO, I. S., BYRNE, S. & SANDERS, K. A. 2016b. Obesity and psychological wellbeing in patients undergoing fertility treatment. *Reproductive Biomedicine Online*, 32, 104-112.
- RODINO, I. S., BYRNE, S. M. & SANDERS, K. A. 2017. Eating disorders in the context of preconception care: fertility specialists' knowledge, attitudes, and clinical practices. *Fertility and Sterility*, 107, 494-501.
- RODINO, I.S., GIGNAC, G. E., SANDERS, K. A. 2018. Stress has a direct and indirect effect on eating pathology in infertile women: avoidant coping style as a mediator. *Reproductive Biomedicine and Society Online*, 5, 110-118.
- ROONEY, K. L. & DOMAR, A. D. 2014. The impact of lifestyle behaviors on infertility treatment outcome. *Current Opinion in Obstetrics and Gynecology*, 26, 181-185.
- ROSENBAUM, M. & LEIBEL, R.L. 2014. 20 years of leptin: role of leptin in energy homeostasis in human. *Journal of Endocrinology*, 223, T83-T96.

- ROSENBERG, M. 1965. *Society and the Adolescent Self-Image*. Princeton University Press, Princeton, New Jersey.
- ROSEVINGE, J. H., SKARDERUD, F. & THUNE-LARSEN, K. 2003. Can educational programmes raise clinical competence in treating disorders? Results from a Norwegian trial. *European Eating Disorders Review*, 11, 329-343.
- ROWE, E. 2017. Early detection of eating disorders in general practice. *Australian Family Physician*, 46, 833-838.
- ROYAL AUSTRALIAN AND NEW ZEALAND COLLEGE OF OBSTETRICS AND GYNAECOLOGY Activities Report, East Melbourne, Victoria. <https://www.ranzcog.edu.au/RANZCOG-MEDIA/Governance/Final-Copy-30-April-2015-2014-Activities-Report>. Accessed 21st November 2016.
- ROYAL COLLEGE OF AUSTRALIAN AND NEW ZEALAND COLLEGE OF OBSTETRICIANS AND GYNAECOLOGISTS – Guideline C-Ob(s) [49], 2013. <https://www.ranzcog.edu.au/Statements-Guidelines>. Accessed 22nd March, 2016.
- ROYAL AUSTRALIAN AND NEW ZEALAND COLLEGE OF PSYCHIATRISTS. 2014. Royal Australian and New Zealand College of Psychiatrists clinical practice guidelines for the treatment of eating disorders. *Australian and New Zealand Journal of Psychiatry*, 48, 1-62.
- RUSSELL, G. 1979. Bulimia nervosa: an ominous variant of anorexia nervosa. *Psychological Medicine*, 9, 429-448.
- SASSAROLI, S. & RUGGIERO, G. M. 2005. The role of stress in the association between low self-esteem, perfectionism, and worry, and eating disorders. *International Journal of Eating Disorders*, 37, 135-141.
- SAVAGE, J. S. & BIRCH, L. L. 2010. Patterns of weight control strategies predict differences in women's 4-year weight gain. *Obesity*, 18, 513-520.
- SBARAGLI, C., MORGANTE, G., GORACCI, A., HOFKENS, T., DE LEO, V. & CASTROGIOVANNI, P. 2008. Infertility and psychiatric morbidity. *Fertility and Sterility*, 90, 2107-2111.
- SCHEIER, M. F. & CARVER, C. S. 1988. A model of behavioral self-regulation: Translating intention into action. *Advances in Experimental Social Psychology*, 21, 300-346.
- SCHEID, J. L. & DE SOUZA, M. J. 2010. Menstrual irregularities and energy deficiency in physically active women: the role of ghrelin, PYY and adipocytokines. *Medicine and Sport Science*, 55, 82-102.
- SCHEURS, P. J. G., WILIGE, G., VAN DE BROSSCHOT, J. F., TELLEGEN, B. & GRAUS, G. M. H. 1993. *The Utrecht Coping List: Dealing with Problems and Situations: Reviewed Manual*. Swets & Zeitlinger, Lisse, The Netherlands.
- SCHMIDT, L. 2009. Social and psychological consequences of infertility and assisted reproduction—what are the research priorities? *Human Fertility*, 12, 14-20.

- SCHMIDT, L., HOLSTEIN, B., CHRISTENSEN, U. & BOIVIN, J. 2005a. Communication and coping as predictors of fertility problem stress: cohort study of 816 participants who did not achieve a delivery after 12 months of fertility treatment. *Human Reproduction*, 20, 3248-3256.
- SCHMIDT, L., HOLSTEIN, B., CHRISTENSEN, U. & BOIVIN, J. 2005b. Does infertility cause marital benefit? An epidemiological study of 2250 women and men in fertility treatment. *Patient Education and Counseling*, 59, 244-251.
- SCHMIDT, U. 2002. Risk factors for eating disorders. In CG Fairburn and KD Brownell (Eds.) *Eating Disorders and Obesity: A Comprehensive Handbook*, 2nd Edn. Guildford Press, New York, pp. 247-250.
- SCHMIDT, U. & TREASURE, J. 2006. Anorexia nervosa: Valued and visible. A cognitive-interpersonal maintenance model and its implications for research and practice. *British Journal of Clinical Psychology*, 45, 343-366.
- SCHNEIDER, J. E. 2004. Energy balance and reproduction. *Physiology & Behavior*, 81, 289-317.
- SCHNEIDER, L. F. & WARREN, M. P. 2006. Functional hypothalamic amenorrhea is associated with elevated ghrelin and disordered eating. *Fertility and Sterility*, 86, 1744-1749.
- SCHNEIDERMAN, N., IRONSON, G. & SIEGEL, S. D. 2005. Stress and health: psychological, behavioral, and biological determinants. *Annual Review Clinical Psychology*, 1, 607-628.
- SCHULZ, S. & LAESSLE, R. 2010. Associations of negative affect and eating behaviour in obese women with and without binge eating disorder. *Eating and Weight Disorders*, 15, e287-e293.
- SCHWARTZ, M. W., PESKIND, E., RASKIND, M., BOYKO, E. J. & PORTE JR, D. 1996. Cerebrospinal fluid leptin levels: relationship to plasma levels and to adiposity in humans. *Nature Medicine*, 2, 589-593.
- SCHWARZER, R. & KNOLL, N. 2007. Functional roles of social support within the stress and coping process: A theoretical and empirical overview. *International Journal of Psychology*, 42, 243-252.
- SCHWEIGER U., LAESSLE, R. G., TUSCHL, R. J., BROOCKS, A., KRUSCHE, T. & PIRKE, K. M. 1989. Decreased follicular phase gonadotropin secretion is associated with impaired estradiol and progesterone secretion during the follicular and luteal phases in normally menstruating women. *The Journal of Clinical Endocrinology & Metabolism*, 68, 888-892.
- SCHWEIGER, U., SCHWEIGER, J. U. & SCHWEIGER, J. I. 2018. Mental disorders and female infertility. *Archives of Psychology*, 2, 1-14.
- SHAFRAN, R., COOPER, Z. & FAIRBURN, C. G. 2002. Clinical perfectionism: A cognitive-behavioural analysis. *Behaviour Research and Therapy*, 40, 773-791.
- SHAFRAN, R., EGAN, S. & WADE, T. 2010. *Overcoming Perfectionism: A Self-Help Guide Using Cognitive Behavioural Techniques*. 2nd edn. Robinson, London, UK.

- SHEA, M. E. & PRITCHARD, M. E. 2007. Is self-esteem the primary predictor of disordered eating? *Personality and Individual Differences*, 42, 1527-1537.
- SHIMIZU, H., OH, S., OKADA, S. & MORI, M. 2007. Leptin resistance and obesity. *Endocrine Journal*, 54, 17-26.
- SINGHAL, V., MISRA, M. & KLIBANSKI, A. 2014. Endocrinology of anorexia nervosa in young people: recent insights. *Current Opinion in Endocrinology, Diabetes, and Obesity*, 21, 64-70.
- SKINNER, E. A., EDGE, K., ALTMAN, J. & SHERWOOD, H. 2003. Searching for the structure of coping: a review and critique of category systems for classifying ways of coping. *Psychological Bulletin*, 129, 216-269.
- SLIWOWSKA, J. H., FERGANI, C., GAWALEK, M., SKOWRONSKA, B., FICHNA, P. & LEHMAN, M. N. 2014. Insulin: its role in the central control of reproduction. *Physiology & Behavior*, 133, 197-206.
- SLOBODA, D. M., HICKEY, M. & HART, R. 2011. Reproduction in females: the role of the early life environment. *Human Reproduction Update*, 17, 210-227.
- SOH, N. L.-W. & WALTER, G. 2013. Publications on cross-cultural aspects of eating disorders. *Journal of Eating Disorders*, 1, 4, doi: 10.1186/2050-2974-1-4.
- SOLLID, C. P., WISBORG, K., HJORT, J. & SECHER, N. J. 2004. Eating disorder that was diagnosed before pregnancy and pregnancy outcome. *American Journal of Obstetrics & Gynecology*, 190, 206-210.
- SPEROFF, L. & FRITZ, M.A. 2005. *Clinical Gynecologic Endocrinology and Infertility*. 7th edn. Lippincott Williams & Wilkins, USA.
- SPIELBERGER, C. D. 1989. *Manual for the State-Trait Anxiety Inventory (Form Y)*, Consulting Psychologists Press Inc., Palo Alto, CA.
- SPOOR, S. T., BEKKER, M. H., VAN STRIEN, T. & VAN HECK, G. L. 2007. Relations between negative affect, coping, and emotional eating. *Appetite*, 48, 368-376.
- STEELE, A. L., WAITE, S., EGAN, S. J., FINNIGAN, J., HANDLEY, A. & WADE, T. D. 2013. Psycho-education and group cognitive-behavioural therapy for clinical perfectionism: a case-series evaluation. *Behavioural and Cognitive Psychotherapy*, 41, 129-143.
- STEWART, D. E., ROBINSON, E., GOLDBLOOM, D. S. & WRIGHT, C. 1990. Infertility and eating disorders. *American Journal of Obstetrics & Gynecology*, 163, 1196-1199.
- STICE, E. 2002. Risk and maintenance factors for eating pathology: a meta-analytic review. *Psychological Bulletin*, 128, 825-848.
- STICE, E., AGRAS, W. S., TELCH, C. F., HALMI, K. A., MITCHELL, J. E. & WILSON, T. 2001. Subtyping binge eating-disordered women along dieting and negative affect dimensions. *International Journal of Eating Disorders*, 30, 11-27.

- STICE, E., HAYWARD, C., CAMERON, R. P., KILLEN, J. D. & TAYLOR, C. B. 2000. Body-image and eating disturbances predict onset of depression among female adolescents: a longitudinal study. *Journal of Abnormal Psychology*, 109, 438-444.
- STICE, E., MARTI, C. N. & DURANT, S. 2011. Risk factors for onset of eating disorders: Evidence of multiple risk pathways from an 8-year prospective study. *Behaviour Research and Therapy*, 49, 622-627.
- STICE, E., MARTI, C. N., SHAW, H., JACONIS, M. 2009. An 8-year longitudinal study of history of threshold, subthreshold, and partial eating disorders from a community sample of adolescents. *Journal of Abnormal Psychology*, 118, 587-597.
- STICE, E. & SHAW, H. E. 2002. Role of body dissatisfaction in the onset and maintenance of eating pathology: A synthesis of research findings. *Journal of Psychosomatic Research*, 53, 985-993.
- STOMMEL, M. & OSIER, N. 2013. Temporal changes in bias of body mass index scores based on self-reported height and weight. *International Journal of Obesity (Lond)*, 37, 461-467.
- STRAHAN, E. J., SPENCER, S. J. & ZANNA, M. P. 2007. Don't take another bite: how socio-cultural norms for appearance affect women's eating behaviour. *Body Image*, 4, 331-342.
- STRIEGEL-MOORE, R. H. & BULIK, C. M. 2007. Risk factors for eating disorders. *American Psychologist*, 62, 181-198.
- STUNKARD, A. J. 1959. Eating patterns and obesity. *Psychiatric Quarterly*, 33, 284-295.
- STUNKARD, A. J., FAITH, M. S. & ALLISON, K. 2003. Depression and obesity. *Biological Psychiatry*, 54, 330-337.
- SULKOWSKI, M. L., DEMPSEY, J. & DEMPSEY, A. G. 2011. Effects of stress and coping on binge eating in female college students. *Eating Behaviors*, 12, 188-191.
- TABACHNICK, B. G. & FIDELL, L. S. 2001. *Using Multivariate Statistics*. Allyn and Bacon. Needham Heights.
- TABLER, J., UTZ, R. L., SMITH, K. R., HANSON, H. A. & GEIST, C. 2018. Variation in reproductive outcomes of women with histories of bulimia nervosa, anorexia nervosa, or eating disorder not otherwise specified relative to the general population and closest-aged sisters. *International Journal of Eating Disorders*, 51, 102-111.
- TANIGUCHI, C. M., EMANUELLI, B. & KAHN, C. R. 2006. Critical nodes in signalling pathways: insights into insulin action. *Nature Reviews Molecular Cell Biology*, 7, 85-96.
- TANTLEFF-DUNN, S., BARNES, R. D. & LAROSE, J. G. 2011. It's not just a "woman thing:" The current state of normative discontent. *Eating Disorders*, 19, 392-402.
- TARANIS, L., TOUYZ, S. & MEYER, C. 2011. Disordered eating and exercise: development and preliminary validation of the compulsive exercise test (CET). *European Eating Disorders Review*, 19, 256-268.

- TEEDE, H., DEEKS, A. & MORAN, L. 2010. Polycystic ovary syndrome: a complex condition with psychological, reproductive and metabolic manifestations that impacts on health across the lifespan. *BMC Medicine*, 8, 41 doi: 10.1186/1741-7015-8-41.
- TERRY, D. J. & HYNES, G. J. 1998. Adjustment to a low-control situation: Re-examining the role of coping responses. *Journal of Personality and Social Psychology*, 74, 1078-1092.
- THOITS, P. A. 1995. Stress, coping, and social support processes: Where are we? What next? *Journal of Health and Social Behavior*, 35, 53-79.
- THOME, J. L. & ESPELAGE, D. L. 2007. Obligatory exercise and eating pathology in college females: replication and development of a structural model. *Eating Behaviors*, 8, 334-349.
- THOMPSON-BRENNER, H., SATIR, D.A., FRANKO, D.L. & HERZOG, D.B. 2012. Clinician reactions to patients with eating disorders: a review of the literature. *Psychiatric Services*, 63, 73-78.
- TIGGEMANN, M. 2004. Body image across the adult life span: Stability and change. *Body Image*, 1, 29-41.
- TOFTAGER, M., SYLVEST, R., SCHMIDT, L., BOGSTAD, J., LØSSL, K., PRÆTORIUS, L., ZEDELER, A., BRYNDORF, T. & PINBORG, A. 2018. Quality of life and psychosocial and physical well-being among 1,023 women during their first assisted reproductive technology treatment: secondary outcome to a randomized controlled trial comparing gonadotropin-releasing hormone (GnRH) antagonist and GnRH agonist protocols. *Fertility and Sterility*, 109, 154-164.
- TRENT, M., AUSTIN, S. B., RICH, M. & GORDON, C. M. 2005. Overweight status of adolescent girls with polycystic ovary syndrome: body mass index as mediator of quality of life. *Ambulatory Pediatrics*, 5, 107-111.
- TROOP, N. A., HOLBREY, A., TROWLER, R. & TREASURE, J. L. 1994. Ways of coping in women with eating disorders. *Journal of Nervous and Mental Disease*, 182, 535-540.
- ÜNLÜTÜRK, U., SEZGIN, E. & YILDIZ, B. O. 2016. Evolutionary determinants of polycystic ovary syndrome: part 1. *Fertility and Sterility*, 106, 33-41.
- UNUANE, D., TOURNAYE, H., VELKENIERS, B. & POPPE, K. 2011. Endocrine disorders & female infertility. *Best Practice & Research Clinical Endocrinology & Metabolism*, 25, 861-873.
- USDAN, L., KHAODHIAR, L. & APOVIAN, C. 2008. The endocrinopathies of anorexia nervosa. *Endocrine Practice*, 14, 1055-1063.
- VAN DEN BROECK, U., D'HOOGHE, T., ENZLIN, P. & DEMYTTENAERE, K. 2010. Predictors of psychological distress in patients starting IVF treatment: infertility-specific versus general psychological characteristics. *Human Reproduction*, 25, 1471-1480.
- VAN ECK, M. M.M & NICHOLSON, N. A. 1994. Perceived stress and salivary cortisol in daily life. *Annual Behavioural Medicine*, 16, 221-227.

- VANDEREYCKEN, W. & VAN HUMBEECK, I. 2008. Denial and concealment of eating disorders: a retrospective survey. *European Eating Disorders Review*, 16, 109-114.
- VARTANIAN, L. R. & PORTER, A. M. 2016. Weight stigma and eating behavior: a review of the literature. *Appetite*, 102, 3-14.
- VELTMAN-VERHULST, S. M., BOIVIN, J., EIJKEMANS, M. J. & FAUSER, B. J. 2012. Emotional distress is a common risk in women with polycystic ovary syndrome: a systematic review and meta-analysis of 28 studies. *Human Reproduction Update*, 18, 638-651.
- VERHAAK, C. M., LINSTEN, A. M. E., EVERS, A. W. M. & BRAAT, D. D. M. 2010. Who is at risk of emotional problems and how do you know? Screening of women going for IVF treatment. *Human Reproduction Update*, 25, 1234-1240.
- VERHAAK, C. M., SMEENK, J., EVERS, A. W., KREMER, J.A., KRAAIMAAT, F. W. & BRAAT, D.D.M. 2007. Women's emotional adjustment to IVF: a systematic review of 25 years of research. *Human Reproduction Update*, 13, 27-36.
- VERHAAK, C. M., SMEENK, J. M. J., EVERS, A. W. M., VAN MINNEN, A., KREMER, J. A. M. & KRAAIMAAT, F. W. 2005. Predicting emotional response to unsuccessful fertility treatment: a prospective study. *Journal of Behavioral Medicine*, 28, 181-190.
- VITZTHUM, V. J. 2009. The ecology and evolutionary endocrinology of reproduction in the human female. *American Journal of Physical Anthropology*, 140, 95-136.
- VOLAND, E. 1998. Evolutionary ecology of human reproduction. *Annual Review of Anthropology*, 27, 347-374.
- WADE, G. N. & JONES, J. E. 2004. Neuroendocrinology of nutritional infertility. *American Journal of Physiology-Regulatory, Integrative and Comparative Physiology*, 287, R1277-R1296.
- WADE, G. N., SCHNEIDER, J. E. & LI, H. 1996. Control of fertility by metabolic cues. *American Journal of Physiology-Endocrinology And Metabolism*, 270, E1-E19.
- WADE, T., TIGGEMANN, M., MARTIN, N. G. & HEATH, A. C. 1997. Characteristics of interview refusers: women who decline to participate in interviews relating to eating. *International Journal of Eating Disorders*, 22, 95-99.
- WADE, T. D., BERGIN, J. L., TIGGEMANN, M., BULIK, C. M. & FAIRBURN, C. G. 2006. Prevalence and long-term course of lifetime eating disorders in an adult Australian twin cohort. *Australian and New Zealand Journal of Psychiatry*, 40, 121-128.
- WANG, J.-Y., LI, Y.-S., CHEN, J.-D., LIANG, W.-M., YANG, T.-C., LEE, Y.-C. & WANG, C.-W. 2015. Investigating the relationships among stressors, stress level, and mental symptoms for infertile patients: a structural equation modeling approach. *PloS One*, 10, e0140581.
- WARREN, M. P. & FRIED, J. L. 2001. Hypothalamic amenorrhea: the effects of environmental stresses on the reproductive system: a central effect of the central nervous system. *Endocrinology and Metabolism Clinics*, 30, 611-629.

- WASHINGTON, R. L. 2011. Childhood obesity: Issues of weight bias. Preventing chronic disease, *Public Health, Research, Practice and Policy*, 8, A94.
- WATSON, D., CLARK, L. A. & TELLEGEN, A. 1988. Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology*, 54, 1063-1070.
- WATSON, H. J., TORGERSEN, I., ZERWAS, S., REICHBORN-KJENNERUD, T., KNOPH, C., STOLTENBERG, C., SIEGA-RIZ, A-M., VON HOLLE, A., HAMER, R. M., MELTZER, H., FERGUSON, E. H., HAUGEN, M., MAGNUS, P., KUHNS, R. & BULIK, C. M. 2014. Eating disorders, pregnancy, and the postpartum period: findings from the Norwegian Mother and Child Cohort Study (MoBa). *Norwegian Journal of Epidemiology*, 24, 51-62.
- WILKSCH, S. M. & WADE, T. D. 2010. Risk factors for clinically significant importance of shape and weight in adolescent girls. *Journal of Abnormal Psychology*, 119, 206-215.
- WILLIAMS, M. & LEICHTNER, P. 2006. More training needed in eating disorders: a time cohort comparison study of Canadian psychiatry residents. *Eating Disorders*, 14, 323-334.
- WILLIAMS, N., REED, J., LEIDY, H., LEGRO, R. & DE SOUZA, M. 2010. Estrogen and progesterone exposure is reduced in response to energy deficiency in women aged 25–40 years. *Human Reproduction*, 25, 2328-2339.
- WILSON, J. & KOPITZKE, E. 2002. Stress and infertility. *Current Women's Health Reports*, 2, 194-199.
- WILSON, G. T., WILFREY, D. E., AGRAS, W. S., BRYSON, S. W. 2010. Psychological treatments of binge eating disorder. *Archives of General Psychiatry*, 67, 94-101.
- WORLD HEALTH ORGANIZATION. 1992. *International statistical classification of diseases and related health problems*, 10th revision (ICD-10). World Health Organization, Geneva.
- WORLD HEALTH ORGANIZATION. 2000. *Obesity: Preventing and Managing the Global Epidemic*. Report of a WHO consultation. WHO Technical Report Series: 894. WHO, Geneva.
- WORLD HEALTH ORGANIZATION. 2009. *Global Health Risks: Mortality and Burden of Disease Attributable to Selected Major Risks*. World Health Organization, Genova ISBN 978 92 4 156387 1.
- WU, Y. K. & BERRY, D. C. 2018. Impact of weight stigma on physiological and psychological health outcomes for overweight and obese adults: A systematic review. *Journal of Advanced Nursing*, 74, 1030-1042.
- YOUNG, S., TOUYZ, S., MEYER, C., ARCELUS, J., RHODES, P., MADDEN, S., PIKE, K., ATTIA, E., CROSBY, R. D. & WALES, J. 2017. Validity of exercise measures in adults with Anorexia Nervosa: The EDE, Compulsive Exercise Test and other self-report scales. *International Journal of Eating Disorders*, 50, 533-541.

- YU, Y. & SHERMAN, K. A. 2015. Communication avoidance, coping and psychological distress of women with breast cancer. *Journal of Behavioral Medicine*, 38, 565-577.
- ZEGERS-HOCHSCHILD, F., ADAMNSON, G.D., DYER, S., RACOWSKY, C., DE MOUZON, J., SOKOL, R., RIENZI, L., SUNDE, A., SCHMIDT, L., COOKE, I.D., SIMPSON, J.L., VAN DER POEL, S. 2017. The international glossary on infertility and fertility care, 2017. *Fertility and Sterility*, 108, 393-406.
- ZEGERS-HOCHSCHILD, F., ADAMSON, G. D., DE MOUZON, J., ISHIHARA, O., MANSOUR, R., NYGREN, K., SULLIVAN, E. & VAN DER POEL, S. 2009. The international committee for monitoring assisted reproductive technology (ICMART) and the world health organization (WHO) revised glossary on ART terminology, 2009. *Human Reproduction*, 24, 2683-2687.
- ZURLO, M. C., DELLA VOLTA, M. F. C. & VALLONE, F. 2018. Predictors of quality of life and psychological health in infertile couples: the moderating role of duration of infertility. *Quality of Life Research*, 27, 945-954.

APPENDIX A – Project One

Appendix A outlines the questionnaires used in *Studies One to Three*.

The battery consisted of the following

- (1) Cover page
- (2) Participant Information Sheet
- (3) Questionnaires
 - Survey A: Demographics
 - Survey B: Eating Disorder Examination Questionnaire (EDE-Q)
 - Survey C: International Physical Activity Questionnaire (IPAQ)
 - Survey D: Rosenberg Self Esteem Scale (RSES)
 - Survey E: Positive and Negative Affect Schedule (PANAS)
 - Survey F: Depression Anxiety and Stress Scale – 21 Items (DASS-21)
 - Survey G: Fertility Problem Inventory (FPI)
 - Survey H: Clinical Perfectionism Questionnaire (CPQ)
 - Survey I: Brief COPE
 - Survey J: Perceived Stress Scale (PSS)
- (4) Participant Debriefing Sheet

COVER PAGE



THE UNIVERSITY OF
WESTERN AUSTRALIA
Achieve International Excellence

Questionnaire

How do mood, behaviour and stress interact to affect fertility?



If you have any queries or concerns please contact one of the research staff members:

Iolanda Rodino
Project Researcher
ph: 9389 7212
iolanda@perthivf.com

Dr Susan Byrne
Project Supervisor
ph: 6488 3579
sue.byrne@uwa.edu.au

Dr Kathy Sanders
Project Supervisor
ph: 6488 1527
kathy.sanders@uwa.edu.au



THE UNIVERSITY OF
WESTERN AUSTRALIA
Achieve International Excellence

Associate Professor Susan Byrne
School of Psychology
The University of Western Australia
Mailbag M304
35 Stirling Highway
Crawley WA 6009
AUSTRALIA

Phone +61 8 6488 3579
Email sue.byrne@uwa.edu.au

Participant Information Sheet

Psychosocial Factors and Fertility Study

This information sheet is about a study that is being conducted at The University of Western Australia by Ms Iolanda Rodino, who is a PhD student in the schools of Psychology and Anatomy and Human Biology. This research is being conducted under the supervision of Associate Professor Susan Byrne and Assistant Professor Kathy Sanders.

This study is investigating how mood, behaviours and stress interact to affect fertility. The study aims to gain a better understanding of the lifestyle, psychological and social factors impacting on fertility treatment. In the future, we hope to use the information gained from this research to help people who receive fertility treatment to achieve better treatment outcomes.

What Participation in the Study Involves

Participating in this study involves completing a booklet of questionnaires. The questions contained within this booklet relate to a range of lifestyle factors and different types of feelings and behaviours that many people undergoing fertility treatment may experience. Most of the questions can be answered very simply by ticking a box. We would greatly appreciate it if you could try to respond to all questions as accurately as you can. It is best not to think about each question for too long, and to trust your initial reaction. Please be assured that there are no right or wrong answers, and that the information you provide will be contributing to a study involving more than 300 other women undergoing similar types of fertility treatment.

- ◆ Most of the questions can be answered with a tick.
- ◆ Please answer every question.
- ◆ The questionnaire pack will take about 1 hour to complete.
- ◆ Please return the completed questionnaire in the enclosed postage paid envelope
- ◆ You are not required to write your name or address on the questionnaires or return envelope

Benefits of the Study

Whilst there is no guarantee that you will personally benefit from participating in this study, the knowledge gained may help individuals undergoing fertility treatment in the future. For example, the study may assist in identifying factors that might predict a successful or unsuccessful fertility treatment outcome.

Risks of the Study

There are no anticipated risks involved in participating in this study however if you have any concerns that arise from completing the questionnaire it is recommended that you speak to your Fertility Specialist, your family doctor or contact Iolanda Rodino, Clinical Psychologist on 9389 7212 or Associate Professor Susan Byrne on 6488 3579 who can link you into support services.

What will be done with the information?

The questionnaires you complete require you to remain anonymous so you do not have to provide your name or contact details. The information obtained from the questionnaires will be kept confidential and only be used for the purpose of this project. Responses from all participants will be grouped and analysed together rather than being examined individually. The information that you provide may be published in scientific journals but your anonymity will be preserved at all times.

Participation Statement

By proceeding to complete the questionnaire package I acknowledge that:

- ◆ I have understood the information given to me about this study
- ◆ I can contact Iolanda Rodino, Clinical Psychologist, for clarification of any aspect of the study
- ◆ That completion and return of the questionnaires is considered evidence of consent to participate in the study

Thank you for your willingness to participate in this research and
for completing these questionnaires.

If you would like to discuss any of the issues raised in these questionnaires please do not hesitate to contact:

Ms Iolanda Rodino:	The University of Western Australia Tel: 9389 7212 Email: iolanda@perthivf.com
--------------------	--

Associate Professor Susan Byrne:	The University of Western Australia Tel: 6488 3579 Email: sue.byrne@uwa.edu.au
----------------------------------	--

Dr Kathy Sanders:	The University of Western Australia Tel: 6488 1527 Email: kathy.sanders@uwa.edu.au
-------------------	--

Approval to conduct this research has been provided by The University of Western Australia, in accordance with its ethics review and approval procedures. Any person considering participation in this research project, or agreeing to participate, may raise questions or issues with the researchers at any time.

In addition, any person not satisfied with the response of researchers may raise ethics issues or concerns, and may make any complaints about this research project by contacting the Human Research Ethics Office at The University of Western Australia on (08) 6488 3703 or by emailing to hreo-research@uwa.edu.au. All research participants are entitled to remove and retain a copy of any Participant Information Form relating to this research project.

PSYCHOSOCIAL FACTORS AND FERTILITY STUDY

SURVEY A - Demographics

Today's Date ____/____/____

1. Fertility Treatment (Please circle the treatment that you are currently undergoing)

Tracking

IUI (Natural Cycle)

IVF (Fresh Collection Cycle)

IVF (Frozen Transfer Cycle)

IUI (Stimulated Cycle)

ICSI (Fresh Collection Cycle)

ICSI (Frozen Transfer Cycle)

2. Is this your First attempt at IVF/ICSI/IUI or a Repeat Cycle? Please state:

3. **DEMOGRAPHICS**

3a. Residential postcode _____

3b. Your Age: _____ 3c. Your partner's age: _____

4a. What is your current weight? _____ **kilograms**
OR _____ **stones** _____ **lbs**

4b. What is your partner's current weight? _____ **kilograms**
OR _____ **stones** _____ **lbs**

5a. What is your height? _____ **centimetres**
OR _____ **feet** _____ **inches**

5b. What is your partner's height? _____ **centimetres**
OR _____ **feet** _____ **inches**

6. First Language (Circle): **English or Other (If other please state: _____)**

7. What ethnic/cultural background are you from? Please state: (e.g. Australian, Vietnamese)

8. (a) Currently, I am: (b) Currently, I am: (mark all that apply)

- | | |
|---|--|
| <input type="checkbox"/> engaged | <input type="checkbox"/> living alone |
| <input type="checkbox"/> married | <input type="checkbox"/> living with a spouse/ partner |
| <input type="checkbox"/> de-facto | <input type="checkbox"/> living with a friend |
| <input type="checkbox"/> separated | <input type="checkbox"/> living with children |
| <input type="checkbox"/> divorced | <input type="checkbox"/> living with parents/step parents |
| <input type="checkbox"/> other (Please state) | <input type="checkbox"/> living with other relatives (e.g. sister) |

9. Highest level of education completed (please circle one)

<u>High School</u>	<u>TAFE / Apprenticeship</u>	<u>University</u>
Yr. 8 9 10 11 12		Bachelors/Honours/Masters/PhD

10. Do you currently have a full time or part time job of any kind excluding home duties?
Yes / No

a. How many hours a week do you currently work? (circle one)

< 10 10-20 21-30 31-40 41-50 > 50

b. What is your main occupation? (e.g. Home duties, lawyer, secretary) _____

c. Is this work: **Paid full time /Paid part time /Voluntary full time /Voluntary part time**

d. What is the total yearly pre-tax income of your current household (i.e. including a partner or parents if you live with them)?

a. less than \$30, 000	e. \$90, 000- \$110, 000
b. \$30, 000- \$50, 000	f. \$110, 000- \$130, 000
c. \$50, 000- \$70, 000	g. \$130, 000- \$150, 000
d. \$70, 000- \$90, 000	h. more than \$150, 000

The following questions are concerned with your reproductive history

11. How long have you been trying to have a baby? _____ years _____ months

12. Fertility Issue (Tick all Reasons)

- | | | |
|---|---|--|
| <input type="checkbox"/> Male Factor | <input type="checkbox"/> Unexplained | <input type="checkbox"/> Don't Ovulate |
| <input type="checkbox"/> Female Factor | <input type="checkbox"/> Blocked Tubes | <input type="checkbox"/> Chromosome Issue |
| <input type="checkbox"/> Endometriosis | <input type="checkbox"/> Irregular Periods | <input type="checkbox"/> Premature Ovarian Failure (POF) |
| <input type="checkbox"/> Fibroids | <input type="checkbox"/> PCOS (On Metformin) | <input type="checkbox"/> PCOS (No Metformin) |
| <input type="checkbox"/> Sexual Functioning (Circle male or female) | <input type="checkbox"/> Other issue: Please specify: | |

The following questions are concerned with your lifestyle

13. (a) Do you regularly exercise or play sport?

Yes **No**

(b) How many hours of exercise/sport do you play on average a week? _____

14. Are you currently taking any medications? **Yes** **No**

If Yes, please specify _____

15. (a) Over the last 3 months have you had a change in weight?

No change in weight

Gain in weight **Number of kg gained** _____ **kg** **or** _____ **lbs**

Loss in weight **Number of kg lost** _____ **kg** **or** _____ **lbs**

(b) What was your weight 1 year ago? _____

How certain are you about this weight? Please circle: sure/not sure

16. Do you smoke cigarettes? **Yes** **No**

If Yes, (a) how often do you smoke cigarettes? (Please circle)

(i) Never (ii) Every Day (iii) 2-6 Days (iv) Monthly (v) Only on social occasions

(b) On average, on those occasions when you smoke, how many cigarettes do you smoke?

(Please circle)

(i) Less than 1 cigarette (ii) 1-9 cigarettes (iii) 10-20 cigarettes (iv) 20+ cigarettes

17. Have you ever had any problems at any time with depression, anxiety, or other emotions that disrupt your normal functioning? (Circle one). **Yes or No**

18. (a) Do you currently have an eating disorder? Circle: **Yes or No**

(b) If Yes what type: Circle: **(i) anorexia nervosa (ii) bulimia nervosa**

(iii) binge eating disorder (iv) Other (Specify Other Type: _____)

(c) Does your Fertility Specialist know you have this eating disorder? **Yes or No**

19. (a) Do you have a past history of eating disorder? Circle: **Yes or No**

(b) If Yes what type: Circle: **(i) anorexia nervosa (ii) bulimia nervosa**

(iii) binge eating disorder or iv) Other (Specify Other Type: _____)

(c) If yes when? **(i) 0- 6months ago (ii) 6 to 12months ago (iii) 1 – 2 years ago**

(iv) more than 2 years ago OR v) as a teenager

d) Does your Fertility Specialist know about this past history of eating disorder? **Yes or No**

20. (a) On average, how often do you consume alcoholic beverages of any kind?

(i) Never (ii) Every Day (iii) Less than 6 days a week (iv) Monthly (v) Only on social occasions

(b) If you drink alcohol, on average, how many “drinks” do you have each time or occasion when you drink alcoholic beverages? Please state: _____

21. (a) On average how many hours do you sleep each night? _____

(b) Circle: Is your sleep – **very restless/restless/average/sound/very sound?**

22. How would you rate your general physical health? (Please circle)

(i)Very good (ii) Average (iii) Not that good (iv) Not good at all

23. Do you have any physical health problems? If yes please list:

SURVEY B – EDE-Q

Instructions: The following questions are concerned with the past four weeks (28 days) only. Please read each question carefully. Please answer all of the questions. Thank you.

Questions 1 to 12: Please circle the appropriate number on the right. Remember that the questions only refer to the past four weeks (28 days) only.

On how many of the past 28 days.....	<u>No</u> <u>Days</u>	<u>1-5</u> <u>days</u>	<u>6-12</u> <u>days</u>	<u>13-15</u> <u>Days</u>	<u>16-22</u> <u>days</u>	<u>23-27</u> <u>days</u>	<u>Every</u> <u>Day</u>
1. Have you been deliberately <u>trying</u> to limit the amount of food you eat to influence your shape or weight (whether or not you have succeeded)?	0	1	2	3	4	5	6
2. Have you gone for long periods of time (8 waking hours or more) without eating anything at all in order to influence your shape or weight?	0	1	2	3	4	5	6
3. Have you <u>tried</u> to exclude from your diet any foods that you like in order to influence your shape or weight (whether or not you have succeeded)?	0	1	2	3	4	5	6
4. Have you <u>tried</u> to follow definite rules regarding your eating (for example, a calorie limit) in order to influence your shape or weight (whether or not you have succeeded)?	0	1	2	3	4	5	6
5. Have you had a definite desire to have an <u>empty</u> stomach with the aim of influencing your shape or weight?	0	1	2	3	4	5	6
6. Have you had a definite desire to have a <u>totally flat</u> stomach?	0	1	2	3	4	5	6
7. Has thinking about <u>food, eating or calories</u> made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)?	0	1	2	3	4	5	6
8. Has thinking about <u>shape or weight</u> made it very difficult to concentrate on things you are interested in (for example, working, following a conversation, or reading)?	0	1	2	3	4	5	6
9. Have you had a definite fear of losing control over eating?	0	1	2	3	4	5	6
10. Have you had a definite fear that you might gain weight?	0	1	2	3	4	5	6
11. Have you felt fat?	0	1	2	3	4	5	6
12. Have you had a strong desire to lose weight?	0	1	2	3	4	5	6

Questions 13-18: Please fill the appropriate number on the right. Remember that the questions only refer to the past four weeks (28 days).

OVER THE PAST FOUR WEEKS (28 DAYS)...

13. Over the past 28 days, how many times have you eaten what other people would regard as an unusually large amount of food (given the circumstances)? _____

14. On how many of these times did you have a sense of having lost control over your eating (at the time that you were eating)? _____

15. Over the past 28 days, on how many DAYS have such episodes of overeating occurred (i.e. you have eaten an unusually large amount of food and have had a sense of loss of control at the time)? _____

16. Over the past 28 days, how many times have you made yourself sick (vomit) as a means of controlling your shape or weight? _____

17. Over the past 28 days, how many times have you taken laxatives as a means of controlling your shape or weight? _____

18. Over the past 28 days, how many times have you exercised in a “driven” or “compulsive” way as a means of controlling your weight, shape or amount of fat, or to burn off calories? _____

Questions 19-21: Please circle the appropriate number on the right. Please note that for these questions the term “binge eating” means what others would regard as an unusually large amount of food for the circumstances, accompanied by a sense of having lost control over eating.

19. Over the past 28 days, on how many days have you eaten in secret (i.e., furtively)?Do not count episodes of binge eating	No Days	1-5 Days	6-12 Days	13-15 Days	16-22 Days	23-27 Days	Every Day
	0	1	2	3	3	5	6
20. On what proportion of the times that you have eaten have you felt guilty (felt that you’ve done wrong) because of its effect on shape or weight?..... Do not count episodes of binge eating	None of the times	A few of the times	Less than half	Half of the times	More than half the time	Most of the time	Every time
	0	1	2	3	4	5	6
21. Over the past 28 days, how concerned have you been about other people seeing you eat? Do not count episodes of binge eating	Not at all	Slightly		Moderately		Markedly	
	0	1	2	3	4	5	6

Questions 22-28: Please circle the appropriate number on the right. Remember that the questions only refer to the past four weeks (28 days).

OVER THE PAST 28 DAYS.....	Not at all		Slightly		Moderately		Markedly	
22. Has your <u>weight</u> influenced how you think about (judge) yourself as a person?	0	1	2	3	4	5	6	
23. Has your <u>shape</u> influenced how you think about (judge) yourself as a person?	0	1	2	3	4	5	6	
24. How much would it upset you if you had been asked to weigh yourself once a week (no more, or less, often) for the next four weeks?	0	1	2	3	4	5	6	
25. How dissatisfied have you been with your <u>weight</u>?	0	1	2	3	4	5	6	
26. How dissatisfied have you been with your <u>shape</u>?	0	1	2	3	4	5	6	
27. How uncomfortable have you felt seeing your body (for example, seeing your shape in the mirror, in a shop window reflection, while undressing, or taking a bath or shower)?	0	1	2	3	4	5	6	
28. How uncomfortable have you felt about <u>others</u> seeing your body (for example, in communal changing rooms, when swimming, or wearing tight clothes)?	0	1	2	3	4	5	6	

29. Over the past three-to-four months have you missed any menstrual periods?

If so, how many? _____

SURVEY C - IPAQ

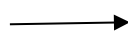
We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the times you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise and sport.

1. Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobic, or fast bicycling?

_____ **days per week**

No vigorous activities



Please skip to question 3

2. How much time in total did you usually spend on one of those days doing **vigorous** physical activities?

_____ **hours per day**

_____ **minutes per day**

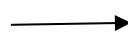
Don't know/not sure

3. Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

During **the last 7 days**, on how many days did you do moderate physical activities like carry light loads, bicycling at a regular pace, or double tennis? Do not include walking.

_____ **days per week**

No moderate activities



Please skip to question 5

4. How much time in total did you usually spend on one of those days doing **moderate** physical activities?

_____ **hours per day**

_____ **minutes per day**

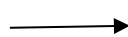
Don't know/not sure

5. Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you might do solely for recreation, sport, exercise, or leisure.

During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

_____ **days per week**

No walking



Please skip to question 7

6. How much time in total did you usually spend walking on one of those days?

_____ **hours per day**

_____ **minutes per day**

Don't know/not sure

7. The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, travelling on a bus, or sitting or lying down watching television.

During the last 7 days, how much time in total did you spend **sitting** on a **week day**?

_____ **hours per day**

_____ **minutes per day**

Don't know/not sure

SURVEY D - RSES

Below is a list of statements dealing with your general feelings about yourself. If you strongly agree, circle SA. If you agree with the statement, circle A. If you disagree, circle D. If you strongly disagree, circle SD.

	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE
1. On the whole, I am satisfied with myself.	SA	A	D	SD
2. At times, I think I am no good at all.	SA	A	D	SD
3. I feel that I have a number of good qualities.	SA	A	D	SD
4. I am able to do things as well as most other people.	SA	A	D	SD
5. I feel I do not have much to be proud of.	SA	A	D	SD
6. I certainly feel useless at times.	SA	A	D	SD
7. I feel that I'm a person of worth, at least on an equal plane with others.	SA	A	D	SD
8. I wish I could have more respect for myself.	SA	A	D	SD
9. All in all, I am inclined to feel that I am a failure.	SA	A	D	SD
10. I take a positive attitude towards myself.	SA	A	D	SD

SURVEY E – DASS-21

Please read each statement and tick the box which indicates how much the statement applied to you over the past week. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 = Did not apply to me at all

1 = Applied to me to some degree or some of the time

2 = Applied to me a considerable degree, or a good part of the time

3 = Applied to me very much, most of the time

	Not at All 0	Some Degree 1	Considerable Degree 2	Very Much 3
1) I found it hard to wind down.				
2) I was aware of dryness of my mouth.				
3) I couldn't seem to experience any positive feeling at all.				
4) I experienced breathing difficulty (e.g. excessively rapid breathing, breathlessness in the absence of physical exertion).				
5) I found it difficult to work up the initiative to do things.				
6) I tended to over-react to situations.				
7) I experienced trembling (e.g. in the hands).				
8) I felt that I was using a lot of nervous energy.				
9) I was worried about situations in which I might panic and make a fool of myself.				
10) I felt that I had nothing to look forward to.				
11) I found myself getting agitated.				
12) I found it difficult to relax.				

13) I felt down-hearted and blue.				
14) I was intolerant of anything that kept me from getting on with what I was doing.				
15) I felt I was close to panic.				
16) I was unable to become enthusiastic about anything.				
17) I felt I wasn't worth much as a person.				
18) I felt that I was rather touchy.				
19) I was aware of the action of my heart in the absence of physical exertion (e.g. sense of heart rate increase, heart missing a beat).				
20) I felt scared without any good reason.				
21) I felt that life was meaningless.				

SURVEY F - PANAS

Below is a list of words that describe feelings and emotions people have. Please read each word carefully. Then, for each word please indicate how much you feel like that ON AVERAGE by placing a tick in the appropriate box.

	Very slightly or not at all	A little	Moderately	Quite a bit	Very much
1. Attentive					
2. Strong					
3. Distressed					
4. Inspired					
5. Hostile					
6. Nervous					
7. Determined					
8. Scared					
9. Alert					
10. Upset					
11. Enthusiastic					
12. Proud					
13. Irritable					
14. Afraid					
15. Excited					
16. Guilty					
17. Interested					
18. Jittery					
19. Active					
20. Ashamed					

SURVEY G - FPI

The following statements express different opinions about a fertility problem. Please indicate how much you agree or disagree with each statement by ticking the appropriate box.

	Strongly disagree	Moderately disagree	Slightly disagree	Slightly agree	Moderately agree	Strongly agree
1. Couples without a child are just as happy as those with children.						
2. Pregnancy and childbirth are the two most important events in a couple's relationship.						
3. I find I've lost my enjoyment of sex because of the fertility problem.						
4. I feel just as attractive to my partner as before.						
5. For me, being a parent is a more important goal than having a satisfying career.						
6. My marriage needs a child (or another child).						
7. I don't feel any different from other members of my sex.						
8. It is hard to feel like a true adult until you have a child.						
9. It doesn't bother me when I'm asked questions about children.						
10. A future without a child (or another child) would frighten me.						
11. I can't show my partner how I feel because it will make him/her feel upset.						
12. Family don't seem to treat us any differently.						
13. I feel like I've failed at sex.						
14. The holidays are especially difficult for me.						

	Strongly disagree	Moderately disagree	Slightly disagree	Slightly agree	Moderately agree	Strongly agree
15. I could see a number of advantages if we didn't have a child (or another child).						
16. My partner doesn't understand the way the fertility problem affects me.						
17. During sex, all I can think about is wanting a child (or another child).						
18. My partner and I work well together handling questions about our infertility.						
19. I feel empty because of our fertility problem.						
20. I could visualize a happy life together, without a child (or another child).						
21. It bothers me that my partner reacts differently to the problem.						
22. Having sex is difficult because I don't want another disappointment.						
23. Having a child (or another child) is not the major focus of my life.						
24. My partner is quite disappointed with me.						
25. At times, I seriously wonder if I want a child (or another child).						
26. My partner and I could talk more openly with each other about our fertility problem.						
27. Family get-togethers are especially difficult for me.						
28. Not having a child (or another child) would allow me time to do other satisfying things.						
29. I have often felt that I was born to be a parent.						
30. I can't help comparing myself with friends who have children.						
31. Having a child (or another child) is not necessary for my happiness.						

	Strongly disagree	Moderately disagree	Slightly disagree	Slightly agree	Moderately agree	Strongly agree
32. If we miss a critical day to have sex, I can feel quite angry.						
33. I couldn't imagine us ever separating because of this.						
34. As long as I can remember, I've wanted to be a parent.						
35. I still have lots in common with friends who have children.						
36. When we try to talk about our fertility problem, it seems to lead to an argument.						
37. Sometimes I feel so much pressure, that having sex becomes difficult.						
38. We could have a long, happy relationship without a child (or another child).						
39. I find it hard to spend time with friends who have young children.						
40. When I see families with children I feel left out.						
41. There is a certain freedom without children that appeals to me.						
42. I will do just about anything to have a child (or another child).						
43. I feel like friends or family are leaving us behind.						
44. It doesn't bother me when others talk about their children.						
45. Because of infertility, I worry that my partner and I are drifting apart.						
46. When we talk about our fertility problem, my partner seems comforted by my comments.						

SURVEY H - CPQ

For each item please place a tick in the column below which best describes you over the past month.

	Item	Not at all	Some of the time	Most of the time	All of the time
1	Over the past month, have you pushed yourself really hard to meet your goals?				
2	Over the past month, have you tended to focus on what you <u>have</u> achieved, rather than on what you have not achieved?				
3	Over the past month, have you been told that your standards are too high?				
4	Over the past month, have you felt a failure as a person because you have not succeeded in meeting your goals?				
5	Over the past month, have you been afraid that you might not reach your standards?				
6	Over the past month, have you raised your standards because you thought they were too easy?				
7	Over the past month, have you judged yourself on the basis of your ability to achieve high standards?				
8	Over the past month, have you done just enough to get by?				
9	Over the past month, have you <u>repeatedly</u> checked how well you are doing at meeting your standards (for example, by comparing your performance with that of others)?				
10	Over the past month, do you think that other people would have thought of you as a “perfectionist”?				
11	Over the past month, have you kept trying to meet your standards, even if this has meant that you have missed out on things?				
12	Over the past month, have you avoided any tests of your performance (at meeting your goals) in case you failed?				

SURVEY I – Brief COPE

We are interested in your response towards difficult or stressful events. Please indicate what you generally do and feel when you experience stressful events. There are no “right” or “wrong” answers, so tick the box that best describes your responses, not what you think most people would say or do.

	Item	Never	Rarely	Sometimes	Often
1	I concentrate my efforts on doing something about the situation I'm in.				
2	I try to come up with a strategy about what to do.				
3	I try to see it in a different light, to make it seem more positive.				
4	I accept the reality of the fact that it has happened.				
5	I make jokes about it.				
6	I try to find comfort in my religious or spiritual beliefs.				
7	I get emotional support from others.				
8	I try to get advice or help from other people about what to do.				
9	I turn to work or other activities to take my mind off things.				
10	I say to myself “this isn't real”.				
11	I say things to let my unpleasant feelings escape.				
12	I use alcohol or other drugs to make myself feel better.				
13	I give up trying to deal with it.				
14	I criticize myself.				

	Item	Never	Rarely	Sometimes	Often
15	I take action to try to make the situation better.				
16	I think hard about what steps to take.				
17	I look for something good in what is happening.				
18	I learn to live with it.				
19	I make fun of the situation.				
20	I pray or meditate.				
21	I get comfort and understanding from someone.				
22	I get help and advice from other people.				
23	I do something to think about it less, such as reading, watching TV, daydreaming or sleeping.				
24	I refuse to believe that it has happened.				
25	I express my negative feelings.				
26	I use alcohol or other drugs to help me get through it.				
27	I give up the attempt to cope.				
28	I blame myself for things that happen.				

SURVEY J - PSS

Instructions: The questions in this scale ask you about your feelings and thoughts during the **last month**. In each case, please indicate how often you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer each question fairly quickly.

1. In the last month, how often have you been upset because of something that happened unexpectedly?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

2. In the last month, how often have you felt that you were unable to control the important things in your life?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

3. In the last month, how often have you felt nervous and "stressed"?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

4. In the last month, how often have you dealt successfully with irritating life hassles?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

5. In the last month, how often have you felt that you were effectively coping with important changes that were occurring in your life?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

6. In the last month, how often have you felt confident about your ability to handle your personal problems?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

7. In the last month, how often have you felt that things were going your way?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

8. In the last month, how often have you found that you could not cope with all the things that you had to do?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

9. In the last month, how often have you been able to control irritations in your life?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

10. In the last month, how often have you felt that you were on top of things?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

11. In the last month, how often have you been angered because of things that happened that were outside of your control?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

12. In the last month, how often have you found yourself thinking about things that you have to accomplish?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

13. In the last month, how often have you been able to control the way you spend your time?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often

14. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?

___0=never ___1=almost never ___2=sometimes ___3=fairly often ___4=very often



THE UNIVERSITY OF
WESTERN AUSTRALIA
Achieve International Excellence

Associate Professor Susan Byrne
School of Psychology M304
The University of Western Australia
35 Stirling Highway Crawley WA 6009
AUSTRALIA

Office +61 8 6488 3579
Email sue.byrne@uwa.edu.au

Psychosocial Factors and Fertility: Debriefing Sheet

Thank you for completing the questionnaire package and allowing us to collate and analyse your questionnaire responses in an anonymous fashion. If you have any concerns about your own emotional experiences in response to these questionnaires we recommend that you talk to your Fertility Specialist or family doctor who can link you into support services. Alternatively, do not hesitate to contact Ms Iolanda Rodino or Associate Professor Susan Byrne, both experienced Clinical Psychologists, who can link you into relevant support services.

The contact details for advice on support services or if you have any questions about the research being conducted are:

Ms Iolanda Rodino: 9389 7212 or iolanda@perthivf.com
Associate Professor Susan Byrne: 6488 3579 or sue.byrne@uwa.edu.au

The Human Ethics Committee at the University of Western Australia requires that all participants are informed that if they have a complaint regarding the manner in which a research project is conducted, it may be given to the researcher or, alternatively to the Secretary, Human Research Ethics Committee, Registrar's Office, University of Western Australia, 35 Stirling Highway, Crawley, WA 6009 (telephone number +61 8 6488 3703). All study participants will be provided with a copy of the Information Sheet.

APPENDIX B - Human Research Ethics Approvals



THE UNIVERSITY OF
WESTERN AUSTRALIA
Achieving International Excellence

*Research Ethics and Biosafety Office
Research Services*

Phone: +61 8 6488 3703
Fax: +61 8 6488 8775
email: hreo-research@uwa.edu.au
MBDP: M459

Our Ref: RA/4/1/4642

06 May 2011

Associate Professor Susan Byrne
Psychology (School of)
MBDP: M304

Dear Professor Byrne

HUMAN RESEARCH ETHICS APPROVAL - THE UNIVERSITY OF WESTERN AUSTRALIA
An Integrated Model Of Stress and Disordered Eating In Women Presenting with Infertility (Study 1)

Student(s): Iolanda Sandra Rodino

Ethics approval for the above project has been granted from 03 May 2011 to 01 May 2012 in accordance with the requirements of the *National Statement on Ethical Conduct in Human Research* (National Statement) and the policies and procedures of The University of Western Australia.

You are reminded of the following requirements:

1. The application and all supporting documentation form the basis of the ethics approval and you must not depart from the research protocol that has been approved.
2. The Human Research Ethics Office must be approached for approval in advance for any requested amendments to the approved research protocol.
3. The Chief Investigator is required to report immediately to the Human Research Ethics Office any adverse or unexpected event or any other event that may impact on the ethics approval for the project.
4. The Chief Investigator must inform the Human Research Ethics Office as soon as practicable if a research project is discontinued before the expected date of completion, providing reasons.

Any conditions of ethics approval that have been imposed are listed below:

Special Conditions

None specified

The University of Western Australia is bound by the National Statement to monitor the progress of all approved projects until completion to ensure continued compliance with ethical standards and requirements.

Please note that the maximum period of ethics approval for this project is five (5) years from the date of this notification. However, ethics approval is conditional upon satisfactory progress reports being received by the designated renewal date for continuation of ethics approval.

The Human Research Ethics Office will forward a request for a Progress Report approximately 60 days before the due date. A further reminder will be forwarded approximately 30 days before the due date.

If your progress report is not received by the due date for renewal of ethics approval, **your ethics approval will expire**, requiring that all research activities involving human participants cease immediately.

If you have any queries please do not hesitate to contact the Human Research Ethics Office (HREO) at hreo-research@uwa.edu.au on (08) 6488 3703.

Please ensure that you quote the file reference – RA/4/1/4642 – and the associated project title in all future correspondence.

Yours sincerely



Peter Johnstone
Manager
Human Research Ethics Committee

20 May 2011

Ms Iolanda Rodino
School of Psychology, UWA
Mailbag M304
35 Stirling Highway
CRAWLEY WA 6009

Joondalup Hospital Pty Ltd trading as
Joondalup Health Campus
ABN 61 106 723 193
Cnr Grand Blvd & Shenton Ave
Joondalup WA 6027
PO Box 242
Joondalup WA 6919
Telephone: 08 9400 9400
Facsimile: 08 9400 9054
Web: www.ramsayhealth.com.au

Dear Ms Rodino

RE: An integrated model of stress and disordered eating in women presenting with infertility (1111)

The Human Research Ethics Committee of Joondalup Health Campus is pleased to notify you that your proposal to undertake research in conjunction with Fertility North was discussed at the HREC meeting on 19 May 2011 and has been approved. As the Committee is bound by NHMRC Guidelines, the following conditions apply:

- That the Committee be notified immediately of any substantial changes in the design, methodology, time line or intended subjects of the project,
- That the Committee be notified immediately of any unforeseen complications of the project,
- That the Committee be notified if the project does not commence within six months of approval,
- That the Committee receive annual/final reports on the study (you will receive a pro forma from the Committee in twelve months), and
- That the Committee be informed of any other matters which arise during the course of the project which may have ethical implications.

Your approval is initially for four years; after this period you may be asked to re-apply. You are also required to notify the Committee promptly of any changes in your contact details.

Our best wishes for a successful implementation of your research project.

Yours sincerely



Ann Y Hammer
Executive Officer, JHC HREC

2nd December 2011

Monash Avenue, Nedlands

Locked Bag 2002
NEDLANDS WA 6909

T 08 9346 6000
F 08 9389 8470

ABN 36 003 184 889

Ms Iolanda Rodino
School of Psychology, UWA
Mailbag M304
35 Stirling Hwy
CRAWLEY WA 6009

Dear Ms Rodino,

HPH334: An integrated model of stress and disordered eating in women presenting with infertility (Study 1)

The above project was reviewed at the Hollywood Private Hospital Research Ethics Committee (HPHREC) meeting held on Tuesday 22 November 2011 and Ethics approval has been granted effective **2 December 2011 until 31 December 2012**.

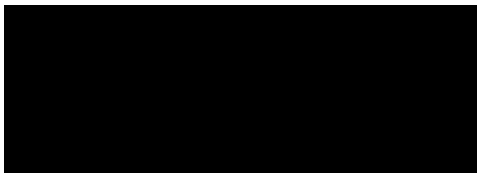
The Hollywood Private Hospital Research Ethics Committee is constituted and functions in accordance with the *NH&MRC National Statement on Ethical Conduct in Research Involving Humans - March 2007*.

In accordance with the committee's monitoring requirements please provide the HPHREC a report or abstract of the results when the project is completed.

Please quote the reference number **HPH334** in all correspondence to the Hollywood Private Hospital Research Ethics Committee.

On behalf of the HPHREC, I wish you every success with your project. If you have any queries, please do not hesitate to contact Carolyn Konzewitsch, Research Administrator or me.

Yours sincerely,



Terry Bayliss
Chair
Hollywood Private Hospital Research Ethics Committee

cc: Dr Simon Turner - HPH Fertility Clinic
Ms Itziar Rebollar-Lazaro - HPH Fertility Clinic
Professor Susan Byrne - UWA



Our Ref: RA/4/1/6552

20 December 2013

Assistant Professor Katherine Sanders
Office of the Registrar
MBDP: M009

Dear Professor Sanders

HUMAN RESEARCH ETHICS APPROVAL - THE UNIVERSITY OF WESTERN AUSTRALIA

Fertility Specialist Knowledge & Attitudes towards Eating Disorders in Patients Undergoing Fertility Treatment

Student(s): Iolanda Rodino

Ethics approval for the above project has been granted in accordance with the requirements of the *National Statement on Ethical Conduct in Human Research* (National Statement) and the policies and procedures of The University of Western Australia. Please note that the period of ethics approval for this project is five (5) years from the date of this notification. However, ethics approval is conditional upon the submission of satisfactory progress reports by the designated renewal date. Therefore initial approval has been granted from 20 December 2013 to 01 December 2014.

You are reminded of the following requirements:

1. The application and all supporting documentation form the basis of the ethics approval and you must not depart from the research protocol that has been approved.
2. The Human Research Ethics Office must be approached for approval in advance for any requested amendments to the approved research protocol.
3. The Chief Investigator is required to report immediately to the Human Research Ethics Office any adverse or unexpected event or any other event that may impact on the ethics approval for the project.
4. The Chief Investigator must inform the Human Research Ethics Office as soon as practicable if a research project is discontinued before the expected date of completion, providing reasons.

Any conditions of ethics approval that have been imposed are listed below:

Special Conditions

None specified

The University of Western Australia is bound by the National Statement to monitor the progress of all approved projects until completion to ensure continued compliance with ethical standards and requirements.

The Human Research Ethics Office will forward a request for a Progress Report approximately 60 days before the due date. A further reminder will be forwarded approximately 30 days before the due date.

If your progress report is not received by the due date for renewal of ethics approval, **your ethics approval will expire**, requiring that all research activities involving human participants cease immediately.

If you have any queries please contact the HREO at hreo-research@uwa.edu.au.

Please ensure that you quote the file reference – RA/4/1/6552 – and the associated project title in all future correspondence.

Yours sincerely



Dr Mark Dixon
Associate Director, Research Ethics and Biosafety

APPENDIX C – Project Two

Participant Information Sheet

Knowledge and Attitudes of Fertility Specialists regarding Eating Disorders

This information sheet is about a study that is being conducted at The University of Western Australia by Ms. Iolanda Rodino, who is a PhD Candidate in the schools of Anatomy, Physiology & Human Biology, and Psychology. This research is being conducted under the supervision of Associate Professor Kathy Sanders and Associate Professor Sue Byrne with the assistance of Professor Roger Hart (Fertility Specialist). This study invites you to take part in a survey looking at the knowledge, views and attitudes of Fertility Specialists towards eating disorders. Before you decide to take part please read the information below.

Reproduction and pregnancy outcomes are directly influenced by eating disorders. The aim of this survey is to examine fertility specialists' knowledge about eating disorders and their attitudes towards these conditions. By doing so we will be able to focus future training to meet the needs of fertility specialists and improve patient care.

What Participation Involves

You will be asked to anonymously complete a questionnaire assessing both knowledge of and attitudes towards eating disorders which should take approximately 10 minutes to complete. No identifying information is collected and data is stored on a secure online server. At any stage you can withdraw from the study by not proceeding to the "submit" section of the questionnaire. Your participation is entirely voluntary.

What will happen with the data?

Responses from all participants will be grouped and analysed together rather than being examined individually. The information that you provide may be published in scientific journals and presented at national and international conferences, but your anonymity is preserved at all times. The study has been approved by the Human Research Ethics Committee of The University of Western Australia (Ethics Number RA/4/1/6552).

If you decide to take part then please complete the Participation and Consent section below and proceed to the questionnaire. If you have any concerns or require any further information please do not hesitate to contact Iolanda Rodino at iolanda@thinkfertility.com or (08) 9389 7212 or Associate Professor Kathy Sanders: kathy.sanders@uwa.edu.au

Participation and Consent Statement

By proceeding to complete the online questionnaire I acknowledge and agree that:

- I have understood the information outlined to me about this study
- I can contact Iolanda Rodino, Clinical Psychologist, for clarification of any aspect of the study
- I can exit the study at any stage prior to submission of the questionnaire
- That completion and submission of the questionnaire is considered evidence of consent to participate in the study

Thank you for your willingness to participate in this research. To acknowledge consent and to proceed to the online Questionnaire click **“Next”** below

NEXT

Fertility Specialist Online Survey

Section One: Demographics

Gender: Please chose only one of the following

- Male
- Female

Age: Please choose only one of the following

- 25-35
- 36-45
- 46-55
- 56-65
- 66 and above

What state in Australia or New Zealand do you practice?

- ACT
- NSW
- NT
- QLD
- SA
- TAS
- VIC
- WA
- New Zealand

How many years have you worked as a fertility specialist?

- 0-5
- 6-10
- 11-15
- 16-20
- 21-25
- 26+

As a Fertility Specialist do you have a primary special interest? (Choose all that apply)

- Male factor
- Endometriosis
- Fertility Preservation
- Pelvic Surgery
- PCOS
- Menopause
- Other (Please indicate_____)

Have you undertaken advanced courses in fertility? (Please choose all that apply)

- CREI
- Masters (e.g. Reproductive Medicine)
- Other: _____)

Section 2: Current Practice Protocols

Please answer the following:

	YES	NO
I routinely measure BMI at a patient's initial consultation		
I routinely ask about a history of eating disorders in my clinical practice		
I routinely screen for disordered eating symptomatology when women present with low BMI, PCOS and/ovulatory disorders		
I have used the services of specialist eating disorder personnel		
Our practice has guidelines on the management of eating disorders		
There is a need for education or recommendations about treatment guidelines following disclosure of an eating disorder		

Clinical Question: If a woman disclosed that she had the eating disorder bulimia nervosa and was using inappropriate behaviours to counteract weight gain, what would you do?

Please provide an answer for each item:

	Yes	No	Unsure
Continue with fertility treatment irrespective			
Suspend treatment temporarily			
Consult another fertility specialist			
Send the patient to a dietitian			
Refer to a psychiatrist or psychologist			
Refer to a specialist eating disorder intervention team			

Section 3: General Diagnostic Knowledge

We are interested in the base knowledge about eating disorders amongst fertility specialists. Please answer each question without assistance from other colleagues or accessing other sources of information. Do not be concerned if you do not know the answers.

Which of the following are DSM-IV criteria for anorexia nervosa? Select all that apply.

- Persistent energy intake restriction leading to weight that is maintained at least 15% below the expected BMI (BMI is below 17.5 kg/m^2)
- Persistent energy intake restriction leading to weight that is maintained at least 20% below the expected BMI (BMI is below 16.0 kg/m^2)
- Binge eating (eating large amounts of food when not hungry or until uncomfortably full)
- Persistent behaviour that interferes with weight gain, even though at a significant low weight
- Absence of at least three consecutive menstrual cycles
- Absence of at least six consecutive menstrual cycles
- Disturbance in self-perceived weight and shape
- Intense fear of gaining weight or becoming fat

Which of the following are DSM-IV criteria for bulimia nervosa? Select all that apply.

- Recurrent episodes of binge eating at least twice a week for 3 months
- A sense of lack of control over eating during a binge episode
- Persistent energy intake restriction leading to weight that is maintained at least 15% below the expected BMI (BMI is below 17.5 kg/m^2)
- Extreme weight-control behaviours (e.g., strict dieting, self-induced vomiting, exercising or laxative use) at least a twice week for 3 months
- Over evaluation of weight and shape
- Weight is maintained above a body mass index (BMI) of 17.5 kg/m^2

Which of the following are criteria for binge eating disorder? Select all that apply.

- A sense of lack of control over eating during a binge episode
- Extreme weight-control behaviours (e.g. strict dieting, self-induced vomiting, exercising or laxative use) at least once a week
- Marked distress regarding binge eating episode is present

Section 4: Attitudes to Eating Disorders

Please indicate how much you agree with each statement

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
It is important to screen for current eating disorders during preconception assessments					
Women with eating disorders should treat their eating problem before starting fertility treatment					
It is important to routinely ask about exercise					
Women who have very low or very high BMI should be referred to a dietitian					
Assessing patients for eating disorders is not my clinical role					
There is not enough time to assess for eating disorders at initial consultations					
Information on eating disorders is not of prime importance					

Section 5: Training Needs

Please indicate to what extent you agree with each item

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
I am confident in my ability to identify symptoms of eating disorders in my current practice					
I am confident in my knowledge of local treatment resources and referral pathways					
I am satisfied with the level of training in eating disorders received during my clinical training					
I feel I need more training on eating disorders					

Any final comments? Please write your answer here:

Thank you for assisting with this PhD study which is part of a broader investigation looking at issues relating to women undergoing fertility treatment who have an eating disorder. Should you have any further questions please do not hesitate to contact Ms. Iolanda Rodino (Clinical Psychologist/PhD Candidate) at iolanda@thinkfertility.com

To proceed with submission of your survey answers..... **CLICK 'SUBMIT'**

APPENDIX D: The SCOFF questionnaire

The SCOFF questions:

Do you make yourself Sick (vomit) because you feel uncomfortably full?

Do you worry that you have lost Control over how much you eat?

Have you recently lost more than One stone in a 3 month period?*

Do you believe yourself to be Fat, even though others say you are too thin?

Would you say that Food dominates your life?

Scoring Procedure: Give one point for every “yes” answer; a score of ≥ 2 indicates a likely case of anorexia nervosa or bulimia nervosa.

(*Note: metric weight conversion: one stone = 6.35 kg)

Source: MORGAN, J. F., REID, F. & LACEY, J. H. 1999. The SCOFF questionnaire: assessment of a new screening tool for eating disorders. *British Medical Journal*, 319, 1467-1468.