A test of the tripartite model of anxiety and depression in postpartum psychiatric inpatients

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Abstract

The aims of the present thesis were to (a) examine the psychometric integrity in a postpartum inpatient population of two measures, the Edinburgh Postnatal Depression Scale (EPDS; Cox, Holden, & Sagovsky, 1987) and the Depression Anxiety Stress Scales (DASS; S. H. Lovibond & P. F. Lovibond, 1995); (b) examine whether the tripartite model – a conceptual model of anxiety and depression previously supported in non-postpartum populations – provided an optimal fit to self-reported anxiety and depression data in a postpartum clinical sample; and (c) examine the relationship of the factors underlying postpartum anxiety and depression symptoms to diagnoses of unipolar mood disorders, anxiety disorders, and disorders characterised by mixed anxiety and depressive symptoms. These aims were tested using self-report anxiety and depression data from questionnaires completed by inpatients with postpartum psychiatric disorders.

An initial aim was to determine whether two self-report questionnaires were suitable for measuring depression and anxiety in the postpartum inpatient sample. The EPDS was considered given evidence that it measures both anxiety and depression. However, its factor structure has varied across previous studies, and has not previously been examined in a postpartum inpatient sample. Thus, Chapter 2 aimed to examine the factor structure of the EPDS in the postpartum inpatient sample. The factor structure of the EPDS was not consistent across admission and discharge, which was in line with previous literature indicating that the EPDS lacks factorial invariance. However, it was unclear whether the non-invariant factor structure was specific to the EPDS, or whether it was characteristic of the postpartum inpatient sample more generally.

Therefore, Chapter 3 aimed to examine the psychometric properties and factor structure of the DASS, a self-report measure previously found to have a robust, replicable factor structure. In this study, the same three factor structure identified

previously in other populations provided the best fit in the postpartum sample, both at hospital admission and discharge. These findings suggested that the DASS was reliable and valid in the inpatient sample, and suggested that the variability of the EPDS factor structure was specific to the EPDS, rather than due to the nature of distress in the postpartum sample. Furthermore, the results provided evidence that the latent structure of anxiety and depression symptoms in postpartum inpatients is similar to that observed in non-postpartum populations.

Chapter 4 turned to the second objective of the thesis: to test whether the tripartite model provided an adequate fit to anxiety and depression data (collected at hospital admission) in a sample of postpartum psychiatric inpatients. Confirmatory factor analyses revealed that a three factor model consistent with the tripartite model (comprising factors reflecting negative affect, positive affect, and autonomic arousal) provided an adequate fit to the data, and was superior to alternative, simpler models. Consistent with the tripartite model, the factors were differentially related to depression, anxiety, and mixed anxiety/depressive diagnoses.

In conclusion, the present thesis provided evidence for validity of the DASS in a postpartum inpatient sample, and extended the utility of the tripartite model of anxiety and depression to a postpartum inpatient sample. In addition to demonstrating a tripartite symptom structure consistent with that observed in non-postpartum populations, the present study also found that anxiety, depressive, and mixed diagnoses were differentially associated with the tripartite model symptom dimensions. The present thesis demonstrated that the structure of anxiety and depressive symptoms in postpartum psychiatric inpatients is similar to that at other life stages, consistent with the view that postpartum anxiety and depression are the same clinical entities as non-postpartum anxiety and depression. The results from the three studies contained in the thesis are summarised in the General Discussion (Chapter 5) and are interpreted in the

context of the wider literature on postpartum (and non-postpartum) anxiety and depression. Implications and future directions for the measurement and treatment of postpartum emotional disorders are also discussed.

Contents

Manuscripts Arising from this Thesis

Chapter 2

Cunningham, N. K., Brown, P. M., & Page, A. C. (2014). Does the Edinburgh Postnatal Depression Scale measure the same constructs across time? *Archives of Women's Mental Health, 18*(6), 793-804.

Chapter 3

Cunningham, N. K., Brown, P. M., Brooks, J., & Page, A. C. (2013). The structure of emotional symptoms in the postpartum period: Is it unique? *Journal of Affective Disorders, 151*(2), 686-694.

Chapter 4

Cunningham, N. K., Brown, P. M., & Page, A. C. (2016). The structure of negative emotional states in a postpartum inpatient sample. *Journal of Affective Disorders, 192,* 11-21.

Author Contributions

Chapter 2: Nadia Cunningham (70%) and Andrew Page (20%) designed the study. Philippa Brown (10%) and Nadia Cunningham managed data collection. Nadia Cunningham conducted the literature searches and undertook the statistical analyses. All authors discussed the results and implications of the study. Nadia Cunningham wrote the first draft of the manuscript. All authors have contributed to and have approved the final manuscript.

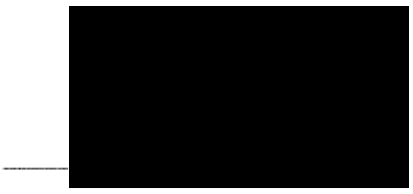
Chapter 3: Nadia Cunningham (70%) and Andrew Page (10%) designed the study. Philippa Brown (10%), Janette Brooks (10%), and Nadia Cunningham managed data collection. Nadia Cunningham and Andrew Page undertook the statistical analyses. Nadia Cunningham wrote the first draft of the manuscript. All authors have contributed to and have approved the final manuscript.

Chapter 4: Nadia Cunningham (70%) and Andrew Page (20%) designed the study and wrote the protocol. Philippa Brown (10%) and Nadia Cunningham managed data collection. Nadia Cunningham conducted the literature searches. Nadia Cunningham and Andrew Page undertook the statistical analyses. All authors discussed the results and implications of the study. Nadia Cunningham wrote the first draft of the manuscript. All authors have contributed to and have approved the final manuscript.

For the remainder of the thesis, Nadia Cunningham conducted all literature reviews, data analyses, interpreted results, and prepared and revised chapters.

All co-authors approved inclusion of the papers in this thesis.

Nadia Cunningham (Candidate)



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Chapter 1: General Introduction

Introduction

This thesis aimed to (a) examine the psychometric integrity in a postpartum inpatient population of two measures, the Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987) and the Depression Anxiety Stress Scales (DASS; S. H. Lovibond & P. F. Lovibond, 1995); (b) examine whether the tripartite model of anxiety and depression provided an adequate fit to self-report anxiety and depression data in a postpartum clinical sample; and (c) examine the relationship of the factors underlying postpartum anxiety and depression symptoms to ICD-10 diagnoses of unipolar mood disorders, anxiety disorders, and disorders characterised by a mixture of anxiety and depressive symptoms (adjustment disorder, mixed anxiety-depressive disorder). The present thesis set out to test these aims using self-report anxiety and depression data from questionnaires completed by postpartum psychiatric inpatients at admission to a psychiatric mother and baby unit. Before describing the research, it is helpful to begin by describing postpartum psychological pathology.

Postpartum psychological disorders

A range of psychological symptoms can present in the postpartum period (variably defined as the weeks, months, or first year following childbirth). Until recently, research has primarily focused on the concept of postpartum depression; however, there is increasing recognition that anxiety is also common in the postpartum period. The current conceptualisations of postpartum depression and anxiety are summarised below.

Postpartum depression

Postpartum depression is the term given to the phenomenon of depressive symptoms and disorders occurring in the postpartum period. An estimated 10-15% of women experience depression in the postpartum period (O'Hara & Swain, 1996). A considerable amount of research has focused on delineating the specific course,

symptomatology, and aetiological factors associated with postpartum depression, in order to improve its conceptualisation, detection, and treatment.

The term postpartum depression has not been used uniformly to refer to a specific diagnostic entity. Broadly speaking, a distinction can be made between studies defining postpartum depression based on standardised diagnostic criteria for depressive disorders, and those that have defined postpartum depression by the frequency and intensity of symptoms endorsed on self-report depression symptom measures (Stuart, Couser, Schilder, O'Hara, & Gorman, 1998). However, there is not yet a consensus on the optimal classificatory method. In addition to the adoption of different diagnostic criteria, the temporal definition of the postpartum period has also varied across studies, ranging widely from weeks to the first year postpartum.

Classification of postpartum depression

A recurring debate in the postpartum psychological disorders literature is whether postpartum emotional disorders, including postpartum depression, should be included as separate diagnoses in classification systems such as the Diagnostic and Statistical Manual of Mental Disorders (DSM; American Psychiatric Association, 2013a) (American Psychiatric Association, 2013b) and the International Classification of Diseases and Related Health Problems (ICD; World Health Organization, 1992), or whether they should be diagnosed according to the standard diagnostic categories. This debate reflects a lack of consensus regarding the aetiology and clinical presentation of postpartum emotional disorders. In the years leading up to the release of the DSM-5, there was a resurgence of literature related to the nature and classification of postpartum emotional disorders. The classification of postpartum depression within recent diagnostic systems including ICD-10, DSM-IV, and DSM-5, is outlined below (see Table 1).

ICD-10. The ICD-10 (World Health Organization, 1992) recommends that postpartum depression be classified within the standard mood disorder categories. However, it does make provision for the diagnosis of F53: 'Mental Disorders associated with the Puerperium, not elsewhere classified'. This numerical code is applicable to psychiatric episodes commencing within 6 weeks of delivery, which do not meet criteria for other mental disorders because of (a) insufficient information or (b) additional features making classification elsewhere inappropriate. The F53 category is further divided into: 'postnatal depression' (mild); 'puerperal psychosis' (severe) and 'other'. This postpartum-specific code suggests that there are at least a subset of postpartum disorders (not classifiable under the standard mood disorder categories) that are aetiologically and/or phenomenologically unique (Austin, 2010).

Table 1

Recent Diagnostic Classification of Postpartum Psychiatric Disorders

Classification system	Postpartum disorders	Criteria for use and description
ICD-10	F53.0 Mild mental and behavioural disorders associated with the puerperium, not elsewhere classified Includes: postnatal depression NOS, postpartum depression NOS	Should be diagnosed according to the standard criteria, except where the presentation: Commences within 6 weeks of delivery Does not meet criteria for disorders classified elsewhere in ICD-10, because of: 1) Insufficient information 2) Presence of additional clinical features which make classification elsewhere inappropriate
	F53.1 Severe mental and behavioural disorders associated with the puerperium, not elsewhere classified Includes: puerperal psychosis NOS Other mental and behavioural disorders associated with the puerperium, not elsewhere classified	
	F53.9 Puerperal mental disorder, unspecified	
	099.3 Mental diseases and diseases of the nervous system complicating the puerperium	Should be applied when an F code for a specific type of mental disorder associated with puerperium
DSM-IV	With Postpartum Onset specifier, applicable to: Major Depressive Disorder Manic Episode Bipolar I Disorder Bipolar II Disorder Brief Psychotic Disorder	Postpartum disorders should be diagnosed according to usual diagnostic categories. However, a With Postpartum Onset specifier can be assigned to the listed disorders if they commence within 4 weeks of delivery
DSM-5	With Peripartum Onset specifier, applicable to: Major Depressive Disorder Manic Bipolar I Disorder Bipolar II Disorder Brief Psychotic Disorder	Postpartum disorders should be diagnosed according to usual diagnostic categories. However, a With Peripartum Onset specifier can be assigned to the listed disorders if they commence in pregnancy or within 4 weeks of delivery

Note. NOS = not otherwise specified.

DSM-IV. In DSM-IV (American Psychiatric Association, 2000), patients with depression occurring in the postpartum period are classified according to the standard mood disorder categories. However, a postpartum onset specifier can be applied to mood disorders (including major depressive disorder and bipolar disorders) and brief psychotic disorder when onset has occurred within 4 weeks after delivery. Unlike other specifiers in the DSM-IV (e.g., psychotic features and severity specifiers), the postpartum onset specifier is a written addition only, and cannot be numerically coded. As a result, it is more difficult to record and unlikely to be clinically documented (Austin, 2010). The DSM-IV also states that postpartum depression is often characterised by additional symptoms including mood lability, disinterest in infant, initial insomnia, and severe anxiety or panic attacks, thus implying differences in clinical presentation compared to non-postpartum major depression. Consequently, the inclusion of postpartum depression within the standard diagnostic categories suggests that there is no distinction between postpartum and non-postpartum depression, whereas the descriptions associated with the postpartum onset specifier suggest that there is a distinction.

DSM-5. In the years leading up to the release of the DSM-5 (American Psychiatric Association, 2013a), a number of recommendations for the classification of postpartum emotional disorders (i.e., anxiety and depressive disorders) were made based on existing literature. Researchers have largely supported the continued classification of postpartum depression within the standard diagnostic categories in DSM-5, rather than in separate categories (e.g., Jones & Cantwell, 2010). However, many suggested that modifications be made to the specifier. These suggestions included increasing the length of the specifier from four weeks to six months or more (as the four week specifier is too narrow and is not supported by research and clinical practice) and extending the specifier to be applicable to anxiety disorders (Di Florio, Seeley, & Jones,

2015; Jones & Cantwell, 2010). The recommendation for the extension of the specifier to anxiety disorders occurred in the context of increasing evidence that anxiety is also common in the postpartum period, and can also occur without comorbid depression (Fisher, Feekery, & Rowe-Murray, 2002; Matthey, Barnett, Howie, & Kavanagh, 2003).

Despite these suggestions, in DSM-5, postpartum depression continued to be diagnosed within existing categories; and the postpartum onset specifier was retained, albeit with several changes. Firstly, the specifier was changed into a peripartum onset specifier (encompassing pregnancy as well as the postpartum period). The time criterion for postpartum onset was not extended beyond four weeks after delivery. As in the DSM-IV, the DSM-5 continued to describe additional symptoms of postpartum major depressive episodes, including severe anxiety. However, the peripartum onset specifier was not extended to anxiety disorders. Thus, whilst anxiety is recognised as a feature of postpartum major depression, postpartum anxiety disorders do not have an equivalent specifier.

Summary. It is evident from the previous description of the taxonomies that there is variability in the classification of postpartum emotional disorders. This variability can be seen to reflect two broader, unresolved debates regarding the nature of postpartum emotional disorders within the literature. Firstly, there is a lack of agreement as to whether postpartum depression is a distinct entity, different from depression occurring at other times. Secondly, there is debate regarding the relationship between depression and anxiety in the postpartum period. These issues are relevant to the classification, identification, and treatment of postpartum emotional disorders, and are outlined in further detail below.

Clinical presentation of postpartum depression

An unresolved issue that has contributed to the lack of consensus regarding the nosological status of postpartum depression is whether it differs substantially from depression occurring at other life stages. There has been longstanding debate as to whether postpartum depression is different to depression occurring at other times. On one side of the debate, some view postpartum depression as part of a spectrum of emotional disorders specifically related to childbearing. Proponents of this view have argued that the clinical presentation of postpartum depression is unique. For example, Pitt (1968) described postpartum depression as milder than typical depression, with less suicidal ideation, more anxiety and irritability, and with some symptoms showing reverse patterns (e.g., increased appetite). As aforementioned, the DSM-IV postpartum onset specifier and DSM-5 peripartum onset specifier suggest that postpartum onset major depression is commonly characterised by additional symptoms including mood lability, guilt, initial insomnia, severe anxiety and panic attacks (American Psychiatric Association, 2000, 2013a). As well as additional symptoms, some have argued that certain depression symptoms (e.g., sleep disruption, appetite and weight changes) are confounded with normal physiological changes associated with childbearing and are therefore unreliable indicators of depression in postpartum women (Cox et al., 1987). If this view is supported, existing methods developed for measuring and treating depression in the general population may not be appropriate in the postpartum period, and hence postpartum-specific measures and treatments need to be developed. Furthermore, existing diagnostic criteria for depressive disorders may not be appropriate and may require modification for postpartum samples (Matthey, 2010).

The hypothesis that postpartum depression has a distinct clinical presentation contributed to the development of psychometric instruments specifically designed to detect postpartum depression. For example, the Edinburgh Postnatal Depression Scale

(EPDS; Cox et al., 1987) is a widely used 10-item self-report instrument designed to screen for major depression in the postpartum period. The EPDS deliberately excludes somatic symptoms (e.g., lack of sleep, weight and appetite changes, and difficulty concentrating) that are purported to be unreliable indicators of depression in the postpartum period. Moreover, the EPDS includes anxiety symptoms, reflecting the notion that anxiety is a common feature of postpartum depression (Ross, Evans, Sellers, & Romach, 2003).

On the other side of the debate it has been argued that postpartum depression is not exclusively related to physiological events of the postpartum period, and therefore the clinical presentation is not distinct. Proponents of this view argue that there is insufficient evidence to support a distinction between postpartum and non-postpartum depression, and that the triggers of postpartum emotional disorders are not unique (Hendrick, Altshuler, & Suri, 1998). They propose that the perinatal period may trigger or exacerbate emotional disorders not unlike any other stressful life event (P. J. Cooper & Murray, 1995; Riecher-Rössler & Rohde, 2005). That is, in stress-diathesis models, a variety of stressors trigger a disorder by acting upon a pre-existing diathesis (vulnerability). From this perspective, existing assessment and treatment methods for depression are likely to be applicable to postpartum samples.

A small number of studies have addressed this debate by comparing symptoms of depression in postpartum versus non-postpartum women. However, results have been inconsistent. Whilst some studies have reported higher levels of depression in postpartum samples (Augusto, Kumar, Calheiros, Matos, & Figueiredo, 1996; Hendrick, Altshuler, Strouse, & Grosser, 2000; Nieland & Roger, 1997), others have reported lower levels of depression (Eberhard-Gran, Tambs, Opjordsmoen, Skrondal, & Eskild, 2003; Whiffen & Gotlib, 1993). In a related line of research, several studies have examined differences between specific symptoms (e.g., loss of interest, insomnia) of

postpartum and non-postpartum depression as well as severity levels: for example, whilst Whiffen and Gotlib (1993) reported that the postpartum group obtained a lower mean depression score than the non-postpartum group, they also reported lower levels of insomnia, somatic complaints, and psychomotor agitation. A more detailed review is presented in Chapter 3, but overall there is no consistent pattern regarding differences in symptom type or intensity between postpartum and non-postpartum samples. It is likely that the lack of consistency across these studies is in part due to methodological differences, such as different recruitment strategies or comparison groups; inconsistent definitions of the postpartum period; and different assessment and diagnostic methods. Despite a lack of evidence that postpartum depression has a unique clinical presentation, many researchers and clinicians continue to espouse the view that it is somehow unique. This is an important issue to resolve because it has implications for assessment and treatment of postpartum depression. For example, if postpartum depression is distinct, then the general depression literature may not be generalisable to postpartum depression (Whiffen, 1992). Validated assessment methods and evidence-based treatments for depression may be inappropriate for postpartum women. On the other hand, if postpartum depression is not phenomenologically distinct from non-postpartum depression, there may not be a need to develop postpartum-specific measures and treatments. Thus, the current lack of consensus may be hindering research as well as implementation of assessment and treatment programs for postpartum depression. In addition, there is increasing recognition that anxiety is also common in the postpartum period, and the clinical presentation of postpartum anxiety (and its relationship to non-postpartum anxiety) has been the subject of increasing research (Phillips, Sharpe, Matthey, & Charles, 2009).

Postpartum depression and anxiety

A second conceptual issue relates to the nature of the relationship between depression and anxiety in the postpartum period. The term 'postpartum depression' has often served as an umbrella term for a wide range of affective symptoms presenting in the postpartum period (Rowe, Fisher, & Loh, 2008). In particular, anxiety has often been subsumed within the concept of postpartum depression.

For decades, anxiety has been observed in postpartum women, but until recently it was primarily viewed as a feature of postpartum depression (e.g., Pitt, 1968; Ross et al., 2003; Stuart et al., 1998). There is increasing evidence that postpartum women may experience new onset or exacerbation of existing anxiety disorders in the postpartum period, and anxiety may present without comorbid depression (Matthey et al., 2003; Ross et al., 2003; Wenzel, Haugen, Jackson, & Robinson, 2003). In addition to anxiety disorders, elevated anxiety symptoms (not necessarily meeting diagnostic criteria for an anxiety disorder) have also been observed in studies of postpartum women at rates comparable to, or higher than, depression symptoms (e.g., Fisher et al., 2002; Stuart et al., 1998). Furthermore, anxiety and depression have been observed to co-occur in postpartum samples: postpartum individuals with elevated anxiety symptoms often report elevated depression symptoms (Ross et al., 2003), and postpartum individuals with a diagnosis of depressive disorder may also meet diagnostic criteria for an anxiety disorder (e.g., Austin et al., 2010).

Given increasing evidence that anxiety disorders are common in the postpartum period, researchers have expressed the importance of identifying postpartum anxiety, and distinguishing it from postpartum depression, so that treatments can be individually tailored to the presenting syndrome (e.g., Austin & Priest, 2005; Matthey et al., 2003). The concept of postpartum anxiety has therefore emerged as distinct from postpartum depression, and research has begun to follow a similar path taken by postpartum

depression research: delineating the specific course, symptomatology, and risk factors associated with anxiety disorders presenting in the postpartum period, and assessing the suitability of existing anxiety treatments in a postpartum context. Some studies have also attempted to identify differences in the clinical presentation of anxiety disorders in postpartum versus non-postpartum women (e.g, Phillips, Sharpe, et al., 2009).

However, an obstacle to the detection of postpartum anxiety in both clinical practice and research has been a lack of anxiety measures validated for use in postpartum samples (Meades & Ayers, 2011). Several different approaches have been taken to measure anxiety in postpartum women. One approach has been to use the EPDS. The EPDS was originally described as a unidimensional measure of depression, but several factor analytic studies of the scale have identified an 'anxiety subscale' consisting of three items ('I have blamed myself unnecessarily when things went wrong'; 'I have been anxious or worried for no good reason'; 'I have felt scared or panicky for no very good reason'; e.g., Ross et al., 2003; Rowe et al., 2008). This anxiety scale has been found to correlate with other anxiety measures (Phillips, Charles, Sharpe, & Matthey, 2009). Whilst some studies have suggested that the EPDS may be used to identity women with postpartum anxiety disorders (Matthey, 2008), other studies have indicated that the EPDS is unable to reliably distinguish postpartum women with an anxiety disorder from those with a depressive disorder (e.g., Matthey et al., 2003; Rowe et al., 2008). Hence, there is a risk that the EPDS confounds postpartum depression and anxiety. Further research is required to determine whether the EPDS is able to discriminate between depression and anxiety.

Another approach has been to develop postpartum-specific anxiety measures. For example, the Perinatal Anxiety Screening Scale (PASS; Somerville et al., 2014) was developed to measure a wide range of anxiety symptoms in perinatal samples. However, many of these measures are newly developed and require further validation.

Furthermore, some focus on a narrow presentation of postpartum-related anxiety (e.g., experience of delivery).

A third approach has been to use self-report measures developed to assess anxiety in the general population. However, some researchers have questioned the appropriateness and validity of general anxiety measures in postpartum samples, with some arguing that postpartum anxiety might have a different clinical presentation to non-postpartum anxiety (Phillips, Sharpe, et al., 2009). Others have expressed concern that somatic anxiety symptoms might be confounded with 'normal' postpartum experiences (e.g., gastrointestinal symptoms, nausea, shortness of breath). Thus, further validation studies are required for general anxiety measures in postpartum samples.

An issue that potentially bears on all three measurement approaches is that postpartum anxiety has been found to overlap with postpartum depression (Matthey et al., 2003; Ross et al., 2003). In the broader anxiety and depression literature it is recognised that anxiety and depression exhibit overlap, both at the symptom level (e.g., high correlations between anxiety and depression scales) and as clinical disorders (i.e., high comorbidity of anxiety and depressive disorders; L. A. Clark & Watson, 1991). This overlap has posed difficulty for psychometric assessment and discrimination of the two syndromes. Efforts to measure and distinguish these syndromes in postpartum may be similarly hindered by their overlap. In order to understand problems associated with distinguishing these syndromes, it is important to review the general anxiety and depression literature, and to introduce an alternative model of anxiety and depression, the tripartite model.

Depression and anxiety in the general population

It is well established that depression and anxiety overlap in both nonclinical and clinical populations. At the diagnostic level, there is substantial comorbidity of mood

and anxiety disorders. Approximately 50 per cent of all patients diagnosed with a depressive disorder also meet diagnostic criteria for an anxiety disorder, and vice versa (Brown, Campbell, Lehman, Grisham, & Mancill, 2001; Kessler, Nelson, McGonagle, & Liu, 1996). Many patients with a depressive or an anxiety disorder also report symptoms of the other disorder (Mineka, Watson, & Clark, 1998). A number of symptoms are shared by depressive and anxiety disorders (e.g., sleep problems, fatigue, concentration difficulties). Dimensional measures of anxiety and depression show poor discriminant validity: studies have consistently shown that self-report and clinician-report measures of anxiety and depression are strongly correlated in clinical and nonclinical samples, typically in the range of .62 to .70 (L. A. Clark & Watson, 1991).

This overlap is inconsistent with the conceptualisation of anxiety and depression in diagnostic systems as categorically distinct disorders (L. A. Clark & Watson, 1991). As a result, alternative models of the relationship between depression and anxiety have been proposed. For example, the poor discrimination between anxiety and depression has been taken by some investigators as evidence for a unitary model of anxiety and depression, which posits that anxiety and depression represent insignificant variations in the manifestation of a broader underlying syndrome that are erroneously classified as separate disorders (e.g., Andrews, 1996).

Whilst there is evidence to support shared variance and common genetic influences underlying depressive disorders and anxiety disorders (Andrews, 1996; Andrews, Stewart, Morris-Yates, Holt, & Henderson, 1990), evidence for discriminating features of anxiety and depression contradicts the unitary position (L. A. Clark & Watson, 1991). Content analyses of scales suggested that the anxiety scales with the best discriminant validity tend to measure physiological symptoms of anxiety rather than anxious mood, and the depression scales with the best discriminant validity tended to assess loss of interest and pleasure rather than other aspects of depressed

mood (L. A. Clark & Watson, 1991). Factor analytic studies have provided evidence for two broad distinct mood constructs underlying affective experience, identified as negative affect (NA) and positive affect (PA; Tellegen, 1985). NA reflects the extent to which a person is feeling upset or unpleasantly engaged instead of peaceful, and corresponds to a range of negative mood states, including fear, sadness, disgust, anger, and nervousness (Watson, Clark, & Carey, 1988). High PA reflects pleasant engagement with the environment, enthusiasm, and interest; whereas the absence of (or low) PA is characterised as tendency towards experiencing fatigue, lethargy, and lack of interest (L. A. Clark & Watson, 1991; Watson, Clark, & Carey, 1988). NA and PA have been found to be differentially related to depression and anxiety: NA is a nonspecific factor related to both depression and anxiety; whereas PA is specifically related to depressed mood and symptomatology but unrelated to anxious mood and symptoms (Tellegen, 1985; Watson, Clark, & Carey, 1988).

In reviewing the existing anxiety and depression literature, L. A. Clark and Watson (1991) extended the two-factor model of affect by proposing a third factor – autonomic arousal (AA) – that is specific to anxiety. Thus, according to their 'tripartite' model, anxiety and depression overlap due to a shared underlying general distress factor called NA. However, depression and anxiety also have unique symptom components: depression is specifically associated with PA, whereas anxiety is specifically associated with AA. That is, depression is characterised by reduced PA, or a reduced ability to respond to PA. AA includes physiological anxiety symptoms reflecting over-arousal of the sympathetic nervous system, and is specifically related to anxiety.

Evidence for the tripartite model in adults

The tripartite model was proposed after reviewing psychometric evidence related to anxiety and depression (L. A. Clark & Watson, 1991). Since its proposal, numerous studies have tested the construct validity of the tripartite model by examining

the factor structure of mood and anxiety symptoms in various adult clinical and nonclinical populations. These studies can broadly be divided into studies using the Mood and Anxiety Symptom Questionnaire (MASQ), and those using other self-report measures of anxiety and depression.

To operationalise and measure the dimensions of the tripartite model, Watson, Weber, et al. (1995) developed the MASQ, a 90-item self-report measure assessing a broad range of depression and anxiety symptoms. Watson, Weber et al. divided the symptoms into five subscales: those specific to anxiety, labelled "Anxious Arousal"; those specific to depression, labelled "Anhedonic Depression"; those that are less specific to anxiety and depression, labelled "General Distress: Anxiety", and "General Distress: Depression", respectively; and those common to both anxiety and depression, labelled "General Distress: Mixed". In a second study, Watson, Clark, et al. (1995) conducted exploratory factor analysis (EFA) of the MASQ in five samples: three student samples (*n*s = 516, 381, 522), one adult community sample (*n* = 329), and one clinical sample consisting of outpatients with substance use problems (*n* = 470). They obtained broad support for a three-factor structure across these samples: general distress (i.e., NA), somatic arousal (i.e., AA), and PA. Whilst there were some discrepancies with the hypothesised factor solution (for example, some items theorised to reflect general distress, such as 'feeling nauseous' and 'tense or sore muscles', loaded onto the somatic arousal factor; and one item, 'slept very well', did not load onto any factor), the study provided support for the tripartite model factors as distinct but related factors.

Several other studies have used the MASQ to test the validity of the tripartite model. Bedford et al. (1997) conducted EFA of the MASQ using the same samples as in the original MASQ validation studies (Watson, Clark, et al., 1995; Watson, Weber, et al., 1995). Bedford et al. obtained a three-factor structure similar to that of Watson, Clark et al. (1995); however, using their cut-off criteria for a meaningful factor loading,

the depression-specific factor included only items reflecting the presence, rather than the presence and absence, of PA. In a confirmatory factor analysis (CFA) of the MASQ using the student and clinical samples from the original validation studies, Burns and Eidelson (1998) found that a two-factor model (comprising separate anxiety and depression factors) provided a better fit than a three-factor model. However, this study excluded the "General Distress: Mixed" subscale from the analyses; thus, it is not surprising that a two-factor structure was supported.

In an EFA of the MASQ in an undergraduate student sample (n = 534), Keogh and Reidy (2000) obtained a three-factor model consistent with the tripartite model. However, they also found that some items cross-loaded and other items loaded onto factors differently to what had been hypothesised. Similar to the findings of Watson, Clark, et al. (1995), the somatic arousal factor also included other somatic symptoms theorised to reflect general distress. Several recent studies have not supported a three-factor structure of the MASQ (Boschen & Oei, 2006; Buckby, Cotton, Cosgrave, Killackey, & Yung, 2008). Boschen and Oei (2006) used CFA to examine the factor structure of the MASQ in 470 psychiatric outpatients with anxiety and mood disorder diagnoses, and found that neither a three-factor nor alternative two- or five-factor models provided an acceptable fit to the data. Buckby et al. (2008) used CFA to examine the MASQ in a sample of 137 older adolescents and young adults, and found that a two-factor model provided a better fit than one- or three-factor models.

Whilst these studies may indicate that the tripartite model needs refining, it has also been argued that variability in factor structure of the MASQ may result from the scale containing redundant items which load onto more than one, or none, of the tripartite model factors (Boschen & Oei, 2006). This has led to the development of a shorter version of the MASQ, and initial studies have provided support for a factor structure consistent with the tripartite model (Lin et al., 2014; Wardenaar et al., 2010).

In addition to analyses using the MASQ, a number of studies have tested the tripartite model by conducting factor analyses of other scales of depression and anxiety in adult samples. Steer, Clark, and Ranieri (1994) conducted a principal components analysis of the Symptom Checklist-90-Revised (SCL-90-R; Rallis, Skouteris, McCabe, & Milgrom, 2014) completed by outpatients diagnosed with mixed psychiatric disorders (n = 900). Their analyses revealed a single component accounting for nearly a third of the total item variance, which was interpreted as reflecting general distress. After partialling out this component, a second principal components analysis was conducted, in which they found four specific residual components interpreted as somatic anxiety, depression, irritability, and attention problems. Steer et al. concluded that their findings provided partial support of the tripartite model, as the somatic anxiety and depression components resembled the tripartite model dimensions of AA and PA respectively.

Several studies have examined the factor structure underlying the pooled items of the Beck Anxiety Inventory (BAI; Beck, Epstein, Brown, & Steer, 1988) and the Beck Depression Inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). Clark, Steer, and Beck (1994) conducted a principal factor analysis with oblique rotation on the pooled items of the BDI and BAI in undergraduate (n = 420) and psychiatric outpatient samples (n = 844). In both samples, they obtained two correlated factors reflecting depression and anxiety. Next, Clark et al. conducted a second-order factor analysis on the correlation matrices of these two factors, which revealed a large general distress/NA factor, as well as specific depression and anxiety factors in both samples. Clark et al. concluded that their results provided support for the existence of common and specific anxiety and depression factors as hypothesised by the tripartite model. These findings were also replicated in a sample of 1000 outpatients with mixed psychiatric disorders (Steer, Clark, Beck, & Ranieri, 1995); and again using the BAI and the Beck Depression Inventory-II (BDI-II; Beck, Steer, & Brown, 1996) in 840

outpatients with mixed disorders (Steer, Clark, Beck, & Ranieri, 1999). These studies provide support for the tripartite model but suggest a hierarchical arrangement of factors. It has also been argued that these higher-order models may at least partly result from the high internal consistency of the BAI and BDI (each measure was developed to have a high internal consistency and to measure a specific construct), as well as the underrepresentation of items reflecting low PA in the BDI (Mineka et al., 1998).

An alternative hierarchical model of the tripartite model factors was supported in a study by Brown, Chorpita and Barlow (1998), who examined the relations of several DSM-IV anxiety and mood disorder factors and the three tripartite model factors in a sample of 350 psychiatric outpatients with anxiety or depressive disorders. NA and PA were measured using the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988), and AA was measured using items from the BAI and the Anxiety scale of the Depression Anxiety Stress Scales (DASS; S. H. Lovibond & P. F. Lovibond, 1995). Latent variables were formed for diagnoses of depression (major depression and dysthymia), generalised anxiety disorder (GAD), panic disorder/agoraphobia, obsessive-compulsive disorder (OCD), and social phobia. Structural equation modelling was used to test the measurement models and examine the relations between the tripartite and disorder factors. The best-fitting model was mostly consistent with their predictions, albeit with several modifications: NA emerged as a higher order factor influencing all of the disorders; PA emerged as a higher order factor that influenced depression and social phobia; and AA emerged as a lower order factor: rather than being related to all of the anxiety disorders, it was positively related to panic disorder/agoraphobia and inversely related to GAD (Brown et al., 1998). This model provided support for the tripartite structure of anxiety and depression symptoms and demonstrated that the factors are differentially related to anxiety and depressive diagnoses. In contrast to previous studies, their model had a hierarchical arrangement

suggesting that NA and PA are second-order mood dimensions, and that AA is a first-order symptom factor that is predicted by NA.

Other studies have reported non-hierarchical arrangements of the tripartite model factors: that is, the factors are related but do not have causal associations with one another. Joiner (1996) conducted CFA on subscales formed from existing self-report measures completed by 205 undergraduate students. Scales were formed from items drawn from measures including the BDI (reflecting NA and PA), the Rosenberg Self-Esteem Questionnaire (reflecting NA; Rosenberg, 1965); the BAI (reflecting AA and NA), and the PANAS (reflecting PA and NA). The best fitting model was a non-hierarchical three-factor model consisting of depression-specific, anxiety-specific, and NA symptom factors. This model structure closely resembled the tripartite model. Anxiety/AA and NA were positively correlated (r = .61), whereas the other factors were not significantly correlated.

Similarly, Marshall, Sherbourne, Meredith, Camp, and Hays (2003) examined the structure of self-reported symptoms in a sample of adults diagnosed four years prior as having depression (n = 315) or hypertension (n = 403). Items were selected from a self-report battery developed for use in the medical outcomes study from which the samples were drawn, and included a range of psychological and physical symptoms. The items were mapped onto the hypothesised tripartite model factors (NA, PA, and AA), and CFA was used to assess goodness of fit. A three-factor model consistent with the tripartite model provided the best fit. However, the authors noted several discrepancies with the hypothesised tripartite model. Firstly, the AA factor also included other nonspecific somatic symptoms (e.g., ‘back aches’) in addition to physiological anxiety symptoms. Secondly, the three tripartite factors were statistically differentiable but were all highly correlated, ranging from -.81 to -.86.

The tripartite structure of anxiety and depression has also been observed to exhibit measurement invariance across different age groups. Teachman, Siedlecki, and Magee et al. (2007) examined measurement invariance of the tripartite model in young (n = 90), middle (n = 133), and older (n = 111) adult cohorts. Item parcels were created from items drawn from various questionnaires: NA was measured using items drawn from the State Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), the Neuroticism subscale for the International Personality Item Pool (IPIP; Goldberg, 1999), STAI, and the PANAS; PA was measured using items drawn from the PANAS, the IPIP Neuroticism scale, and the Centre for Epidemiological Studies-Depression Scale (CES-D; Radloff, 1977); and AA was measured using items drawn from the STAI. Structural equation modelling was used was used to compare the goodness of fit of one-, two-, and three-factor models. They found that a three-factor model with a higher order NA factor and lower order AA and PA factors provided the best fit across the three age groups. Furthermore, multigroup analyses revealed that the groups showed invariance of the model, supporting the robustness of the tripartite model across younger, middle, and older adult populations.

It should be noted that more complex models of the underlying structure of anxiety and depression have been proposed in recent years, based on studies examining patterns of comorbidity in anxiety and depressive disorders, and examination of the symptoms underlying specific disorders. For example, Watson (2009) more recently proposed a revised 'quadripartite' model of anxiety and depression. Whereas the tripartite model classifies symptoms as either specific or non-specific, the quadripartite model classifies symptoms in terms of their distress (high or low) and their specificity to depression or anxiety (e.g., high or low). Whilst these more complex models have led to a more detailed understanding of the common and unique symptom dimensions underlying anxiety and depressive disorders (including the specific and non-specific

symptoms for individual anxiety disorders), these analyses have continued to support the basic tenets of the tripartite model: for example, that anxiety and depression share a common factor of general distress/NA, and that low PA is specific to depression (Watson, 2009). Thus, the tripartite model still remains a potentially useful framework for understanding the relationship between anxiety and depression symptoms, particularly in populations where the relationship between depression and anxiety is less well studied. Therefore, the present program of research elected to focus on the tripartite model.

Summary. Overall, the tripartite model has received support across numerous studies using clinical and non-clinical adult samples. Factor analytic studies of self-report anxiety and depression data have largely found that a three-factor model (consisting of three correlated factors NA, PA, and AA) provides a better fit than alternative models. Whilst studies have at times differed in the hierarchical arrangement of these factors (e.g., Brown et al., 1998), the specific item composition of factors (Marshall et al., 2003), and the strength of the relationship between factors, they have generally supported a tripartite structure of anxiety and depressive symptoms. Some of the inconsistencies across studies may have resulted from methodological differences, such as analytic methods (exploratory vs. confirmatory factor analysis) and different units of analysis (scale level vs. item level). Furthermore, the findings may vary according to the measures used (e.g., scales which underrepresent certain tripartite model symptom dimensions, or include redundant items). These previous findings will guide the present thesis in terms of methodology and analytic methods.

Other support for the tripartite model. Further support for the construct validity of the tripartite model has emerged from studies demonstrating that NA, PA, and AA are differentially related to external variables, including anxiety and depressive diagnoses. In a sample comprising psychiatric inpatients and their twins, Watson, Clark,

and Carey (1988) examined the relationship between NA and PA and anxiety and depressive diagnoses, and found that NA was associated with both anxiety and depressive disorders, whereas PA was uniquely associated with diagnoses of depressive disorders. As described earlier, Brown et al. (1998) found that NA, PA, and AA were differentially related to several anxiety and depressive disorders. These studies have strengthened the construct validity of the tripartite model by linking the symptom dimensions to anxiety and depressive diagnoses.

The tripartite model factors have also been shown to be associated with physiological measures, including differential brain activity in anxious and depressed individuals. For example, high NA has been linked to increased activity in the bed nucleus of the stria terminalis, and the right frontal cortex; high AA has been linked to increased activity in the right parietotemporal region; whereas low PA has been linked to decreased activity in this region, as well as in the left frontal region (see Mineka et al., 1998, for review).

In addition, the tripartite model factors have been found to be differentially associated with life events. Some studies have examined the association between daily life events and the tripartite model symptom dimensions. For example, L. A. Clark and Watson (1988) examined the relationship between daily life events and PA and NA in 18 young adults over a three month period. PA was found to be associated with wide range of daily events, including social interactions; whereas NA was unrelated to social activity. Low PA was also associated with health complaints, whereas high NA was associated with physical problems. Other studies have examined the associations between major negative life events (e.g., major financial difficulties, death of a close relative) and the tripartite model factors. For example, Wardenaar, van Veen, Giltay, Zitman, and Penninx (2014) examined the longitudinal associations (at baseline, one year, and two year follow-up) between negative life events and self-reported NA, PA,

and AA as measured using the MASQ's "General Distress", "Anhedonic Depression", and "Anxious Arousal" subscales, respectively, in 2252 individuals with and without psychiatric diagnoses. Negative life events were associated with increasing NA and AA, and had a lesser association with PA. The association between negative life events and PA was larger in participants without previous psychiatric problems. These findings suggest that life events differentially affect the symptom dimensions underlying anxiety and depression.

Implications of the tripartite model

The tripartite model has a number of implications for the conceptualisation, measurement, and treatment of anxiety and depression. Firstly, the tripartite model provides an account for the overlap between anxiety and depression, as it posits that anxiety and depression have shared and overlapping features (NA) as well as specific features (PA and AA). The tripartite model therefore suggests that anxiety and depression do not represent completely separable constructs. However, improved discrimination of depression and anxiety may be achieved by focusing on their specific components (i.e., assessing levels of PA and AA), rather than their shared component, NA (L. A. Clark & Watson, 1991). There is evidence that focusing on assessing the specific symptoms of anxiety (AA) and depression (PA) enhances discriminant validity of measures (Brown et al., 1998).

The finding that NA accounts for a significant proportion of variance across a number of DSM-IV unipolar mood and anxiety disorders has led some to conclude that their commonalities surpass their differences (e.g., Barlow, 2004). Thus, based on this premise, treatments can be designed to be applicable across the spectrum of emotional disorders, rather than trying to develop specific treatments for each disorder (Barlow, 2004). This has led to the development of transdiagnostic psychotherapies, which purport to have their effect by modifying the nonspecific component of the emotional

disorders (Norton & Philipp, 2008). In support of this premise, studies of transdiagnostic treatments targeting anxiety disorders have reported corresponding reductions in depressive symptoms, despite depression not being specifically addressed in the treatment (Norton, Hayes, & Hope, 2004). It has been proposed that existing treatments that are broadly effective across the emotional disorders (e.g., cognitive-behavioural therapy, selective serotonin reuptake inhibitors) may primarily act by decreasing NA (or may target more than one dimension). NA therefore appears to represent an important and modifiable common factor underlying depression and anxiety.

Whilst NA accounts for a substantial proportion of variance of the anxiety and depressive disorders, research suggesting that anxiety and depressive symptoms cannot be collapsed into a single dimension (e.g., Brown et al., 1998) suggests that the symptom dimensions PA and AA may also represent specific targets in treatment. Several recent studies have examined changes in NA, PA, and AA over the course of treatment, and have found that they are differentially modified by particular treatments (e.g., Kring, Persons, & Thomas, 2007; Mausbach, Roepke, Depp, Patterson, & Grant, 2009). Thus, the presence of elevated levels of PA or AA may indicate different treatment strategies that have specificity to depression or anxiety respectively. For example, empirically supported treatments for depression may act by increasing PA (e.g., interpersonal psychotherapy, tricyclic antidepressants, specific components of cognitive-behavioural therapy such as scheduling pleasant activities and reducing social withdrawal). Anxiety, on the other hand, is characterised by high AA, and may indicate additional arousal reduction techniques (such as exposure to feared stimuli and relaxation training).

In addition to guiding development of psychotherapeutic methods, the tripartite model has also contributed to the development of psychopharmacological treatment

models. Even though the treatment of postpartum psychopathology is beyond the scope of the present thesis, it is important to briefly review some of these therapeutic implications. For example, Shelton and Tomarken (2001) proposed a treatment heuristic proposing that different psychotropic medications act by differentially modifying the dimensions of PA, NA, and AA. Shelton and Tomarken suggested that PA is primarily dependent on dopamine and noradrenaline, and hence low PA may indicate catecholaminergic drugs. On the other hand, NA and PA are theorised to be significantly modulated by serotonin, and thus elevations on these symptom dimensions may indicate serotonergic drugs. Some studies have examined the differential effects of medication on tripartite model symptom dimensions. Nutt et al. (2007) reviewed preliminary evidence suggesting that antidepressants that enhance noradrenergic and dopaminergic activity may be more effective over serotonergic antidepressants for symptoms of low PA. Consistent with their findings, Tomarken, Dichter, Freid, Addington, and Shelton (2004) observed greater impact of a dopaminergic antidepressant on low PA compared to anxiety symptoms. On the other hand, Dichter, Tomarken, Freid, Addington, and Shelton (2005) did not observe differential effects of serotonergic and noradrenergic antidepressants on PA and NA – rather, both drugs led to changes in these symptom dimensions. These studies further highlight the potential utility in measuring specific symptom dimensions throughout assessment and treatment.

Summary. The tripartite model has continued to be supported by psychometric evidence indicating that anxiety and depression have shared and unique symptom components. Whilst increasingly complex models of the underlying structure of anxiety and depression have emerged as successors to the tripartite model, these analyses have largely continued to support the basic premises of the tripartite model. The tripartite model provides a model for understanding the relationship between anxiety and depression, and has also facilitated the refinement of methods used to assess and treat

anxiety and depression. The tripartite model may therefore provide a useful framework for examining the broad structure of anxiety and depression in postpartum samples where the symptoms and relationship between anxiety and depression are less well understood. If the tripartite model is demonstrated to apply to a postpartum sample, then its implications for assessment and treatment will also be relevant to postpartum emotional disorders.

A test of the tripartite model of anxiety and depression in a postpartum psychiatric inpatient sample

Rationale for this thesis

There is increasing recognition that both depression and anxiety (at both the symptom and diagnostic level) are common in the postpartum period. However, few self-report measures of anxiety have been validated for use in postpartum samples. Furthermore, as the literature moves to differentiate these constructs, and to refine measurement of postpartum anxiety, it is important to recognise that in other populations, anxiety and depression are known to overlap, and that this poses an obstacle for their assessment and differentiation. In the wider anxiety and depression literature, previous research has supported a tripartite structure of anxiety and depressive symptoms, which posits that these syndromes share a common symptom component, but each also has its own unique symptom component (L. A. Clark & Watson, 1991). Thus, measurement of anxiety and depression can be refined by assessing their specific components, which may also represent specific targets in treatment.

Given that there is little evidence to support phenomenological differences between postpartum and non-postpartum emotional disorders, and there is increasing recognition that both anxiety and depression are common in postpartum, the tripartite model may provide a framework for understanding the nature and relationship of

anxiety and depression in the postpartum period. This model has the potential to guide improved assessment as well as treatment in postpartum samples, but only if it is able to describe emotional symptoms in postpartum as well as it does in other populations. On the other hand, if a tripartite structure of postpartum anxiety and depression symptoms is not supported, the findings will similarly have implications for the conceptualisation and measurement of postpartum anxiety and depression.

Despite its prominence in the general depression and anxiety literature, few studies have tested aspects of the tripartite model in postpartum samples. Given that the literature has primarily focused on postpartum depression, most studies have focused on examining the factor structure of depressive symptoms. Buttner, O'Hara, and Watson (2012) conducted an exploratory factor analysis of self-reported mood symptoms in a nonclinical sample of women in the first week postpartum, and identified two factors consistent with the symptom dimensions NA and PA. Based on the identification of these dimensions, the authors concluded that the structure of women's mood post-delivery is no different to that outside of the early postpartum period. V. J. M Pop et al. (2015) also found support for separate NA and PA factors underlying the Maternity Blues Scale (Kennerley & Gath, 1989) in a sample of women assessed one week postpartum. Tuohy and McVey (2008) conducted an EFA of the EPDS, and then examined the relations of the EPDS factors with PA and NA, as measured using the PANAS (Watson, Clark, & Tellegen, 1988). The EFA revealed three factors reflecting anxiety, depression, and anhedonia. The three EPDS factors were correlated with NA, whereas PA was only related to the anhedonia factor. These results suggest that the EPDS comprises subscales reflecting nonspecific anxiety and depression symptoms (i.e., NA) and low PA.

Overall, whilst the aforementioned studies support the existence of separate symptom domains (NA and PA) underlying postpartum negative emotional states,

analyses have not been extended to include anxiety. To our knowledge, only one study has concurrently examined the factor structure of anxiety and depressive symptoms in a postpartum sample. Segre, McCabe, Chuffo-Siewert, and O'Hara, 2014 (2014) examined the factor structure of depression and anxiety symptoms in a sample of postpartum mothers of infants hospitalised in a neonatal intensive care unit (NICU). Participants were administered the EPDS, the BAI, and the Panic and Traumatic Intrusions subscales of the Inventory of Depression and Anxiety Symptoms (IDAS; Watson et al., 2007). Structural equation modelling was used to compare a diagnostic classification model (positing distinct depression and anxiety factors) with a 'common factor' model, consisting of three lower order factors (depression, anxious arousal, trauma symptoms) and a higher order factor called negative emotionality (representing the shared variance amongst the lower order factors). The 'common factor' model provided a superior fit compared to the diagnostic classification model. Whilst this study did not explicitly test the tripartite model, the findings provided support for a common negative emotionality/NA factor, as well as distinct depression and anxious arousal factors; and suggested that a model composed of common and specific symptom factors provided a better fit than a two-factor (anxiety symptoms vs. depression symptoms) model.

The present thesis set out to examine the psychometric integrity of several self-report instruments in a sample of postpartum psychiatric inpatients, and to test whether the tripartite model adequately described the latent structure of anxiety and depression symptoms in postpartum psychiatric inpatients. For this purpose, self-report anxiety and depression data was collected from female psychiatric inpatients at the Western Australian Mother and Baby Unit (WAMBU) between June 2007 and December 2013[1].

[1] Given that the analyses for the studies across Chapters 2 to 4 were conducted at different times, the sample sizes and data collection times differ slightly.

The WAMBU is a public psychiatric unit that provides inpatient assessment and treatment of women experiencing acute psychiatric conditions in the perinatal period, and allows admission of women with their infants.

There were various reasons why a psychiatric inpatient sample was advantageous to use in these analyses. Firstly, previous studies attempting to recruit nonclinical samples of postpartum women have reported low rates of participation (e.g., Appleby & Whitton, 1993). Whilst a hospital inpatient sample is not representative of postpartum women drawn from the general population, using such a sample would allow for a higher participation rate, hence providing adequate sample sizes for conducting factor analyses. Moreover, using a hospital sample enabled the collection of data at admission and discharge from the hospital, thereby making it possible to examine any change across the two time points.

Secondly, it was theorised that a clinical sample with severe psychopathology would have a higher base rate of symptoms and would therefore endorse a broader range of symptoms. Based on their review of existing anxiety and depression literature, L. A. Clark and Watson (1991) posited that nonclinical samples tend to primarily endorse symptoms of NA and that symptoms reflecting low PA and high AA are less common in these samples compared to clinical samples As a result, anxiety and depression are more easily differentiable as severity increases (L. A. Clark & Watson, 1991). Thus, using an inpatient sample could arguably allow for broader symptom coverage and easier discrimination between the factors underlying anxiety and depression.

Finally, using a clinical sample with high rates of current psychiatric diagnoses would allow the examination of relations between symptom factors and assigned psychiatric diagnoses. In the inpatient sample, patients were assigned a principal

diagnosis, classified according to International Statistical Classification of Diseases and Related Health Problems, Tenth Revision, Australian Modification (ICD-10-AM; National Centre for Classification in Health Publications, 2002) criteria. Several previous studies have found that the tripartite model factors are differentially related to diagnoses of anxiety and depressive disorders (e.g., Watson, Clark, & Carey, 1988), which has strengthened construct validity of the factors. Using an inpatient sample would allow the examination of the relationship of diagnoses, including anxiety diagnoses, depressive diagnoses, and diagnoses representing mixed anxiety and depressive presentations (e.g., adjustment disorder, mixed anxiety-depressive disorder) to tripartite model symptom dimensions.

Organisation of this thesis

This thesis specifically aims to (a) examine the psychometric integrity in a postpartum inpatient population of two measures, the Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987) and the Depression Anxiety Stress Scales (DASS; S. H. Lovibond & P. F. Lovibond, 1995); (b) examine whether the tripartite model of anxiety and depression provides an optimal fit to self-reported anxiety and depression data in a postpartum clinical sample; and (c) examine the relationship of the factors underlying postpartum anxiety and depression symptoms to ICD-10 diagnoses of unipolar mood disorders, anxiety disorders, and disorders characterised by a mixture of anxiety and depressive symptoms (adjustment, mixed anxiety-depressive disorder). The present thesis set out to test these aims using self-report anxiety and depression data from questionnaires completed by postpartum psychiatric inpatients at admission to a psychiatric mother and baby unit.

In addition to testing the tripartite model, there were several questions regarding the measurement of postpartum anxiety and depression that warranted investigation. These investigations formed separate studies prior to testing the tripartite model of

anxiety and depression. Firstly, the psychometric properties of several self-report measures of anxiety and depression in the postpartum inpatient sample were examined. The EPDS was examined, as the instrument is widely used in perinatal research and clinical practice, but its factor structure and psychometric properties have varied across studies. Previous studies have suggested that the EPDS contains separate depression and anxiety factors (e.g., Matthey, 2008; Phillips, Charles, et al., 2009), suggesting that the EPDS may be useful for assessing both anxiety and depressive symptoms in an inpatient sample. However, the factor structure of the EPDS has varied across previous studies, and some studies have not provided evidence for a distinct anxiety factor (e.g., Ross et al., 2003; Small, Lumley, Yelland, & Brown, 2007). A more detailed review of existing factor analyses of the EPDS is included in Chapter 2. This issue needed to be investigated to determine whether the EPDS was suitable for measuring anxiety and depression in a postpartum clinical sample. As a result, Chapter 2 aimed to examine the factor structure of the EPDS in the sample of postpartum psychiatric inpatients, and to examine whether the factor structure remained stable across hospital admission and discharge.

It was found that the factor structure of the EPDS was not stable across admission and discharge: two factors emerged at admission, whereas three factors emerged at discharge. These findings suggested that the constructs reflected by the EPDS changed over time, possibly as a function of symptom severity: that is, patients may have interpreted and/or responded to the EPDS items differently at hospital admission versus discharge. These findings raised a question regarding the factor structure of self-report measures in the postpartum sample: was the issue of non-invariance of the factor structure specific to the EPDS, or was it characteristic of the postpartum inpatient sample more generally? That is, do the postpartum inpatients respond differently to self-report measures when their symptoms are more severe? This

conceptual issue related to a longstanding debate as to whether postpartum emotional disorders (anxiety and depression) have a unique clinical presentation compared to non-postpartum emotional disorders. If the clinical presentation is different, then it could be expected that the underlying structure of depression and anxiety symptoms in a postpartum clinical sample would also differ.

Chapter 3 therefore aimed to explore this issue by examining the factor structure of an existing self-report measure of anxiety and depression that has previously been found to have a stable and robust factor structure. The Depression Anxiety Stress Scales (DASS; S. H. Lovibond & P. F. Lovibond, 1995) was chosen for this purpose: the DASS is a 42-item self-report test, consisting of three scales that assess three negative emotional states: depression, anxiety, and stress. Previous studies have provided robust support for the DASS as a measure of three distinct but related emotional symptom constructs (depression, anxiety, and stress) in non-clinical, psychiatric outpatient, and psychiatric inpatient samples (Brown, Chorpita, Korotitsch, & Barlow, 1997; Crawford & Henry, 2003; Page, Hooke, & Morrison, 2007). The DASS has demonstrated factorial invariance across time, as well as across samples with different levels of symptom severity. Whilst the factor structure of the DASS has not previously been examined in a postpartum sample, an advantage is that it is clear from the wider literature what its factor structure should look like. Thus, the second study set out to examine the reliability, validity, and factor structure of the DASS in a postpartum inpatient sample. In line with the view, based on the existing literature, that there are no substantial differences between postpartum and non-postpartum emotional disorders, it was predicted that the factor structure obtained in previous studies of the DASS would provide the best fit in the postpartum inpatient sample.

The findings of Chapter 3 suggested a three-factor model obtained in previous studies provided the best fit to the DASS in the postpartum sample. Moreover, the

factor structure was invariant across admission and discharge, suggesting that it did not vary as a function of symptom severity. These findings suggested that the variability of the EPDS factor structure was specific to the EPDS, rather than due to the nature of distress in the postpartum sample. Furthermore, the results provided support to the theory that the latent structure of anxiety and depression symptoms (as measured by the DASS) were similar to that observed in non-postpartum populations, and hence it was possible to be more confident in using existing self-report questionnaires developed for use in the general population in a postpartum inpatient sample.

Next, Chapter 4 turned to the second objective of the thesis: to test whether the tripartite model provided an adequate fit to self-report anxiety and depression data in a sample of postpartum psychiatric inpatients. Items were drawn from self-report anxiety and depression measures completed by the psychiatric inpatients at hospital admission. These items were mapped on to the hypothesised tripartite model factors of positive affect, negative affect, and autonomic arousal. Confirmatory factor analysis was used to examine the goodness of fit of a measurement model consistent with the tripartite model, and to compare its goodness of fit to alternative models. The results suggested that the tripartite model provided an adequate fit to the data, and was superior to alternative, simpler models. Next, the relationships of the tripartite model factors to variables indicating the presence/absence of anxiety, depressive, and mixed anxiety-depressive disorder diagnoses were examined. Consistent with the tripartite model, the factors NA, PA, and AA were differentially related to the diagnosis variables.

The results from the three studies contained in the thesis are summarised in the General Discussion (Chapter 5) and are interpreted in the context of the wider literature on postpartum anxiety and depression. Here we also review methodological limitations and suggestions for future research.

Chapter 2: Does the Edinburgh Postnatal Depression Scale measure the same constructs across time?

Foreword to Chapter 2

The study presented in Chapter 2 set out to examine the factor structure of the Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987) in a postpartum psychiatric inpatient sample with mixed psychiatric diagnoses at hospital admission and discharge. The EPDS is a widely used instrument used to screen for depression in postpartum samples. Factor analytic and correlational analyses have provided evidence that it measures both depression and anxiety. However, its utility and validity have not previously been examined in a postpartum psychiatric inpatient sample. Furthermore, a literature review of factor analyses of the EPDS (included in Chapter 2) revealed that the scale's factor structure has varied across studies. This issue needed to be investigated to determine whether the EPDS was suitable for measuring anxiety and depression in the postpartum clinical sample. As a result, Chapter 2 aimed to examine the factor structure of the EPDS in the sample of postpartum psychiatric inpatients, and to examine whether the factor structure remained stable across hospital admission and discharge.

The study presented in this chapter has been published as:

Cunningham, N. K., Brown, P. M., & Page, A. C. (2015). Does the Edinburgh Postnatal Depression Scale measure the same constructs across time? *Archives of Women's Mental Health, 18*(6), 793-804.

Abstract

Purpose. The Edinburgh Postnatal Depression Scale is the most widely used measure for screening for depression in perinatal populations. A weakness is that the factor structure of the scale is inconsistent across studies. It is unclear the degree to which this inconsistency results from variability arising from the EPDS. The present study aimed to determine whether the EPDS factor structure remained stable in the same individuals reporting on their levels of distress across two testing occasions.

Methods. Data were analysed for 636 postpartum inpatient females who were administered the EPDS at admission and discharge from a psychiatric mother and baby unit. Exploratory factor analyses (EFAs) and confirmatory factor analyses (CFAs) were conducted separately on the admission and discharge data to determine the optimal factor structure at each time point.

Results. The EFAs and CFAs supported a two-factor model at admission and a three-factor model at discharge. Given that the EPDS did not demonstrate an invariant number of factors, no further tests of measurement invariance were conducted.

Conclusions. The EPDS does not appear to be invariant from admission to discharge. These findings suggest that individuals may respond differently to items depending on their level of distress. Potential implications for the EPDS in terms of comparability of scores across groups/time and its screening abilities are discussed.

Introduction

The Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987) is a widely used 10-item self-report instrument designed to screen for major depression in the postpartum period. Since its development, the EPDS has been translated to multiple languages and used in many countries to screen for depression in both antenatal and postpartum populations in both research (e.g., Heron, O'Connor, Evans, Golding, & Glover, 2004) and clinical practice (e.g., Schaper, Rooney, Kay, & Silva, 1994). It was developed in response to concern that depression screening measures designed for use in the general population often included somatic symptoms (e.g., lack of sleep, weight and appetite changes, and difficulty concentrating) which were commonly experienced by women in the postpartum period, and could therefore potentially lead to inflated depression scores and false positive rates in this population. Cox et al. (1987) originally validated the EPDS against research diagnostic criteria for major depression, and a score of 13 and over was found to be the optimal cut-off score for probable major depression. In subsequent studies, however, optimal cut-off scores (and their sensitivity, specificity, and positive predictive value) have been found to vary (Eberhard-Gran, Eskild, Tambs, Opjordsmoen, & Ove Samuelsen, 2001; Gibson, McKenzie-McHarg, Shakespeare, Price, & Gray, 2009).

A weakness of the EPDS is that it has an inconsistent factor structure across studies. Whilst Cox et al. (1987) originally described the EPDS as unidimensional, they did not empirically test the factor structure of the final 10-item scale to confirm its dimensionality. Subsequently, more than twenty published studies have reported on the dimensional structure of the EPDS in pregnant or postpartum samples (Table 1). Of these studies, only one has found a unidimensional structure (Berle, Aarre, Mykletun, Dahl, & Holsten, 2003). The majority have found two (Matthey, 2008; Mazhari & Nakhaee, 2007; Phillips, Charles, et al., 2009; V. J. Pop, Komproe, & van Son, 1992) or three (Brouwers,

van Baar, & Pop, 2001; Ross et al., 2003; Small et al., 2007; Tuohy & McVey, 2008) factors or components. Ten studies have reported on the dimensional structure of the English language version of the EPDS: eight using postpartum samples (Astbury, Brown, Lumley, & Small, 1994; Hartley, Barroso, Rey, Pettit, & Bagner, 2014; Lee King, 2012; Matthey, 2008; Phillips, Charles, et al., 2009; Ross et al., 2003; Small et al., 2007; Tuohy & McVey, 2008) and two using pregnant samples (Jomeen & Martin, 2005, 2007). All of these studies have supported either two (Astbury et al., 1994; Hartley et al., 2014; Matthey, 2008; Phillips, Charles, et al., 2009) or three (Lee King, 2012; Ross et al., 2003; Small et al., 2007; Tuohy & McVey, 2008) factor solutions. However, despite similar factor numbers, the item-factor structures have varied. Three studies reported a two-factor structure consisting of a depression factor comprising items 1, 2, 6, 7, 8, 9, and 10, and an anxiety factor comprising items 3, 4, and 5 (Astbury et al., 1994; Matthey, 2008; Phillips, Charles, et al., 2009). A number of other studies also obtained this anxiety factor, but with additional items (e.g., items 6, 7) cross-loading onto it (Ross et al., 2003; Small et al., 2007; Tuohy & McVey, 2008). A factor comprising items 1 and 2 has been distinguished from the depression and anxiety factors in some studies, and has been labelled anhedonia (Tuohy & McVey, 2008). In other studies, a third factor comprising item 10 (amongst other items) has emerged, labelled suicide (Jomeen & Martin, 2005; Ross et al., 2003; Small et al., 2007). These studies suggest that EPDS scores reflect different constructs across different samples.

Table 1

Published principal component and factor analyses of the EPDS

Authors	Country: version	Sample	EPDS mean (SD)	Analysis	Rotation	Factor/component loadings reported	Variance accounted for	CFA factor structure
Adouard, Glangeaud-Freudenthal, & Golse (2005)	France: French	Pregnant, 28-34 weeks (n=60)	9.3 (6.1)	PCA	Orthogonal (Varimax)	F1: 3, 4, 5, 6, 7, 9, 10 F2: 1, 2, 7, 8, 9	62% (total)	-
Agampodi & Agampodi (2013)	Sri Lanka: Sri Lankan	Pregnant women, 24-36 weeks (n=376)	Median = 5.0	PCA	Orthogonal (Varimax)	F1: 3, 4, 5, 7, 8, 9, 10 F2: 1, 2, 8	F1: 29.6% F2: 12.8	-
Astbury et al. (1994)	Australia: English	Postpartum, 6-9 months (n=771)	7.6 (4.8)	PCA	Oblique	F1: 1, 2, 6, 7, 8, 9, 10 F2: 3, 4, 5	F1: 38.9% F2: 5.2%	-
Berle et al. (2003)	Norway: Norwegian	Postpartum, 6-12 weeks (n=411)	Not reported	PCA	Oblique	F1: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10	F1: 46.6%	-
Brouwers et al. (2001)	Netherlands: Dutch	Pregnant, 24 weeks (n=197)	4.9 (3.7)	PCA	Orthogonal (Varimax)	F1: 1, 2, 6, 7, 8, 9 F2: 3, 4, 5, 6 F3: 7, 8, 9, 10	F1: 39.9% F2: 12.2% F3: not reported	-
Chabrol & Teissedre (2004)	France: French	Postpartum, 2-3 days (n=299)	Not reported	PCA	Orthogonal (Varimax)	F1: 3, 4, 5, 6, 7 F2: 8, 9, 10 F3: 1, 2	F1: 28.0% F2: 18.0% F3: 17.0%	Final factors and loadings not reported
Guedeney & Fermanian (1998)	France: French	Postpartum, 0-4 months (n=87)	9.78 (SD not reported)	PCA	Orthogonal (Varimax)	F1: 3, 4, 5, 6, 7, 8, 9, 10 F2: 1, 2, 8, 9, 10	F1: 40.6% F2: 12.7%	-

Authors	Country: version	Sample	EPDS mean (SD)	Analysis	Rotation	Factor/component loadings reported	Variance accounted for	CFA factor structure
Hartley et al. (2014)	United States: 1. English 2. Spanish	Hispanic postpartum women,0-10 months (n=220)	1. English: 6.61 (5.12) 2. Spanish: 5.38 (4.86)	CFA (ML with robust SEs)	-	-	-	1. English: F1: 1, 2, 8, 9 F2: 3, 4, 5 2. Spanish: F1: 1, 2, 8, 9 F2: 3, 4, 5
Jomeen & Martin (2005)	United Kingdom: English	Pregnant women, 14 weeks (n=101)	7.48 (4.40)	PCA, CFA (type not reported)	Oblique (Oblimin)	F1: 1, 2, 6, 7, 8, 9 F2: 3, 4, 5 F3: 10		F1: 1, 2, 8 F2: 3, 4, 5
Jomeen & Martin (2007)	United Kingdom: English	Pregnant women, 27-40 weeks (n=148)	7.62 (4.79)	CFA (WLSMV)	-	-	-	F1: 1, 2, 8 F2: 3, 4, 5, 8 F3: 10
Lee King (2012)	United States: English	African American postpartum women,0-9 months (n=169)	7.27 (6.11)	CFA (diagonally WLS)				F1: 1, 2 F2: 3, 4, 5 F3: 7, 8, 9, 10
Massoudi, Hwang, & Wickberg Massoudi (2013)	Sweden: Swedish	Postpartum women, 3 months (n=925)	Not reported	EFA (ML)	Oblique (Direct oblimin)	F1: 1, 2, 3, 6, 7, 8, 9 F2: 4, 5	F1: 42.9% F2: 7.5%	-
Matthey (2008)	Australian: English	Postpartum, 6 weeks (n=238)	Not reported	PCA	Unrotated	F1: 1, 2, 6, 7, 8, 9, 10 F2: 3, 4, 5	F1: 45.5% F2: 12.3%	-

Authors	Country: version	Sample	EPDS mean (SD)	Analysis	Rotation	Factor/component loadings reported	Variance accounted for	CFA factor structure
Montazeri, Torkan, & Omidvari (2007)	Iran: Persian	Postpartum , 6-14 weeks (n=100)	8.5 (5.1)	PCA	Orthogonal (Varimax)	F1: 3, 4, 5, 8 F2: 6, 7, 8, 9, 10 F3: 1, 2	F1: 33.7% F2: 13.1% F3: 11.2%	-
Phillips et al. (2009)	Australia: English	Postpartum, 0-12 months (n=309)	14.61 (95% CI=13.37–15.87)	EFA (ML), CFA	Oblique (Direct Oblimin)	F1: 1, 2, 6, 7, 8, 9, 10 F2: 3, 4, 5		F1: 1, 2, 6, 7, 8, 9, 10 F2: 3, 4, 5
Pop et al. (1992)	Netherlands: Dutch	Postpartum, 4 weeks (n=293)	5.89 (4.03)	EFA (principal axis factoring), CFA (ML)	Orthogonal (Varimax)	F1: 7, 8, 9, 10 F2: 3, 4, 5, 6 F3: 1, 2, 6, 8	F1: 38.5% F2: 16.8% F3: 11.1%	3 factor EFA model not admissable F1: 1, 2, 6, 7,8, 9, 10 F2: 3, 4, 5, 6 CE: 1↔2, 1↔6, 2↔6, 7↔10
Reichenheim, Moraes, Oliveira, & Lobato (2011)	Brazil: Brazilian Portuguese	Postpartum, 0-5 months (n=811)	7.80 (95% CI=7.4-8.2)	E/CFA, CFA	Oblique (Geomin)	F1: 1, 2, 6 F2: 3, 4, 5 F3: 7, 8, 9, 10		Bi-factor model: General factor: 1-10 F1: 1, 2, 6 F2: 3, 4, 5 F3: 7, 8, 9, 10
Ross et al. (2003)	Canada: English	Postpartum, 6 weeks (n=150)	5.43 (4.59)	PCA	Orthogonal (Varimax)	F1: 1, 2, 6, 7, 8, 9 F2: 3, 4, 5, 6, 7 F3: 2, 10	F1: 27.0% F2: 25.4% F3: 14.7%	-

Small et al. (2007)	Australia: 1. Vietnamese	1. Vietnamese-born women (living in Australia), 6-9mths postpartum (n=103)	1. Vietnamese: 6.6 (4.5)	PCA	Orthogonal (Varimax) and Oblique (not reported)	1. Vietnamese: F1: 1, 2, 3, 6, 8, 9 F2: 3, 4, 5, 7 F3: 10	1. Vietnamese: F1: 46.7% F2: 10.7% F3: 10.2%
	2. Turkish	2. Turkish-born women (living in Australia), 6-9 months postpartum (n=104)	2. Turkish: 9.2 (5.1)			2. Turkish: F1: 3, 4, 5, 6, 7, 8 F2: 3, 9, 10 F3: 1, 2	2. Turkish: F1: 36.1% F2: 13.6% F3: 10.6%
	3. Filipino	3. Philippines-born women (living in Australia), 6-9 months postpartum (n=106)	3. Filipino: 6.6 (4.0)			3. Filipino: F1: 3, 4, 5, 8 F2: 6, 7, 9, 10 F3: 1, 2	3. Filipino: F1: 37.1% F2: 12.7% F3: 10.0%
	4. English (completed by women born in non-English speaking country; SRM-NESB)	4. Women living in Australia born in an English-speaking country (SRM-NESB), 6-7 months postpartum (n=142)	4. SRM-NESB: 8.4 (5.7)			4. SRM-NESB: F1: 3, 4, 5, 6 F2: 7, 8, 9, 10 F3: 1, 2	4. SRM-NESB: F1: 41.7% F2: 15.1% F3: 9.7%
	5. English (completed by women born in an English-speaking	5. Women living in Australia born in English speaking countries (SRM-ESB), 6-7 months postpartum (n=1166)	5. SRM-ESB: 7.1 (5.1)			5. SRM-ESB: F1: 3, 4, 5, 6, 7 F2: 1, 2, 6, 8 F3: 9, 10	5. SRM-ESB: F1: 47.6% F2: 9.3% F3: 9.1%

Authors	Country: version	Sample	EPDS mean (SD)	Analysis	Rotation	Factor/component loadings reported	Variance accounted for	CFA factor structure
	country; SRM-ESB)							
Töreki et al. (2014)	Hungary: Hungarian	Postpartum, 6 weeks (n=266)	Major depression: 16.63 (2.77) Minor depression: 8.78 (3.30) Non-depressed: 4.40 (2.73)	PCA, CFA	Oblique	F1: 3, 4, 5, 6, F2: 1, 2, 9, 10	54.6% (total)	F1: 3, 4, 5, 6 F2: 1, 2, 9, 10
Töreki et al. (2013)	Hungary: Hungarian	Pregnant women, 12 weeks (n=219)	Major depression: 12.71 (7.27) Minor depression: 8.80 (3.75) Non-depressed: 4.11 (2.52)	PCA, CFA	Orthogonal (Varimax)	F1: 2, 4, 5, 6, 10 F2: 3, 8, 9 F3: 1, 7	Not reported	-
Tuohy & McVey (2008)	United Kingdom: English (computerised)	Postpartum, 0-12 months (n=440)	9.42 (5.72)	EFA (PAF)	Oblique (Direct quartimin)	F1: 7, 8, 9, 10 F2: 1, 2 F3: 3, 4, 5		-

Authors	Country: version	Sample	EPDS mean (SD)	Analysis	Rotation	Factor/component loadings reported	Variance accounted for	CFA factor structure
Vivilaki, Dafermos, Kogevinas, Bitsios, & Lionis (2009)Vivilaki	Greece: Greek	Postpartum women, 0-16 weeks (n=120)	8.16 (0.49)	PCA, CFA (ML)	Orthogonal (Varimax)	F1: 7, 8, 9 F2: 4, 5, 6	27.0% 21.96%	F1: 7, 8, 9 F2: 4, 5, 6
Zhong et al. (2014)	Peru: Peruvian	Pregnant women, 0-16 weeks (n=1517)	6.70 (5.60)	PCA, CFA	Orthogonal (Varimax)	F1: 3, 4, 5, 6, 7, 8, 9, 10 F2: 1, 2		F1: 1, 2, F2: 3, 4, 5, 6 F3: 7, 8, 9, 10

Note. CFA = confirmatory factor analysis, CE = correlated error, EFA = exploratory factor analysis, ML = maximum likelihood, PCA = principal components analysis, WLS = weighted least squares, WLSMV = means- and variance-adjusted weighted least squares

It is unclear whether the inconsistent factor structure reported for the EPDS reflects sampling and/or methodological variation across studies (e.g., inconsistencies in factor extraction methods, use of principal components analysis vs. exploratory factor analysis, use of orthogonal rotations for factors which would be expected to correlate, and/or using inappropriate estimation methods for a scale consisting of ordered-categorical items) or whether it reflects that the EPDS is in fact measuring different constructs across studies. When a measurement instrument is used across multiple populations, it is assumed that the instrument is assessing the same construct(s) on the same metric (scale) across populations. Similarly, when an instrument is used in a single population on more than one occasion, it is assumed that the scale is assessing the same construct(s) on the same metric at each time point (Widaman, Ferrer, & Conger, 2010). This measurement property is known as *measurement invariance*. If the assumption of measurement invariance is true, then the same constructs are being assessed in each group (or at each time point), and any differences in scores reflect true change rather than change due to other influences (i.e., measurement error). Thus, meaningful comparisons between the groups (or time points) can be made. If, however, measurement invariance is not supported, such comparisons do not produce meaningful results (Chen, 2008). Measurement invariance is a necessary condition for instruments used to classify or select individuals, to ensure fairness (i.e., a lack of bias) in selection (Borsboom, 2006; Meredith & Teresi, 2006). Given that the EPDS is widely used to detect individuals with probable depression, it is important to determine whether it meets the assumption of measurement invariance across various contexts.

Despite its importance, measurement invariance of the EPDS has scarcely been considered in the literature. Small, Lumley, Yelland, & Brown (2007) used exploratory factor analysis to explore the factor structure of the EPDS in five samples of women who were living in Australia but were born in different countries. Whilst they obtained

three-factor solutions in the five groups, the three factors varied across the groups in terms of their structure. Small et al. (2007) posited that these differences could reflect cultural differences in the experience of postpartum depression or differences due to translation of the scales. Hartley, Barroso, Rey, Pettit, and Bagner (2014) used confirmatory factor analysis to test measurement invariance of English and Spanish versions of the EPDS across two groups of Hispanic postpartum women. They found evidence for dimensional and configural invariance (equivalent number of factors and equivalent pattern of zero and non-zero factor loadings) and metric invariance (equivalent factor loadings) across the two groups.

The evidence for measurement invariance of the EPDS across time (i.e., longitudinal measurement invariance) is also limited. Chabrol and Teissedre (2004) examined the relationship between scores on the EPDS at 2-3 days and 4-6 weeks postpartum, however, they only established the factor structure at the first administration and not at the second administration (thus assuming invariance). Jomeen and Martin (2007) examined the factor structure of the EPDS in the first trimester and again in the third trimester of pregnancy and found some inconsistencies in the factor structure across the two testing occasions.

In order to clarify whether the factor structure of the EPDS is stable, it would be useful to examine its factor structure in a single sample at more than one time point, when it is known that the sample is likely to have experienced change in the underlying construct(s) being assessed by the EPDS (self-reported psychological distress). For this purpose, a sample of postpartum psychiatric inpatients (admitted to a psychiatric mother and baby unit) characterised by severe psychiatric symptomatology at admission and a mean decrease in symptom severity at discharge were administered the EPDS, and the factor structure was examined at each time point and tested for measurement invariance. If EPDS scores in the inpatient sample reflect true change in the same underlying

construct/s across admission and discharge, then the factor structure should remain stable across the two time points. If, however, raw scores on the EPDS do not reflect the same constructs across the two testing occasions, then the factor structure should fail to demonstrate measurement invariance across admission and discharge.

Measurement invariance across time (or longitudinal measurement invariance) is typically tested by specifying a series of increasingly restricted confirmatory factor analysis (CFA) measurement models, and examining change in model fit (Widaman et al., 2010). In these measurement models the factors and loadings for each time point are simultaneously estimated, and it is implied that there is dimensional invariance (i.e., the same number of factors at each time point). Thus, prior to testing these constrained models, it is recommended that separate CFAs are conducted for each time point to establish that there is dimensional invariance (Brown, 2006; Widaman et al., 2010). However, CFA generally requires that one has specific *a priori* hypotheses about the factor structure of a scale. Given that the literature is ambiguous regarding the factor structure of the EPDS in the postpartum period, we did not have a strong evidence to specify a hypothesised factor structure for the EPDS in the present study. EFA is recommended over CFA when one does not have strong *a priori* hypotheses about the factor structure of a scale (Fabrigar, Wegener, MacCallum, & Strahan, 1999). Thus, EFA was used to firstly determine the nature and number of factors at each time point (admission and discharge). As previous studies have largely supported a multifactorial structure for the EPDS, it was expected that two- or three-factor solutions would provide an optimal fit at each time point. If the same number of factors are observed at admission and discharge (i.e., dimensional invariance is upheld; Gregorich, 2006), then CFA would be used to test more stringent levels of measurement invariance. However, if the most basic form of invariance (dimensional invariance) is not upheld in the EFAs,

then these more stringent tests of measurement invariance cannot be conducted, and the hypothesis of measurement invariance will be rejected (Brown, 2006).

Method

Participants

Participants consisted of 875 consecutive female admissions to the Western Australian Mother and Baby Unit (WAMBU) between June 2007 and December 2013. The WAMBU is a public psychiatric unit providing inpatient assessment and treatment of women experiencing acute psychiatric conditions in the perinatal period, allowing admission of women and their infants. Patients were excluded from analyses if their child was over 13 months old (n=2), if the mother was aged under 18 years (n=14), or if they were readmitted and had completed the EPDS more than once within a 12 month period (n=88). Patients who had not completed an EPDS at either admission or discharge (n=135) were also excluded from analyses.

Thus, the final sample comprised 636 consecutive admissions to the WAMBU who had completed the EPDS at admission and/or discharge. Of these 636 admissions, 571 (89.8%) patients had completed the EPDS at admission and 543 (85.4%) at discharge. Four hundred and seventy eight (75.1%) patients had completed the EPDS at both time points.

Each patient had been diagnosed by their treating psychiatrist according to ICD-10-AM criteria (National Centre for Classification in Health Publications, 2002). The majority of patients (98.5%) had at least one ICD-10-AM diagnosis. The predominant primary diagnoses were mood disorders (44.7%); neurotic, stress-related and somatoform disorders (37.7%); schizophrenia, schizotypal and delusional disorders (6.8%); disorders of adult personality and behaviour (4.4%); and severe mental and behavioural disorders associated with the puerperium, not elsewhere classified (4.1%).

Patients' ages ranged from 18 to 47 years (M = 31, SD = 6.00). Infant ages ranged from 0 to 13 months (M = 2.82, SD = 3.03). Length of inpatient stay ranged from 0 to 69 days (M = 20.44, SD = 12.14). The mean EPDS score for the sample was 19.0 (SD = 6.5, range = 0-30) at admission and 9.1 (SD = 5.5, range = 0-28) at discharge. Other demographic characteristics of the patient sample are presented in Table 2.

Table 2

Demographic Characteristics of Patients at the WA Mother and Baby Unit

Variable	N	%
Western Australia residential location		
Metropolitan	504	79.2
Rural-remote	132	20.8
Aboriginal or Torres Strait Islander		
Yes	26	4.1
No	584	91.8
Missing	26	4.1
Marital status		
Married/defacto	507	79.7
Divorced/separated	21	3.3
Single	79	12.4
Widowed	1	0.2
Missing	28	4.4
Country of birth		
Australia	531	68.9
New Zealand/Oceania	24	3.1
NW Europe	71	9.2
SE Europe	8	1.0
Africa	32	4.2
Asia	52	6.7
America	6	0.8
Missing	45	5.7
Socio-economic status[a]		
1st – 25th percentile (lowest rankings)	26	4.1
26th to 50th percentile	147	23.1
51st to 75th percentile	172	27.0
76th to 100th percentile (highest rankings)	285	44.8

[a] Socio-economic status was obtained from participant's postcodes using the Index of Relative Socio-Economic Advantage/Disadvantage 2011, developed by the Australian Bureau of Statistics (2013).

Measure and procedure

The research was approved by the Women and Newborn Health Service Ethics Committee and the University of Western Australia Ethics office. Data were collected

during normal operation of the WAMBU. Demographic information was routinely obtained at admission and during the psychiatric interview. Each patient was given a questionnaire battery at admission and discharge, which consisted of a number of self-report measures, including the EPDS. Patients gave informed consent prior to completion of the questionnaires.

The EPDS consists of 10 four-level ordinal items which are scored from 0 to 3, with total scores ranging from 0 to 30. Respondents are asked to select the response that is closest to how they have felt over the past 7 days. The EPDS has been shown to have acceptable internal consistency (Cronbach's alpha = .87; Cox et al., 1987), and has demonstrated high correlations with other measures of depression and moderate to high correlations with measures of anxiety (see Boyd, Le, & Somberg, 2005, for review). Cut-off scores to screen for depression have been found to vary across studies (Eberhard-Gran et al., 2001; Gibson et al., 2009). The EPDS has also been used as a continuous measure of depressive symptoms.

Data analyses

Longitudinal measurement invariance of the EPDS was tested using exploratory factor analysis and confirmatory factor analysis using Mplus Version 7.1 (L.K Muthén & Muthén, 2012). A means- and variance-adjusted weighted least squares (WLSMV) estimator was used for all factor analyses, given the robustness of this estimator with non-normal and ordered-categorical data (B. O. Muthén, 1984).

The first step of testing longitudinal measurement invariance was to conduct separate tests of the factor structure at admission and discharge to establish baseline models for each testing occasion (Brown, 2006; Widaman et al., 2010). This is important to determine whether there is dimensional invariance – that is, the same number of factors at each time point (Gregorich, 2006). Given that we did not have strong evidence to specify a particular factor structure (due to the ambiguity of previous

EPDS factor analyses) EFA was used to determine the nature and number of factors underlying the EPDS at admission and discharge. A series of EFA models ranging from one to three factors were tested separately for the admission and discharge data. Geomin (oblique) rotation was used, as in multifactorial models the factors would be expected to correlate.

Model fit was evaluated using multiple fit indices including the chi-square statistic (χ^2), Comparative Fit Index (CFI), Tucker-Lewis Fit Index (TLI), Root Mean Square Error of Approximation (RMSEA), and Standardised Root Mean Square Residual (SRMR). The χ^2 statistic is a traditional measure of overall model fit, with a non-significant chi-square suggesting good fit. However, its utility is limited by its sensitivity to sample size (i.e., its tendency to reject models when larger sample sizes are used; Bentler & Bonett, 1980). Thus, model fit was primarily assessed using CFI, TLI, RMSEA, and SRMR. Model fit was considered acceptable when RMSEA ≤ 0.08, SRMR ≤ 0.05, CFI ≤ 0.95 and TLI ≤ 0.95 (Cudeck & Browne, 1983; Hu & Bentler, 1999).

In addition to examining fit indices, goodness of fit was also evaluated by considering the plausibility and interpretability of the models (Brown, 2006). Both statistical significance ($p < .05$) and magnitude of the factor loadings (≥ 0.30) were considered in determining the optimal factor solution at each time point (Brown, 2006). The fitted models were nested and fit was therefore compared using chi-square difference tests (χ^2_{diff}) using the DIFFTEST procedure in Mplus.

Next, separate CFA models were fit to the admission and discharge data. CFA is characterised by strict parameter constraints: for example, factor loadings that are theorised to be non-significant are fixed to zero. The purpose of conducting separate CFAs was to determine whether the constrained models for each time point still provided an optimal fit to the data. The specified CFA models were based on the results

of the EFAs: items that loaded ≥ 0.30 on a factor were specified in the CFA, and items for cross-loadings < 0.30 were fixed to zero. The same fit indices and cut-offs that were used in the EFAs were used to determine acceptable model fit in the CFAs; except WRMR was generated instead of SRMR

The procedures that followed the initial EFAs and CFAs were dependent on whether the assumption of dimensional invariance. If the initial EFAs and CFAs indicated the same number of factors at admission and discharge, then CFA would be used to conduct more stringent tests of measurement invariance by fitting and evaluating a sequence of nested models with increasing constraints. These include (in order of increasing constraints): (a) configural invariance (equivalent pattern of zero and non-zero factor loadings across the two time points), (b) metric invariance (equivalent pattern and magnitude of factor loadings), and (c) scalar invariance (equivalent pattern and magnitude of factor loadings and equivalent thresholds, i.e. the distribution cut-points for items; Sass, 2011).

Results

Missing data analysis

The proportion of missing data for EPDS items ranged from 10.2-10.4% at admission to 14.6% at discharge. A Little's MCAR test indicated that data were missing completely at random, χ^2 (29) = 39.44, p = .094. Missing values were handled in Mplus using Full Information Maximum Likelihood (FIML). In the separate EFAs and CFAs of the admission and discharge data, patients who were missing on all items due to non-completion of the EPDS at that time point were excluded from analysis (L.K Muthén & Muthén, 2012).

Longitudinal measurement invariance

Firstly, exploratory factor analyses (EFAs) were conducted on the EPDS admission data, specifying one, two, and three factors. Fit indices for each EFA model

are presented in Table 3. A one-factor model provided a poor fit to the data. A two-factor model provided a good fit according to all fit indices except the RMSEA which suggested a borderline acceptable fit (RMSEA = 0.081). The two-factor model was a significant improvement over the one-factor model, $\chi^2_{diff}(9) = 260.10$, $p < .001$ and the three-factor model did not lead to improved fit. Therefore, the two-factor model provided the most appropriate fit for the admission data. Factor loadings for the two-factor model are presented in Table 4. Items 1, 2, 3, 6, 7, 8, 9, and 10 loaded significantly and of a substantial (> 0.30) magnitude onto the first factor, and items 3, 4, 5 onto the second factor. Factors 1 and 2 accounted for 60.7% and 9.4% of the variance respectively. The factors were positively and significantly correlated in the two-factor model ($r = .65$, $p < .05$).[2]

Next, one- to three-factor EFAs were conducted on the discharge data. Model fit indices are presented in Table 3. A one-factor model provided a poor fit for the discharge data. Whilst a two-factor model provided a significant improvement in fit compared to the one-factor model, $\chi^2_{diff}(9) = 198.77$, $p < .001$), it did not provide an adequate fit according to RMSEA which fell outside of its acceptable range (RSMEA = 0.10). In contrast, the three-factor model provided an optimal fit according to all fit indices. This model was a significant improvement over the two factor model, $\chi^2_{diff}(8)=120.63$, $p<.001$. The three factors extracted accounted for 61.3%, 9.2%, and 6.5% of the variance respectively. The loadings for this model are presented in Table 5. Items 1 and 2 loaded significantly and of a substantive magnitude (≥0.30) onto the first factor; items 3, 4, 5, and 6 onto the second factor; and items 6, 7, 8, 9, and 10 onto the

[2] Analyses were also conducted excluding the 95 patients with diagnoses of bipolar disorder (current episode manic/hypomanic) or non-affective psychotic disorder. The results were similar: the three-factor model was not admissible in the admission data, whereas the three-factor model provided the best fit at discharge. Given lack of difference after restricting the sample, these patients were retained in the analyses reported in the manuscript.

third factor. The factors were all positively and significantly correlated (factors 1 and 2 = .68; factors 2 and 3 = .69, factors 1 and 3 = .76).

Table 3

Model Fit Indices for Exploratory Factor Analyses of EPDS

Model	χ^2	df	*p*	RMSEA	CFI	TLI	SRMR
Admission							
One factor	485.97	35	<.001	0.150	0.950	0.936	0.072
Two factor	123.67	26	<.001	0.081	0.989	0.981	0.030
Three factor[a]	-	-	-	-	-	-	-
Discharge							
One factor	424.75	35	<.001	0.143	0.949	0.935	0.064
Two factor	186.53	26	<.001	0.107	0.979	0.964	0.037
Three factor	27.89	18	.06	0.032	0.999	0.997	0.016

[a] Not admissible (negative residual variance for item 2).

Table 4

Rotated Factor Matrices for Admission and Discharge EFAs

	Admission		Discharge		
	F1	F2	F1	F2	F3
1. I have been able to laugh and see the funny side of things	0.87	0.01	0.89	-0.00	0.00
2. I have looked forward with enjoyment to things	0.88	0.00	0.83	0.01	0.08
3. I have blamed myself unnecessarily when things went wrong	0.42	0.33	-0.09	0.60	0.20
4. I have been anxious or worried for no good reason	0.08	0.86	0.03	0.82	-0.11
5. I have felt scared or panicky for no very good reason	-0.01	0.88	-0.02	0.91	0.01
6. Things have been getting on top of me	0.74	0.14	0.23	0.34	0.36
7. I have been so unhappy that I have had difficulty sleeping	0.49	0.25	0.09	0.23	0.47
8. I have felt sad or miserable	0.98	-0.10	-0.00	-0.00	0.96
9. I have been so unhappy that I have been crying	0.80	-0.03	-0.05	-0.01	0.91
10. The thought of harming myself has occurred to me	0.50	0.05	0.08	0.23	0.45

Note: Statistically significant (p<.05) loadings are in bold.

Based on the results of the EFAs, CFA models were specified separately for the admission and discharge data, and model fit was evaluated. For these models, all loadings ≥0.30 were specified, and all loadings <0.30 were fixed at zero. For the admission data, the two-factor model provided an acceptable fit ($\chi^2(33) = 154.087$, p <.001, RMSEA = 0.080, CFI = 0.987, TLI = 0.982, WRMR = 1.032). The two factors

were significantly and positively correlated (r=.70, p<.001). For the discharge data, the three-factor model provided an acceptable fit $\chi^2(31) = 98.588$, p <.001, RMSEA = 0.063, CFI = 0.991, TLI = 0.987, WRMR = 0.794. The factors were all significantly and positively correlated (factors 1 and 2 = .70; factors 2 and 3 = .75; factors 1 and 3 = .82, all ps < .001). Given the high correlation between factors 1 and 3, we re-ran the CFA with factors 1 and 3 collapsed into a single factor, however this substantially worsened model fit ($\chi^2_{diff}(2) = 59.482$, p < .001). All specified factor loadings for both models were positive and significant. Standardised (STDYX) loadings are presented in Table 5. Given that the requirement of dimensional invariance (same number of factors at each time point) was not met, no further invariance tests were conducted.

A limitation of the previous analyses is the sample included all patients who completed the EPDS at admission and discharge, including those with missing data at one time point. The purpose of this was to maximise generalizability by using all available data. However, it could be argued that the inclusion of individuals who did not complete the EPDS at both time points may have influenced the results and our subsequent conclusions. As a subsidiary analysis, we re-ran the EFA analyses including only the same participants who completed the EPDS at both admission and discharge (n = 478). The fit statistics and loadings were very similar, leading to the same number of factors extracted and conclusions which were made based on the original analyses using all of the available data. At admission the fit statistics for the two-factor EFA were $\chi^2(26) = 104.713$, p < .001, RMSEA = 0.080, CFI = 0.988, TLI = 0.979, SRMR = 0.032 At discharge the fit statistics for the three-factor EFA were $\chi^2(18) = 26.795$, p < .08, RMSEA = 0.032, CFI = 0.999, TLI = 0.997, SRMR = 0.016.

Table 5

Standardised Loadings for CFA Models Tested

	Admission		Discharge		
Item	F1	F2	F1	F2	F3
1	0.88		0.87		
2	0.88		0.92		
3	0.44	0.29		0.73	
4		0.95		0.74	
5		0.84		0.90	
6	0.84			0.34	0.56
7	0.68				0.75
8	0.90				0.93
9	0.77				0.84
10	0.54				0.72

Note: All loadings are significant at the $p<.001$ level.

Discussion

The present study aimed to determine whether the EPDS factor structure is stable across time in a sample that has experienced change in levels of distress. The EPDS was completed by postpartum inpatients upon admission to and discharge from a psychiatric mother and baby unit, and the factor structure was examined for longitudinal measurement invariance. The EFAs suggested that the EPDS factor structure consisted of a different number of factors at admission and discharge. CFAs also supported differences in the factor structures of the scales. At admission, the best fitting model was a two-factor model composed of depression and anxiety factors. Item 3 (*blaming oneself unnecessarily*) cross-loaded onto both the depression and anxiety factors. These factors were positively correlated at $r=.70$, which is consistent with expectations given that scales measuring anxiety and depression are typically correlated between .60 and .70 in the wider affective disorders literature (P. F. Lovibond & S. H. Lovibond, 1995),

and are also highly correlated in other perinatal samples (Nadia K Cunningham, Brown, Brooks, & Page, 2013; Somerville et al., 2014). In contrast, a three-factor model provided an optimal fit at discharge. A factor comprising items 1 (*able to laugh*) and 2 (*looked forward with enjoyment*) emerged as a distinct factor separate from the depression factor at discharge, reflecting anhedonia. Item 6 (*things getting on top of me*) cross-loaded onto both the depression and anxiety factors. Again, the factors were highly correlated, and the patterns were consistent with expectations given the relationships between these constructs in the wider affective disorders literature (L. A. Clark & Watson, 1991). As the EFAs and CFAs suggested that measurement invariance was not supported at the dimensional level, no further tests of invariance were conducted. Thus, the results of the present study do not provide support to the theory that the EPDS is invariant across time: rather, the EPDS appears to measure different constructs at different testing occasions (Millsap & Kwok, 2004).

Although there are going to be many differences between the studies reported in Table 1, one issue is the severity of the samples. The current study found that at admission, when symptoms were high, the EPDS had a two-factor structure, but at discharge, when symptoms were lower, the EPDS had a three-factor structure. Consistent with this finding, the studies in Table 1 that found a two factor structure had a somewhat higher average EPDS score ($M = 8.71$) than those which found a three factor structure ($M = 7.57$). Thus, further research is needed to clarify the degree to which variability in the factor structure is attributable to symptom severity as opposed to other attributes of the studies.

There are various potential reasons why the EPDS exhibited measurement non-invariance across time in the present sample. The observed differences in factor structure may reflect differences in the applicability or meaning of items to individuals across testing occasions (Chen, 2008). For example, it is possible that the conceptual

meaning of items 1 and 2 changed for patients across different stages of their recovery, and hence patients responded to the items in a different manner at admission and discharge. When patients were experiencing high levels of psychological distress, they may have interpreted and responded to items 1 and 2 in the situational context of their high levels of distress and depressive symptoms. Thus, these items loaded onto the depression factor. At discharge – when mean distress was reduced in the sample – these items may have been interpreted and responded to in reference to patients' psychological wellbeing rather than their depression and anhedonia. This may account for why these items emerged as a factor distinct from depression at discharge. This would be indicative of differences in response patterns (unstable response bias), perhaps as a function of patients' levels of distress or their situational context at the time of completion.

Measurement invariance is particularly important when instruments are used to select individuals (Borsboom, 2006). The possibility that individuals respond differently to EPDS items depending on situational context and/or levels of distress is problematic, particularly as the scale is used to screen for probable depression in a variety of perinatal populations and in a wide range of contexts (including hospitals, research settings, during routine child health nurse visits). If raw scores on the EPDS do not reflect the same constructs across individuals and/or time, then using a specific cut-off score to detect depression across population samples may be problematic. A lack of measurement invariance of the EPDS may account for inconsistent findings regarding its screening abilities (e.g., variation in sensitivity, specificity, and positive predictive value of cut-off scores in previous studies; see Gibson et al., 2009, for review).The minimisation of bias should be a primary goal in development and evaluation of tests used to select individuals (Borsboom, 2006). Based on the findings of the present study, as well as previous studies reporting inconsistent factor structure of the EPDS, the

EPDS may benefit from revision in order to improve its reliability and validity as a depression screening instrument in perinatal populations.

It should be noted that the EPDS was not developed using standard psychometric development procedures, and this indeed may partially account for the lack of measurement invariance observed in this study. Further research is needed to determine why the EPDS might lack invariance over time. Moreover, we cannot conclude from our analyses whether it is more appropriate to use total, subscale, or factor scores. However, measurement non-invariance potentially indicates the presence of measurement bias, and this could affect the validity of total, subscale, and factor scores. Further research is required to determine the specific impact of measurement non-invariance on EPDS scores.

The present study used a postpartum clinical sample, and the extent to which the results are generalisable to other perinatal populations is not known. Thus, it would be useful to examine measurement invariance of the EPDS in other postpartum populations and to investigate the possibility that distress levels may affect the factor structure of the EPDS.

To conclude, the findings of the present study suggest that scores on the EPDS reflect different constructs at different testing occasions. Whilst the specific reasons for the non-invariance, and the impact on the ability of the EPDS to reliably detect depressive cases, is unclear, substantial caution is warranted when using the scale to detect psychological distress (both depression and anxiety) in postpartum samples and in making comparisons across groups and time.

Chapter 3: The structure of emotional symptoms in the postpartum period: Is it unique?

Foreword to Chapter 3

Chapter 2 examined the factor structure of the EPDS in a postpartum inpatient sample, and tested its stability across hospital admission and discharge. It was found that the factor structure of the EPDS was not stable across admission and discharge: two factors emerged at admission, whereas three factors emerged at discharge. These findings suggested that the constructs reflected by the EPDS changed over time, possibly as a function of symptom severity: that is, patients may have interpreted and/or responded to the EPDS items differently at hospital admission versus discharge. Given lack of support for a stable factor structure, it was concluded that the EPDS lacks construct validity in the postpartum inpatient sample and does not reflect a single unitary construct. However, these findings raised a question regarding the factor structure of self-report measures in the postpartum sample: was the issue of non-invariance of the factor structure specific to the EPDS, or was it characteristic of the postpartum inpatient sample more generally? That is, do the postpartum inpatients respond differently to self-report measures when their symptoms are more severe? This conceptual issue related to a longstanding debate as to whether postpartum emotional disorders (anxiety and depression) have a unique clinical presentation compared to non-postpartum emotional disorders. If the clinical presentation is different, then it could be expected that the underlying structure of depression and anxiety symptoms in a postpartum clinical sample would also differ.

Consequently, Chapter 3 aimed to examine the constructs underlying postpartum anxiety and depression symptoms by testing the factor structure of the Depression Anxiety Stress Scales (DASS; S. H. Lovibond & P. F. Lovibond, 1995) in the postpartum inpatient sample. If the symptom structure of postpartum anxiety and depression is different to that of non-postpartum samples, it could be expected that the factor structure of the DASS would differ from that observed in previous studies of non-

postpartum samples. On the other hand, if the clinical presentation of postpartum depression and anxiety is similar to in non-postpartum samples, then it could be expected that the same three-factor model obtained in other studies of non-postpartum samples would provide the best fit in the postpartum sample.

The study presented in this chapter has been published as:

Cunningham, N. K., Brown, P. M., Brooks, J., & Page, A. C. (2013). The structure of emotional symptoms in the postpartum period: Is it unique? *Journal of Affective Disorders*, 151(2), 686-694.

Abstract

Background. In perinatal mental health there is a lack of consensus as to whether postpartum emotional disorders are unique in their aetiology and clinical presentation. If the clinical presentation is unique, then the factor structure should be different in a postpartum sample.

Methods. Admission and discharge scores on the Depression Anxiety Stress Scales (DASS; S. H. Lovibond & P. F. Lovibond, 1995) scores were collected for 527 inpatients admitted to a Psychiatric Mother and Baby Unit. Reliability and validity of the DASS were examined, and confirmatory factor analysis evaluated the fit of a series of models of the DASS.

Results. The DASS had sound reliability and validity in the postpartum inpatient sample. The optimal fitting factor solution for the DASS was a revised three-factor model previously supported in studies of other clinical and non-clinical populations. The factor structure was invariant across admission and discharge.

Limitations. The sample consisted of postpartum inpatients and the generalisability of results to other postpartum samples is not known.

Conclusions. Postpartum emotional symptoms have the same factor structure previously observed in non-postpartum populations, consistent with the hypothesis that postpartum emotional disorders are similar to those occurring at other times, and supports the reliability and validity of the DASS in the postpartum period.

Introduction

A range of psychological symptoms can manifest in the postpartum period. However, the specific nature of postpartum emotional disorders, and their relationship to disorders occurring outside of this period, remains contentious. There is still debate as to whether postpartum emotional disorders should be included as separate diagnoses in classification systems such as DSM (American Psychiatric Association, 2000) and ICD (WHO, 1992), or whether they should be diagnosed according to usual categories (as they currently are). This lack of consistency has led to confusion in both research and clinical practice (Jones & Cantwell, 2010). With the recent publication of DSM-5 (American Psychiatric Association, 2013a) the topic has again become one of prominence (Austin, 2010; Jones & Cantwell, 2010; Kornstein, 2010).

On one side of the debate, some view postpartum emotional disorders as distinct disorders triggered by changes (e.g., endocrinological) associated with childbirth. Proponents of this view argue that the clinical presentation of postpartum emotional disorders is unique. Pitt (1968) described postpartum depression as milder than typical depression, with less suicidal ideation, more anxiety and irritability, and with some symptoms showing reverse patterns (e.g., increased appetite). Dalton and Horton (1996) reported that postpartum women are more likely to endorse agitation, irritability, and anxiety than depressive symptoms. Born and Steiner (1999) argued that the prominence of irritability in perinatal emotional disorders has largely gone unnoticed due to a focus on depressive symptomatology in the literature. Phillips and colleagues (2009) suggested that some postpartum women with clinically significant anxiety do not fit DSM-IV anxiety disorder criteria.

On the other side of the debate it has been contested that postpartum emotional disorders are not exclusively related to physiological events of the postpartum period. Proponents of this view argue that there is insufficient evidence to support a distinction

between postpartum and non-postpartum emotional disorders, and that the triggers of postpartum emotional disorders are not unique (Hendrick et al., 1998). They propose that the perinatal period may trigger or exacerbate emotional disorders not unlike any other stressful life event (P. J. Cooper & Murray, 1995; Riecher-Rössler & Rohde, 2005). That is, in stress-diathesis models, a variety of stressors trigger a disorder by acting upon a pre-existing diathesis (vulnerability).

A small number of studies have addressed this debate by comparing symptoms of depression and anxiety in postpartum versus non-postpartum women. However, results have been inconsistent. Whilst some have reported higher levels of depression in postpartum women (Augusto et al., 1996; Hendrick et al., 2000; Nieland & Roger, 1997), others have reported lower levels of depression (Eberhard-Gran et al., 2003; Whiffen & Gotlib, 1993). Likewise, some studies have reported higher anxiety levels postpartum (Hendrick et al., 2000), whereas others have reported lower anxiety levels (Augusto et al., 1996; Bernstein et al., 2008; Whiffen & Gotlib, 1993). Given the many other factors that may explain why a particular study may find severity differences in samples, it is not surprising that this research has not resolved the debate.

In a related line of research several studies have examined differences between individual symptoms of postpartum and non-postpartum depression and anxiety as well as severity levels: for example, whilst Whiffen and Gotlib (1993) reported that the postpartum group obtained a lower mean depression score than the non-postpartum group, they also reported lower levels of insomnia, somatic complaints, and psychomotor agitation. Thus, there is some suggestion that symptom patterns may be distinct postpartum. Research investigating differences in symptom profiles between postpartum and non-postpartum groups is broadly summarised in Table 1. Overall, samples vary in terms of symptom intensity, but there is no clear outcome regarding the patterns of symptoms. Some studies find differences, but these findings are not

replicated in other studies. Thus, it would be useful to examine the issue by studying a large sample of postpartum women with psychopathology and examine if the overall factor structure of emotional psychopathology is distinguishable from that found in other patient groups. That is, if differences are to be observed, they should be evident in a sample with severe psychopathology.

Table 1

Differences between Postpartum and Non-Postpartum Samples Reported in Previous Studies

		Anxiety		Depression		Stress	
	Samples	Overall Levels	Specific symptoms	Overall Levels	Specific symptoms	Overall Levels	Specific symptoms
Whiffen & Gotlib (1993)	Postpartum women with major depression (6 months postpartum; n=77) and controls with (*n*=32) and without (*n*=18) major depression	Postpartum group: Lower mean score (SADS)		Postpartum group: lower mean score (BDI)	Postpartum group: Lower on insomnia, somatic complaints, psychomotor agitation (BDI)		
Augusto et al. (1996)	Postpartum women (2-5 months postpartum; *n*=118) and age-matched controls without children < 2 yo (*n*=118)	Postpartum group: Lower mean score (EPDS 'anxiety' items)		Postpartum group: Higher mean score (Zung SDS)	Postpartum group: Higher on thoughts of self harm (EPDS) Higher on somatic items (but no longer significant after controlling for EPDS score)		
Nieland & Roger (1997)	Postpartum women (*n*=152) and women without children less than 2yo (*n*=152)			Postpartum group: Higher mean score (purpose-designed checklist)	Postpartum group: Higher on felt unattractive, mood worst late in the day, loss of libido, loneliness, not going out, crying (purpose-designed checklist)		Postpartum group: Higher irritability (purpose-designed checklist)

		Anxiety		Depression		Stress	
	Samples	Overall Levels	Specific symptoms	Overall Levels	Specific symptoms	Overall Levels	Specific symptoms
Wisner et al. (1999)	Postpartum women with major depression (n=37) and non-postpartum women with major depression (n=28)		Of those endorsing obsessional thoughts, a higher median number was endorsed by the postpartum group (Y-BOCS)				
Hendrick et al. (2000)	Postpartum women with major depression (onset < 6 weeks after delivery; *n*=26) and non-postpartum women with major depression (*n*=25)	Postpartum group: Higher levels (clinical observation)		Postpartum group: Higher levels (clinical observation)			
Eberhard-Gran et al. (2003)	Postpartum (n=416) and non-postpartum mothers (*n*=2314)	Equal mean scores across groups (SCL-25)		Postpartum group: Lower mean score (SCL-25)			
C. Cooper et al. (2007)	Postpartum women with major depression (n=50) and non-postpartum women with major depression (n=132)			Equal levels across groups (clinical observation)	Postpartum group: Lower on early morning wakening, poor appetite (clinical observation)		

		Anxiety		Depression		Stress	
	Samples	Overall Levels	Specific symptoms	Overall Levels	Specific symptoms	Overall Levels	Specific symptoms
Bernstein et al. (2008)	Postpartum women with major depression (*n*=95) and non-postpartum women with major depression (*n*=50)	Postpartum group: Lower mean score (QIDS-SR-16)		Postpartum group: Higher mean score (QIDS-SR-16)	Postpartum group: Higher on psychomotor restlessness/agitation, impaired concentration/decision making Lower on sad mood, suicidal ideation, reduced interest (QIDS-SR-16)		
Watson et al. (2007)	Postpartum women (*n*=832*)* and young adults (*n*=271)		Postpartum group: Higher mean score on Traumatic Intrusions subscale Equal mean scores across groups on Panic and Social Anxiety subscales (IDAS)	Equal levels across groups on General Depression subscale (IDAS)	Postpartum group: Higher on Ill Temper subscale Lower on Well-Being subscale Equal on Dysphoria, Suicidality, Lassitude, Insomnia, Appetite Loss/Gain subscales (IDAS)		

Note. BDI = Beck Depression Inventory (Beck et al., 1961); CGI = Clinical Global Impression (Guy, 1976) EPDS = Edinburgh Postnatal Depression Scale (Cox et al., 1987); IDAS = Inventory of Depression and Anxiety Symptoms (Watson et al., 2007); QIDS-SR-16 = Quick Inventory of Depressive Symptomatology (Self-report) (Rush et al., 2003); SADS = Schedule for Affective Disorders and Schizophrenia (Endicott and Spitzer, 1978); SCL-25: Hopkins Symptom Check List Y-BOCS = Yale-Brown Obsessive Compulsive Scale (Goodman et al., 1989); Zung SDS = Zung Self-Rating Depression Scale (Zung, 1965)

Furthermore, it is possible that the lack of consistency across these studies (see Table 1) may partly be due to methodological differences, such as different recruitment strategies or comparison groups; inconsistent definitions of the postpartum period; and different assessment and diagnostic methods. Nevertheless, despite a lack of empirical evidence that postpartum emotional disorders are qualitatively distinct, many researchers and clinicians continue to espouse the view that they are somehow unique. This is an important issue to resolve because it has implications for assessment and treatment of postpartum emotional disorders. For example, if postpartum depression is distinct, then the general depression literature may not be generalisable to postpartum depression (Whiffen, 1992). Validated assessment methods and evidence-based treatments for depression and anxiety may be inappropriate for postpartum women. Thus, the current lack of consensus may be hindering research as well as implementation of assessment and treatment programs for postpartum emotional disorders.

Given the apparent inconsistency in the research literature, it is worthwhile considering a different approach to the question. Beginning with the two sides of the debate, it is clear that if postpartum depression and anxiety are different, then it is reasonable to expect that symptom profiles postpartum will be significantly different from the symptom profiles of people not selected because their disorder occurs after birth. One side of the debate asserts that there will be no differences, while the alternative view asserts that there will be a point of difference in symptom profiles. While it is difficult to prove the null hypothesis, it should be possible to reject the null hypothesis if a difference exists. Therefore, any point of difference between postpartum and non-postpartum emotional disorders could potentially be counted as evidence. One way to answer this question could be to compare symptom profiles of postpartum women with those obtained in other research.

In a recent study, Buttner et al. (2012) examined the structure of women's mood in the days following delivery and found symptom dimensions that were parallel to those found outside of the postpartum period; however, this study was focussed on the early postpartum, specifically around the concept of "postpartum blues", which is a distinct phenomenon.

Confirmatory factor analysis (CFA) is useful for investigating this issue. CFA can examine the relationships between observed variables (e.g., item responses on a questionnaire) and the latent constructs (or factors) theorised to underlie these observed variables. To the extent that postpartum emotional disorders are different from non-postpartum emotional disorders, it could be predicted that the latent structure of a self-report instrument measuring emotional distress would differ. Thus, a factor solution providing optimal fit in a non-postpartum sample may not provide optimal fit in a postpartum sample.

Thus, it should be possible to identify the structure of disorders in typical clinical populations and then examine the degree to which these models apply postpartum. If these disorders are qualitatively different, then the models generated in other research will fit less well or not at all.

Consequently, the present study examined the constructs underlying postpartum emotional symptoms by testing the factor structure of the Depression Anxiety Stress Scales (DASS; S. H. Lovibond & P. F. Lovibond, 1995) in a postpartum sample. The DASS is a 42-item self-report test, consisting of three scales that assess three negative emotional states: depression, anxiety, and stress. Each of the DASS scales were formed from subscales comprising items of similar content (see Table 5). The DASS was specifically designed to measure the full range of core symptoms of depression and anxiety, whilst providing maximal discrimination (i.e., minimising the correlation) between the two scales. During scale development, depression items which failed to

show adequate coherence with the depression scale and differentiation from the anxiety scale were excluded, as were anxiety items which failed to show adequate coherence with the anxiety scale and differentiation from the depression scale. During the development of these two scales (DASS-Depression and DASS-Anxiety), a third factor emerged, consisting of items reflecting chronic non-specific arousal. These items formed the basis for the stress scale (DASS-Stress; S. H. Lovibond & P. F. Lovibond, 1995).

The DASS was a suitable instrument for the present study for several reasons. Firstly, previous studies have shown that the DASS has sound psychometric properties across clinical (Antony, Bieling, Cox, Enns, & Swinson, 1998; Brown et al., 1997; Page et al., 2007) and non-clinical populations (Antony et al., 1998; Crawford & Henry, 2003; P. F. Lovibond & S. H. Lovibond, 1995), including excellent internal consistency, and good convergent and discriminant validity.

In terms of convergent validity, DASS-Depression and DASS-Anxiety have been found to be highly positively correlated with other measures of depression and anxiety respectively (Antony et al., 1998; Brown et al., 1997). Moreover, several previous studies found that DASS-Depression and DASS-Anxiety were able to discriminate between anxious and depressed patient groups (Antony et al., 1998; Brown et al., 1997; Clara, Cox, & Enns, 2001).

In terms of discriminant validity, the DASS appears to perform at least as well as other self-report measures purporting to distinguish between depression and anxiety, with correlations between DASS-Depression and DASS-Anxiety ranging from .44 (Antony et al., 1998) to .70 (Crawford & Henry, 2003), and moderate-to-high correlations of DASS-Depression and DASS-Anxiety with other measures of depression and anxiety respectively. In some contexts, moderate-to-high correlations between scales measuring distinct theoretical constructs would be interpreted as evidence for

poor discriminant validity. However, in the affective disorders literature there is substantial evidence for considerable communality amongst the emotional syndromes. This is reflected by moderate-to-high correlations between dimensional measures of anxiety and depression despite exclusion of overlapping symptoms, as well as by comorbidity between mood and anxiety disorders. Thus, these inter-scale correlations are not unique to the DASS, but are also characteristic of other scales purporting to distinguish between depression and anxiety, such as the Beck Depression Inventory-II (Beck et al., 1996) and Beck Anxiety Inventory, and the Inventory of Depression and Anxiety Symptoms (IDAS; Watson et al., 2007). For example, the BDI-II and the BAI have been found to correlate around .60 (Steer et al., 1999), and the Dysphoria subscale on the IDAS has been found to correlate .68 with the Social Anxiety subscale and.62 with the Panic subscale (Watson et al., 2007). It is likely that there is an irreducible minimum correlation (of around .50) between self-report scales designed to measure depression and anxiety (P. F. Lovibond & S. H. Lovibond, 1995). Rather than reflecting a lack of discriminant validity due to overlapping constructs, these correlations have been theorised by others to reflect common underlying causes of depression and anxiety (L. A. Clark & Watson, 1991)

Furthermore, several studies have provided robust support for the DASS as a measure of three distinct but related emotional constructs: depression, anxiety, and stress. In a non-clinical student sample, P.F. Lovibond and S.H. Lovibond (1995) identified the three factors of Depression, Anxiety, and Stress, and used CFA to demonstrate that this three-factor model provided a superior fit than a one- or two-factor solution. This three-factor solution was replicated by Brown et al. (1997) in a sample of anxious outpatients, but several items loaded onto more than one factor: anxiety item 9 and stress item 33 loaded onto both the Anxiety and Stress factors, and anxiety item 30 loaded weakly onto all three factors.

Antony et al. (1998) and Clara et al. (2001) also replicated P.F. Lovibond and S.H. Lovibond's (1995) three-factor solution in samples of predominantly anxious and depressed outpatients respectively. Crawford and Henry (2003) and Page et al. (2007) also found that the three-factor solution provided a good fit in a non-clinical community sample and a depressed inpatient sample respectively, but both studies reported that model fit was improved by allowing the items identified by Brown et al. (1997) to load onto multiple factors, and permitting correlated residuals between items with similar content. This three-factor model with correlated residuals is henceforth referred to as the 'revised three-factor model'.

Therefore, turning to the present research, two competing outcomes were predicted. Firstly, in line with the view that there are no substantial differences between postpartum and non-postpartum emotional disorders, it was predicted that the revised three-factor model obtained in previous studies (Brown et al., 1997; Crawford & Henry, 2003; Page et al., 2007) would provide the best fit in the postpartum inpatient sample.

An alternative outcome was predicted based on the hypothesis that postpartum emotional disorders are qualitatively distinct from non-postpartum emotional disorders. It was predicted that the models specified *a priori* would provide a poor fit to the data, suggesting that the DASS factor structure differs significantly from that obtained in non-postpartum populations. Such a result would be consistent with the view that postpartum disorders are different in presentation to non-postpartum disorders. Any divergences of the observed model from the hypothesised model may indicate how postpartum and non-postpartum emotional disorders differ.

To test these competing hypotheses, a sample of postpartum females admitted for inpatient treatment to the Western Australian Mother and Baby Unit (WAMBU) was used. The WAMBU is a public psychiatric unit providing inpatient assessment and treatment of women experiencing acute psychiatric conditions in the perinatal period,

allowing admission of women and their infants. An inpatient sample was chosen because with the level of severity and complexity in symptom presentation amongst these women, there should be better chances of identifying symptom differentiation if it exists.

However, before testing the latent structure of the DASS, it was necessary to demonstrate that the DASS was psychometrically sound in the postpartum sample. Thus, the first aim was to evaluate the reliability and validity of the DASS.

Method

Participants

Participants were 527 adult female inpatients admitted to the WAMBU between June 2007 and October 2011. The mean number of days since childbirth for the sample was 103 days (*SD*=95.4, range=0-432 days). During the period of data collection, 380 patients (72%) completed the DASS at admission, and 369 patients (70%) completed the DASS at discharge. About three-quarters of the sample (*n*=286) completed the DASS at both time points.

Patients' mean length of stay was 18 days (*SD*=12.3, range=0-69 days). The mean age was 31 years (*SD*=5.9, range=18-47 years). Of those who indicated relationship status, 78.4% were married or in a de facto relationship, 17.3% were single, and 4.3% were divorced or separated. The most common place of birth was Australia (75%), followed by North-West Europe (9%), Asia (6%), Africa (5%) and New Zealand/Oceania (2%).

Participants were diagnosed by their treating psychiatrist and coded with a primary ICD-10-AM diagnosis (Australian modification; National Centre for Classification in Health Publications, 2002). The most common principal diagnoses included major depression or other unipolar mood disorder (30.6%), bipolar disorder (14.6 %), mixed anxiety and depressive disorder (12.7%), generalised anxiety disorder

(8.0%), adjustment disorder (8.0%), borderline personality disorder (4.4%) and schizophrenia (4.0%). Psychiatric diagnoses could not be obtained for 6.1% of the sample.

Measures

Depression Anxiety Stress Scales (DASS; S. H. Lovibond & P. F. Lovibond, 1995). The DASS is a 42-item self-report measure, consisting of three 14-item scales assessing depression, anxiety, and stress over the past week. Each item has four response options ranging from 0 ('Did not apply to me at all') to 3 ('Applied to me very much, or most of the time'). Higher scores reflect higher levels of depression, anxiety, or stress, with a maximum score of 42 on each scale. The DASS has demonstrated excellent internal consistency and sound construct validity in clinical and non-clinical populations (Antony et al., 1998; Brown et al., 1997; Crawford & Henry, 2003; P. F. Lovibond & S. H. Lovibond, 1995; Page et al., 2007).

Beck Depression Inventory-II (BDI-II; Beck et al., 1996). The BDI-II is a 21-item self-report measure which assesses severity of depression over the past two weeks. The BDI-II has previously demonstrated good reliability and is highly correlated with other measures of depression (Beck et al., 1996).

Beck Anxiety Inventory (BAI; Beck, Epstein, et al., 1988). The BAI is a 21-item self-report measure which assesses severity of anxiety over the past week. The BAI has been well validated in clinical samples, and has demonstrated good internal consistency, convergent and discriminant validity (Beck, Epstein, et al., 1988; Osman, Kopper, Barrios, Osman, & Wade, 1997; Steer, Ranieri, Beck, & Clark, 1993).

Beck Hopelessness Scale (BHS; Beck, Weissman, Lester, & Trexler, 1974). The BHS is a 20-item true-false self-report measure which assesses aspects of hopelessness (feelings about future, loss of motivation, and expectations) over the past week. Previous research has supported a positive relationship between BHS scores,

depression (Beck, Riskind, Brown, & Steer, 1988), and suicide risk (Beck, Steer, Beck, & Newman, 1993).

Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987). The EPDS is a 10-item self-report measure developed as a screening tool for postnatal depression. The EPDS has good reliability and validity as a screening instrument for major depression in perinatal samples, although cut-off scores for detecting depression vary across studies (Eberhard-Gran et al., 2001). The EPDS is also often used as a continuous measure of depressive symptoms in perinatal samples.

Procedure

Data were collected during normal operation of the WAMBU. Each patient was given a questionnaire battery consisting of the EPDS, DASS, BDI-II, BAI, and BHS, upon admission to and discharge from the WAMBU.

Results

Psychometric properties of the DASS

Reliability. The DASS demonstrated excellent internal consistency (Cronbach's α and 95% *CI*s) for the total scale (α=.97, *CI*=.97-.98) and each of the scales (DASS-Depression=.96, *CI*=.96-.97; DASS-Anxiety=.92, *CI*=.91-.93; DASS-Stress=.94, *CI*=.93-.95).

To examine temporal stability of the DASS, intra-class correlations and Pearson correlations (and 95% *CI*s) were calculated between admission and discharge data for each scale. The intra-class correlations for DASS-Depression (*r*=.57; *CI*=.46-.65), DASS-Anxiety (*r*=.60; *CI*=.50-.68), and DASS-Stress (*r*=.56; *CI*=.45-.65) were similar to those of other measures administered, including the EPDS (*r*=.66; *CI*=.58-.73), BDI-II (*r*=.62; *CI*=.53-.70), BAI (*r*=.61; *CI*=.51-.68), and BHS (*r*=.63; *CI*=.54-.70), *p*s<.001. The Pearson correlations for DASS-Depression (*r*=.42; *CI*=.31-.50), DASS-Anxiety (*r*=.44; *CI*=.35-.53), and DASS-Stress (*r*=.39; *CI*=.30-.48) were also similar to those of

the other measures, including the EPDS (r=.50; CI=.41-.57), BDI-II (r=.46; CI=.37-.54), BAI (r=.46; CI=.37-.54), and BHS (r=.48; CI=.39-.56), ps<.001.

Paired-samples t-tests examined the DASS scales' sensitivity to changes. The DASS was sensitive to changes from admission to discharge in terms of DASS-Depression (t(309)=22.43), DASS-Anxiety (t(301)=17.59), and DASS-Stress (t(304)=23.14), ps<.001. Mean scores on the BDI-II (t(317)=23.95), BAI (t(324)=19.89), BHS (t(321)=15.83), and EPDS (t(322)=28.22) also declined significantly from admission to discharge, ps<.001.

Validity. Construct validity of the DASS was first assessed by examining its relationships with other self-report measures. Bivariate correlations were calculated between admission scores on the DASS and other measures. These correlations are presented in Table 2.

Table 2

Correlations of the DASS With Other Self-Report Measures

	DASS						
	Depression	Anxiety	Stress	BDI-II	BAI	BHS	EPDS
DASS							
Depression	-	.64**	.76**	.82**	.56**	.64**	.84**
Anxiety	-	-	.73**	.63**	.86**	.32**	.66**
Stress	-	-	-	.72**	.64**	.45**	.75**
BDI-II	-	-	-	-	.65**	.70**	.79**
BAI	-	-	-	-	-	.37**	.59**
BHS	-	-	-	-	-	-	.54**

** $p < .001$, two-tailed. (N pairwise)

As can be seen in Table 2, all scales were positively and significantly correlated. Correlations were higher between scales purporting to measure similar constructs. For example, DASS-Depression was most highly correlated with the EPDS and BDI-II, whereas DASS-Anxiety was most highly correlated with the BAI.

Between-group comparisons evaluated the extent to which the DASS could discriminate between groups of patients with anxiety versus depressive disorders. Three principal groups were formed: an 'anxiety' group consisting of patients with primary anxiety disorder diagnoses including generalised anxiety disorder, obsessive-compulsive disorder, panic disorder, and social phobia (n=52); a 'depression' group consisting of patients with primary diagnoses of major depression, recurrent depressive disorder, and dysthymia (n=161); and a 'mixed' group consisting of patients with a primary diagnosis of mixed anxiety and depressive disorder (n=67). Since the assumption of homogeneity of variance was violated, Kruskal-Wallis tests compared the distributions of DASS scores across groups. The distributions of scores between the three groups differed for DASS-Depression (p=.04), but not for DASS-Anxiety or DASS-Stress (ps>.05). Examination of group means for DASS-Depression revealed that the depression (M=27.53, SD=10.06) and mixed (M=27.11, SD=10.29) groups scored higher than the anxiety group (M=21.82, SD=12.75).

Factor structure of the DASS

Given *a priori* hypotheses regarding the factor structure of the DASS, CFA was used to test goodness of fit of measurement models. CFA was conducted on the 42 DASS items, using Mplus Version 6.0 (Linda K. Muthén & Muthén, 2010), to evaluate a series of competing models. Given data consisted of ordered categorical variables, a means- and variance-adjusted weighted least squares (WLSMV) estimation method was used. The fit of each CFA model was assessed using the chi-square statistic (χ^2),

Comparative Fit Index (CFI), Tucker-Lewis Fit Index (TLI), and Root Mean Square Error of Approximation (RMSEA). Missing data were imputed using the full information maximum likelihood (FIML) procedure.

Firstly, the goodness of fit of a null (or independence) model, in which all items were assumed to be uncorrelated, was calculated to provide a baseline against which evaluated models could be compared. The resulting fit indices for all models are presented in Table 3. Nested models were compared using chi-square difference tests, and are presented in Table 4.

The first model tested was a one-factor model, in which all DASS items loaded onto a single factor (Model 1a). The model yielded a very large chi-square statistic (indicating a significant difference between the hypothesised model and the obtained data), and low fit indices, suggesting that Model 1a did not represent a good fit of the data. Nevertheless, all items loaded significantly on the single factor, indicating substantial common variance among DASS items. A second one-factor model was tested (Model 1b), in which residuals of items with similar content were permitted to correlate. This led to a significant improvement in model fit, but fit indices were still outside of their acceptable ranges. These results suggest that the DASS is not well represented by one factor in the postpartum sample.

Next, a series of two-factor models were tested, where the DASS-Anxiety and DASS-Stress items were collapsed into a single factor. This model represented the hypothesis that the DASS measures two constructs, anxiety and depression, and that the Stress factor represents anxiety rather than an independent construct. In Model 2a, the factors were constrained to be orthogonal (i.e., uncorrelated). This model yielded a very large chi-square and all fit statistics fell outside acceptable ranges. In Model 2b, the two factors were permitted to correlate. This led to a smaller chi-square indicating improved fit, but fit indices were still not acceptable.

Permitting correlated residuals (Model 2c) led to an improvement in model fit. The CFI and RMSEA indicated a good fit, whereas the TLI fell short of its acceptable range. Despite not providing an optimal fit to the data, the two-factor models improved upon the one-factor models.

A series of three-factor models were then tested, whereby Anxiety, Depression, and Stress were specified as distinct constructs. In Model 3a, these factors were constrained to be orthogonal, whereas in Model 3b they were permitted to correlate (in line with Lovibond and Lovibond's (1995) original specifications). Model 3a was associated with a very high chi-square and low fit indices, suggesting poor fit. Allowing the three factors to be correlated (Model 3b) led to a significant improvement in model fit; however, the fit statistics once again fell short of their acceptable ranges. It is noted that for both Models 3a and 3b, all items loaded significantly on the constructs that they were hypothesised to reflect. All factors were positively correlated in Model 3b (Anxiety and Stress=.81, Anxiety and Depression=.67, Depression and Stress=.78; *p*s<.001).

The 'revised' three-factor model was then tested (Model 3c), in which the following additional cross-loadings were specified: items 9 and 33 loaded onto both Anxiety and Stress, and item 30 onto all three factors. This model provided a better fit than Model 3b, although once again neither the CFI nor TLI were acceptable. All specified factor loadings were positive and significant (see Table 5). Finally, Model 3c was retested, but with the addition of correlated residuals (Model 3d). This model provided an optimal fit to the data: the CFI, TLI, and RMSEA suggested a good fit. Chi-square difference tests revealed that Model 3d provided a significantly better fit than Model 3c, as well as all other models tested. The factor correlations for Model 3d were: Anxiety and Stress=.79, Anxiety and Depression=.68, Depression and Stress=.81 (*ps*<.001).

Table 3

Fit Indices for CFA Models of the DASS

Model	Df	χ^2	CFI	TLI	RMSEA
Null (independence model)	861	30202.513			
1a. Single factor	819	4445.181	.876	.870	.108
1b. Single factor and correl. error	779	3255.649	.916	.907	.091
2a. Two independent factors	819	13024.966	.584	.563	.198
2b. Two correl. factors	818	3015.493	.925	.921	.084
2c. Two correl. factors and correl. error	778	2199.482	.952	.946	.069
3a. Three independent factors	819	14567.998	.531	.507	.210
3b. Three correl. factors	816	2580.943	.940	.937	.075
3c. Three correl. factors with cross loadings	812	2455.105	.944	.941	.073
3d. Three correl. factors, cross loadings, and correl. error	772	1797.525	.965	.961	.059

Given that patients also completed the DASS at discharge, the models were also evaluated for discharge data. Model 3d also provided the optimal fit at discharge ($\chi^2(772)=1322.72$, $p<.001$). All fit indices were in their acceptable ranges (CFI=.98; TLI=.98; RMSEA=.044). All loadings were positive and significant, except that anxiety item 11 did not load significantly onto Depression (see Table 5).

Table 4

Results of Testing for Differences Between Nested CFA Models of DASS

Comparison		Statistics		
More constrained	Less constrained	χ^2 test for difference testing	*df*	*p*
Model 1a	Model 1b	1512.885	40	<.001
Model 2a	Model 2b	472.606	1	<.001
Model1a	Model 2b	140.585	1	<.001
Model 2b	Model 2c	1012.067	40	<.001
Model 1b	Model 2c	105.972	1	<.001
Model 3a	Model 3b	911.538	3	<.001
Model 1a	Model 3b	268.686	3	<.001
Model 2b	Model 3b	105.812	2	<.001
Model 3b	Model 3c	85.544	4	<.001
Model 3c	Model 3d	757.419	40	<.001
Model 1b	Model 3d	312.565	7	<.001
Model 2c	Model 3d	142.340	6	<.001

Table 5

DASS Items With Factor Loadings From CFA Model 3d

Scale/item summary		Subscale	Factor loadings Admission (Discharge) Depression	Anxiety	Stress
Depression					
3	Couldn't experience positive	ANH	.89 (.91)		
5	Couldn't get going	INRT	.79 (.80)		
10	Nothing to look forward to	HLNS	.86 (.89)		
13	Sad & depressed	DYS	.86 (.90)		
16	Lost interest in everything	LoI/I	.90 (.90)		
17	Not worth much as a person	S-Dep	.86 (.90)		
21	Life not worthwhile	DoL	.80 (90)		
24	Couldn't get enjoyment	ANH	.92 (.90)		
26	Downhearted & blue	DYS	.87 (.88)		
31	Unable to become enthusiastic	LoI/I	.91 (.92)		
34	Felt worthless	S-Dep	.86 (.92)		
37	Nothing future hopeful	HLNS	.85 (.93)		
38	Life meaningless	DoL	.83 (.92)		
42	Difficulty to work up initiative	INRT	.82 (.81)		
Anxiety					
2	Dryness of mouth	AutAr		.43 (.59)	
4	Breathing difficulty	AutAr		.69 (.78)	
7	Shakiness	SkME		.75 (.73)	
9	Situations made anxious	SixAnx		.49 (.50)	.32 (.35)
15	Feeling faint	SubAA		.65 (73)	
19	Perspired noticeably	AutAr		.65 (.65)	
20	Scared for no good reason	SubAA		.85 (.86)	
23	Difficulty swallowing	AutAr		.60 (.86)	

Scale/item summary		Subscale	Factor loadings Admission (Discharge) Depression	Anxiety	Stress
25	Aware of action of heart	AutAr		.68 (.73)	
28	Felt close to panic	SubAA		.95 (.94)	
30	Feared would be 'thrown'	SitAnx	.16 **(.06)**	.30 **(.16)**	.36 (.57)
36	Terrified	SubAA		.80 (.91)	
40	Worried about situations/panic	SitAnx		.84 (.83)	
41	Trembling	SkME		.74 (.72)	
Stress					
1	Upset by trivial things	EU/A			.76 (.80)
6	Overreact to situations	I/OR			.78 (.80)
8	Difficult to relax	DRel			.80 (.85)
11	Upset easily	EU/A			.82 (.87)
12	Using nervous energy	NerAr			.81 (.81)
14	Impatient when delayed	IMPT			.71 (.73)
18	Touchy	I/OR			.78 (.83)
22	Hard to wind down	DRel			.74 (.81)
27	Irritable	I/OR			.80 (.87)
29	Hard to calm down	DRel			.88 (.87)
32	Difficulty tolerating interruptions	IMPT			.73 (.75)
33	State of nervous tension	NerAr		.47 (.46)	.40 (.41)
35	Intolerant kept from getting on	IMPT			.73 (.79)
39	Agitated	EUA			.85 (.91)

Note. DYS = dysphoria; HLNS = hopelessness; DoL = devaluation of life; S-Dep = self-depreciation; LoI/I = lack of interest/involvement; ANH = anhedonia; INRT = inertia; AutAr = autonomic arousal; SkME = skeletal musculature effects; SitAnx = situational anxiety; SubAA = subjective anxious arousal; DRel = difficulty relaxing; NerAr = nervous arousal; EU/A = easily upset/agitated; I/OR = irritable/over-reactive; IMPT = impatient. All loadings are significant except those in bold.

In summary, the best fitting model in the postpartum inpatient sample was the same model that had the optimal fit in previous studies, including non-patient (Crawford & Henry, 2003), depressed inpatient (Page et al., 2007), and anxious outpatient samples (Antony et al., 1998; Brown et al., 1997).

Measurement invariance across admission vs. discharge samples. Multiple-group CFA was used to test for measurement invariance of the DASS between admission and discharge. Establishing measurement invariance is important because constructs may have different meanings across different groups; if so, it would be invalid to make mean comparisons between the groups. To test measurement invariance, the total sample was split into two independent groups: an 'admission' group (in which admission data were analysed) and a 'discharge' group (in which discharge data were analysed). A WLSM estimation method was used.

The first step of testing measurement invariance is to test the goodness of fit of the hypothesised model (Model 3d) in each of the samples independently (i.e., configural invariance). The preceding analyses of admission and discharge data (which suggested that Model 3d provided an optimal fit at both time points) were taken as evidence of configural invariance and hence a simultaneous test was conducted consisting of the admission and discharge groups, which suggested a good fit ($\chi^2(1544)=3509.659$, $p<.001$, scaling correction factor=.466). Although the CFI (.992) and TLI (.991) suggested a good fit, the RMSEA (.084) was borderline. The next step was to test the measurement invariance of the groups by simultaneously constraining the factor loadings and thresholds to be equal across the two groups. No difference was found between the groups, as indicated by a Satorra-Bentler chi-square difference test (S-B$\chi^2(169)=35.48$; $p>.05$). Thus, it was concluded that the DASS measurement model was invariant across admission and discharge, providing additional support for the robustness of the revised three-factor model in the sample.

Discussion

It has been argued that postpartum emotional disorders are unique in their presentation and aetiology, and should be classified separately from emotional disorders occurring outside of the postpartum period. However, very few studies have provided empirical support for this view.

The present study aimed to examine the constructs underlying postpartum emotional symptoms by examining the factor structure of the DASS in WAMBU inpatients. CFA was used to evaluate goodness of fit of competing models of the DASS, to examine the degree to which the measurement model corresponded with that obtained in previous studies of clinical and non-clinical populations.

Firstly, the present study obtained strong support for the reliability and validity of the DASS in the postpartum inpatient sample. Consistent with expectations for inpatients, patients' mean scores at admission were in the severe range of the DASS. At discharge, patients' mean scores were significantly lower, although still elevated compared to the normative sample reported by Crawford and Henry (2003).

Internal consistencies were excellent and similar in magnitude to those obtained in previous studies of the DASS (Antony et al., 1998; Brown et al., 1997; Crawford & Henry, 2003; P. F. Lovibond & S. H. Lovibond, 1995; Page et al., 2007). Temporal stability of scores was moderate despite provision of treatment across admission to WAMBU. The intraclass correlations were slightly lower in magnitude than those reported by Page et al. (2007) for a depressed inpatient sample, whereas the Pearson correlations were higher than those reported by Lovibond and Lovibond (1995) for a non-clinical sample across an 8-week period.

Correlational analyses revealed that the DASS had adequate convergent and discriminant validity. DASS-Depression and DASS-Anxiety exhibited good convergent validity, as indicated by high within-construct correlations (e.g., DASS-Depression

correlated highly with the BDI-II and EPDS; and DASS-Anxiety correlated highly with the BAI). However, there were also moderate between-construct correlations for DASS-Depression and DASS-Anxiety. Generally, substantial correlations between instruments measuring distinct theoretical constructs would be interpreted as evidence of poor discriminant validity of the instrument. However, there is considerable evidence in the literature that depression and anxiety are not independent constructs and, hence, measures of depression and anxiety typically exhibit moderate to high relationships. Thus, it was not surprising that DASS-Depression and DASS-Anxiety showed moderate correlations in the present study, as in previous studies of the DASS (Antony et al., 1998; Brown et al., 1997; P. F. Lovibond & S. H. Lovibond, 1995; Page et al., 2007). The BHS correlated to a greater degree with DASS-Depression than with DASS-Anxiety, providing additional support for the construct validity of these DASS scales.

Three previous studies demonstrated that DASS-Depression and DASS-Anxiety were able to discriminate between anxious and depressed patient groups (Antony et al., 1998; Brown et al., 1997; Clara et al., 2001). However, the ability of the DASS to discriminate between patient groups (patients with anxiety disorders, depressive disorders, and mixed anxiety and depressive disorder) in the present study was limited. Only DASS-Depression showed a main effect of group, with the depressed group obtaining higher mean DASS-Depression scores than the anxiety and mixed groups. These findings suggest that DASS-Depression has good discriminant validity, whereas the discriminant validity of DASS-Anxiety for this purpose was limited. The inability of DASS-Stress to discriminate between patient groups was consistent with expectations, as the construct is theorised to represent a non-specific component of emotional disorders (S. H. Lovibond & P. F. Lovibond, 1995).

The main purpose of the present study was to examine the DASS factor structure in the postpartum inpatient sample using CFA. It was predicted that the revised three-

factor model originally proposed by Brown et al. (1997), with the addition of correlated residuals between items of similar content, would provide the best fit to the data. Consistent with our predictions, this model provided an optimal fit to the data.

The revised three-factor model provided a significantly better fit than all other models tested, including Lovibond and Lovibond's (1995) original three-factor model. These results provide further support for the revised three-factor model of the DASS, which has been obtained across a number of clinical and non-clinical populations (Antony et al., 1998; Brown et al., 1997; Crawford & Henry, 2003; Page et al., 2007). The present study supported previous studies suggesting that DASS items 9, 30, and 33 load onto more than one factors, thereby reducing the discriminant validity of its scales. The loadings obtained for the revised three-factor model were comparable to those reported in other studies of the DASS. The DASS factor structure also exhibited measurement invariance across admission and discharge, providing support for the robustness of its latent structure postpartum.

A number of conclusions can be drawn from the results of the present study. Firstly, the DASS appears to be psychometrically sound in this postpartum inpatient sample, and hence is a useful instrument for assessment during the postpartum period.

Secondly, the present findings do not provide support for the theory that postpartum emotional disorders have a unique symptom profile. Instead, when considered amongst previous factor analyses of the DASS, the present data suggest that the latent structure of postpartum emotional disorders is similar to that of the general population. Some authors have suggested that differences in the symptom profiles of postpartum and non-postpartum samples would provide evidence that postpartum emotional disorders are distinct from non-postpartum emotional disorders (Whiffen, 1992). In light of this argument, the results of the present study do not support the theory that postpartum emotional disorders are unique. Rather, the results are consistent

with the theory that postpartum emotional disorders are the same disorders that are seen outside of the postpartum period, perhaps triggered or exacerbated by the stressful nature of this life event (Riecher-Rössler & Rohde, 2005). However, it is important to note that symptom similarity is only one line of evidence considered in the classification of syndromes. For example, in DSM-5, symptom similarity was 1 of 11 indicators used to determine the boundaries of diagnostic groupings. These 11 indicators included "shared neural substrates, family traits, genetic risk factors, specific environmental risk factors, biomarkers, temperamental antecedents, abnormalities of emotional or cognitive processing, symptom similarity, course of illness, high comorbidity, and shared treatment process" (APA, 2013b, p. 12). Thus, whilst the present study provides evidence of symptom similarity, this indicator alone is likely to be insufficient to draw conclusions about the relationship of postpartum emotional disorders to non-postpartum disorders. Rather, a breadth of data need to be synthesised to draw conclusions about diagnostic grouping.

These findings have implications for the assessment and management of emotional symptoms in the postpartum period. If postpartum emotional disorders are not qualitatively different from non-postpartum emotional disorders, then the literature on emotional disorders in the general population may apply to postpartum women (Whiffen, 1992). However, whilst postpartum emotional disorders may not have a unique symptom profile, it is acknowledged that there are specific issues which may require special consideration when assessing and treating postpartum mood disorders, including (but not limited to) the impact of maternal depression on the infant, family, and the mother-infant relationship; the effect of psychotropic medication on breast milk; and the impact of psychosocial role changes in the onset/exacerbation of symptoms (Riecher-Rössler & Hofecker Fallahpour, 2003). Thus, regardless of whether the symptom profiles differ, it may still be useful to flag disorders as having onset in the

postpartum period. In line with this, the DSM-5 includes a “peripartum onset” specifier, which can be used if mood disorder onset occurs during pregnancy or in the four weeks following delivery.

This study has several limitations that should be noted. Firstly, a non-postpartum comparison sample was not used. Doing so would have allowed a direct test of measurement invariance between postpartum and non-postpartum groups, rather than drawing conclusions by indirectly comparing our results to previous studies of the DASS in non-postpartum groups. Thus, future research should recruit both postpartum and non-postpartum samples. Furthermore, the extent to which the results of the current study are generalisable to other postpartum groups is not known.

To conclude, the data in the present study do not add support to the hypothesis that postpartum episodes of emotional disorders are qualitatively distinct from non-postpartum episodes. Rather, the data suggest that postpartum disorders have similar symptom profiles to those occurring outside of the postpartum period, and their occurrence during this period may be explained within a general vulnerability-stress diathesis model of emotional disorders.

Chapter 4: The Structure of Negative Emotional States in a Postpartum Inpatient Sample

Foreword to Chapter 4

The study in Chapter 3 aimed to examine whether the Depression Anxiety Stress Scales (DASS; S. H. Lovibond & P. F. Lovibond, 1995) had the same factor structure in a postpartum inpatient sample as that observed in other non-postpartum populations. In line with previous evidence suggesting overall that there are no substantial differences in the symptom profiles of postpartum and non-postpartum emotional disorders (C. Cooper et al., 2007), it was found that a three-factor model of the DASS obtained in previous studies (Crawford & Henry, 2003; Page et al., 2007) provided the best fit to the DASS in the postpartum inpatient sample. Moreover, the factor structure was invariant across admission and discharge, suggesting that it did not vary as a function of symptom severity. These findings suggested that the variability of the EPDS factor structure observed in Chapter 2 was specific to the EPDS, rather than due to the nature of distress in the postpartum sample. Furthermore, the results provided support to the theory that the factor structure of postpartum anxiety and depression symptoms (as measured by the DASS) is similar to that observed in non-postpartum populations. As a result, it was possible to be more confident in using existing self-report questionnaires developed for use in the general population to test the tripartite model of anxiety and depression in the postpartum inpatient sample.

Chapter 3 included a review of previous studies that had compared symptoms of depression and anxiety in postpartum- and non-postpartum samples. Whilst some of these studies have suggested differences in the severity of particular anxiety or depression symptoms of postpartum and non-postpartum samples, there is not a consistent pattern of differences across these studies. Other studies have not supported differences between postpartum and non-postpartum samples (C. Cooper et al., 2007; Eberhard-Gran et al., 2003). It is important to acknowledge that following the publication of the study contained within Chapter 3 (Nadia K Cunningham et al., 2013),

several additional studies have been published which have compared the frequency and intensity of anxiety and depression symptoms endorsed by postpartum and non-postpartum samples (Hoertel et al., 2015; Pereira et al., 2014). The findings of these studies do not impact or influence the conclusions of the study in Chapter 3. They are consistent with the previous studies in that they suggest that the symptom profile of depression and anxiety are not different in postpartum compared to non-postpartum samples. Another study tested the factor structure of a self-report depression measure in a postpartum and non-postpartum sample, and reported no differences (Williamson, O'Hara, Stuart, Hart, & Watson, 2015). These studies are in line with the findings of Chapter 3 suggesting that the factor structure of anxiety and depression symptoms in postpartum are similar to that observed in non-postpartum samples.

Chapter 4 turned to the second objective of the thesis: to test whether the tripartite model provided an adequate fit to self-report anxiety and depression data in a sample of postpartum psychiatric inpatients. Given a lack of robust evidence for a distinct symptom profile of postpartum versus non-postpartum anxiety and depression, as well support for a similar factor structure of a self-report measure of depression and anxiety symptoms in postpartum inpatients (Chapter 3), it was hypothesised that the tripartite model would provide an adequate fit to the data, and would provide a superior fit to alternative models tested. Furthermore, it was observed from the findings of chapters 2 and 3, as well as previous factor analyses of these scales, that the scales of the DASS and EPDS did not exhibit a one-to-one correspondence to the constructs of the tripartite model. As a result, the analyses in Chapter 4 were not conducted at the scale level (i.e., using scales as indicators), but at the item level (i.e., using individual items as indicators). That is, items were drawn from self-report anxiety and depression measures completed by the psychiatric inpatients at hospital admission. These items were mapped on to the hypothesised tripartite model factors of positive affect (PA),

negative affect (NA), and autonomic arousal (AA). The item level approach allowed for examination of the significance and strength of the relationships between the tripartite model factors and individual items.

The study presented in this chapter has been published as:

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Abstract

Background. Depression and anxiety disorders exhibit comorbidity, and the same relationships have been observed in postpartum samples. The tripartite model posits that anxiety and depression overlap due to shared and unique symptoms components. The present study tested whether the tripartite model adequately described the structure of anxiety and depression symptoms in a postpartum sample.

Methods. The sample consisted of 663 postpartum psychiatric inpatients who completed self-reported questionnaires assessing symptoms of anxiety and depression.

Results. Confirmatory factor analysis revealed that a three-factor model consistent with the tripartite model provided a good fit to anxiety/depression data. This model consisted of three factors: positive affect, negative affect, and autonomic arousal. Positive affect was related to depressive diagnoses and negatively related to anxiety diagnoses; autonomic arousal was related to anxiety diagnoses; and negative affect was uniquely related to mixed anxiety-depressive diagnoses.

Limitations. The sample consisted of postpartum psychiatric inpatients and the generalisability of results to other postpartum samples is not known.

Conclusions. Postpartum anxiety and depression appear to be characterised by three differentiable symptom clusters. Postpartum anxiety, depression, and mixed anxiety-depressive diagnoses are differentially associated with these symptom clusters. These findings suggest that the tripartite model may be useful in guiding assessment, differentiation, and treatment of postpartum emotional disorders.

Introduction

A wide range of psychiatric conditions may present in the postpartum period. Depression is particularly common: approximately 10-15% of women will meet diagnostic criteria for major depression in the first postpartum year (Peter J. Cooper & Murray, 1998). The term 'postpartum depression' has been used to refer to depressive disorders occurring following childbirth, and a substantial amount of research has focused on delineating the specific course, symptomatology, and aetiological factors of postpartum depression (e.g., P. J. Cooper & Murray, 1995; Hendrick et al., 2000; Whiffen & Gotlib, 1993). The term has often served as an umbrella term for a wide spectrum of emotional disorders that may present following childbirth (Rowe et al., 2008).

Whilst postpartum depression may not represent a diagnostic entity distinct from depressive disorder occurring at other life stages (and this has been the subject of considerable debate), the concept has arguably been useful for identifying factors that require special consideration when assessing and treating emotional disorders in a postpartum context (Brockington, 2004; Riecher-Rössler & Rohde, 2005). The concept of postpartum depression has also been useful at times in distinguishing depressive disorders from other psychiatric conditions that may occur following childbirth, such as the mild and transitory postpartum 'blues', and postpartum psychosis (Grigoriadis & Romans, 2006). It has also been useful for raising awareness of postpartum emotional disorders in the community (Buist et al., 2008). Moreover, given increasing awareness of adverse consequences associated with postpartum psychiatric illness, screening instruments (e.g., the Edinburgh Postnatal Depression Scale, EPDS; Cox et al., 1987) have been developed to detect depression in postpartum populations.

Whilst the concept of postpartum depression has been useful, there have also been issues with its use. As aforementioned, the term has not been uniformly used to

refer to a single diagnostic entity, and postpartum depression has sometimes been confounded with other emotional syndromes occurring around childbirth (Rowe et al., 2008). In particular, anxiety has typically been subsumed within the concept of postpartum depression (Matthey et al., 2003). For decades, anxiety has been observed in postpartum women, but until recently it was primarily viewed as a feature of postpartum depressive disorders (e.g., Pitt, 1968; Ross et al., 2003). The confounding of postpartum anxiety and depression is evident in the EPDS, which was described as a unidimensional depression scale, but factor analyses have reported a distinct three-item 'anxiety' factor (see Nadia K Cunningham, Brown, & Page, 2014, for review). Furthermore, several studies have demonstrated that women with anxiety disorders score above validated cut-off scores for probable depressive disorder (Matthey et al., 2003; Rowe et al., 2008). Hence, there is a risk that postpartum anxiety disorders may be overlooked or misdiagnosed as depression if diagnoses are not confirmed with a clinical interview.

Consequently, researchers have expressed the importance of distinguishing postpartum anxiety from depression, so that treatments can be tailored to the presenting syndrome (e.g., Austin & Priest, 2005). The concept of postpartum anxiety has therefore emerged, and research has followed the path taken by postpartum depression research: delineating characteristics and risk factors of postpartum anxiety disorders, and assessing suitability of existing anxiety treatments in a postpartum context.

However, a major obstacle to detection and treatment of postpartum anxiety disorders is that few self-report anxiety scales have been validated for use in postpartum (Ross et al., 2003). One approach has been to develop postpartum-specific anxiety measures (e.g., the Perinatal Anxiety Screening Scale; Somerville et al., 2014). However, in the broader emotional disorders literature it is recognised that anxiety and depression overlap, as syndromes (e.g., high correlation of anxiety and depression

scales) and clinical disorders (i.e., high comorbidity of anxiety and depressive disorders; L. A. Clark & Watson, 1991). This is inconsistent with their classification in diagnostic systems such as DSM-5 and ICD-10 as categorically distinct entities, and poses a difficulty for their psychometric assessment and discrimination. Hence, an alternative framework that accurately represents the relationship between anxiety and depression is required.

One such model proposes that anxiety and depressive disorders reflect a broader underlying syndrome, or "general neurotic syndrome" (Andrews, 1996). That is, emotional disorder symptoms (e.g., generalised anxiety, panic, anhedonia) represent insignificant variations in the manifestation of a broader syndrome that are erroneously classified as separate disorders. Neuroticism (a personality trait representing a tendency to react poorly to stress and experience frequent and intense episodes of distress) has been proposed as the common vulnerability factor underlying the emotional disorders. There is evidence for shared variance and genetic influences underlying neuroticism, depressive disorders, and anxiety disorders (Zinbarg et al., 1994).

An alternative model of anxiety and depression is the tripartite model, originally proposed by Clark and Watson (1991). According to the tripartite model, anxiety and depression overlap due to a shared underlying general distress factor called negative affect (NA). NA reflects the extent to which a person is feeling upset or unpleasantly engaged instead of peaceful, and corresponds to a range of negative emotional states, including fear, sadness, disgust, anger, and nervousness (Watson, Clark, & Carey, 1988). However, anxiety and depressive disorders also have unique symptom components: depressive disorders are specifically associated with positive affect (PA), whereas anxiety disorders are specifically associated with autonomic arousal (AA). High PA reflects pleasant engagement with the environment, enthusiasm, and interest; whereas absence of (or low) PA is characterised as tendency towards experiencing

fatigue and lethargy (L. A. Clark & Watson, 1991). Depressive disorders are characterised by reduced PA. AA is characterised by physiological anxiety symptoms reflecting overarousal of the sympathetic nervous system, and is specifically characteristic of anxiety disorders.

The tripartite model has received support across clinical and non-clinical samples, including children, students, and younger and older adults. Factor analyses of self-report anxiety/depression data have supported a three-factor model over one- or two-factor models (e.g., Chorpita, Albano, & Barlow, 1998; Joiner, 1996; Watson, Clark, et al., 1995). Whilst these studies have occasionally differed in the hierarchical arrangement of these factors (e.g., Brown et al., 1998, found that NA and PA emerged as second-order factors and AA as a first-order factor), they have broadly supported a tripartite structure of anxiety and depressive symptoms, and have provided evidence that the structure is stable across clinical and non-clinical populations.

The tripartite factors have demonstrated differential relations to anxiety and depressive disorder diagnoses. Brown, Chorpita and Barlow (1998) examined relations of anxiety and depressive disorder factors (major depressive disorder, generalised anxiety disorder (GAD), panic disorder/agoraphobia, obsessive-compulsive disorder (OCD), and social phobia) and tripartite factors in psychiatric outpatients. Structural equation modelling was used to test measurement models and relations between factors. In the best-fitting model, NA emerged as a higher-order factor influencing all of the disorders; PA emerged as a higher-order factor influencing depression and social phobia; and AA emerged as a lower-order factor: rather than being related to all of the anxiety disorders, it was positively related to panic disorder/agoraphobia and inversely related to GAD.

The finding that NA accounted for substantial shared variance across anxiety and depressive diagnoses has been used to explain comorbidity of anxiety and

depressive disorders, and has also led to the assertion that treatments can be designed to be applicable across emotional disorders (by targeting NA), rather than trying to develop specific treatments for each disorder (Barlow, 2004). Nevertheless, the finding that the tripartite factors could not be collapsed into one factor (Brown et al., 1998) suggests that PA and AA are also relevant to treatment, and psychometric discrimination of anxiety and depression may be improved by assessing these components (L. A. Clark & Watson, 1991). Several studies have found that NA, PA, and AA are differentially modified by particular treatments (e.g., Kring et al., 2007). If the tripartite model is demonstrated to apply to a postpartum sample, these findings will also be relevant to postpartum emotional disorders.

Whilst the association of tripartite factors to anxiety and depressive disorders have been examined, the symptom profiles of comorbid anxiety/depressive presentations have scarcely been considered. Zinbarg et al. (1994) observed that subthreshold cases of anxiety and depression (i.e., not meeting full criteria for anxiety or depressive disorder) were characterised primarily by nonspecific/NA symptoms and were differentiable from anxiety and depressive disorders by the lack of prominence of PA and AA. In previous studies, subthreshold and mixed diagnoses (including adjustment disorders) have often been assigned in the postpartum period (Austin et al., 2010; Matthey et al., 2003; Phillips, Sharpe, et al., 2009). Further examination of the symptom profiles of mixed, adjustment, and/or subthreshold emotional disorders diagnosed in the postpartum period may aid in defining and treating these subgroups.

Given increasing recognition for the need to assess and differentiate anxiety and depression, as well as increasing evidence that depression and anxiety often co-occur in the postpartum period, the tripartite model may provide a framework for understanding the pattern of postpartum emotional symptoms. That is, the symptom dimensions NA, PA, and AA may extend to emotional symptoms in postpartum women, and may

provide a framework for understanding and conceptualising postpartum anxiety and depression. As postpartum research moves to distinguish anxiety and depressive disorders, the model may also help direct treatment choice, but only if it is able to describe postpartum emotional symptoms as well as it has been found to describe emotional symptoms at other life stages.

Few studies have examined the existence and role of the tripartite factors in the postpartum period. Buttner, O'Hara, and Watson (2012) conducted an exploratory factor analysis of self-reported mood symptoms in women in the first week postpartum, and identified two factors consistent with the symptom dimensions NA and PA. Based on the identification of these dimensions, the authors concluded that the structure of women's mood post-delivery is no different to that outside of the early postpartum period. However, the study did not include symptoms assessing anxiety and hence the presence of AA could not be observed.

The objective of the present study was to examine whether the tripartite model adequately described the structure of postpartum anxiety and depression symptoms. The first aim was to test and compare different models of affect in a postpartum inpatient sample, and to determine which model provided a superior fit to the self-report data. Given that we had specific *a priori* hypotheses regarding the factor structure of the data, confirmatory factor analysis was used to test the construct validity of the models using the items identified (Brown, 2006). Alternative measurement models were tested and compared, including a single-factor model (consistent with the general neurotic syndrome model); and a three-factor model representing NA, PA, and AA (consistent with the tripartite model). It was predicted that the tripartite model would provide a superior overall fit compared to the single-factor model.

The second aim was to examine the relations between tripartite factors and ICD-10 emotional disorder diagnosis variables (depression, anxiety, and mixed anxiety-

depressive diagnoses). It was hypothesised that the factors NA, PA, and AA would be differentially related to depressive and anxiety disorders. Firstly, if NA represents a common factor for all emotional disorders, then it would be expected to exhibit strong positive relations with all diagnoses. Secondly, if reduced PA is uniquely characteristic of depression, then it would be expected that PA would be negatively associated with depressive diagnoses and mixed anxiety-depressive diagnoses, and unrelated to anxiety diagnoses. Finally, if AA is uniquely characteristic of anxiety disorders, then AA will be positively associated with anxiety and mixed anxiety-depressive diagnoses, and unrelated to depressive diagnoses.

Alternatively, if postpartum emotional symptoms reflect a general neurotic syndrome, then it would be expected that one symptom factor would load positively on all diagnosis variables.

Method

Participants

The sample consisted of 869 consecutive admissions to the Western Australian Mother and Baby Unit (WAMBU). The WAMBU is a public psychiatric unit that provides inpatient assessment and treatment of women experiencing acute psychiatric conditions in the perinatal period, and allows admission of women with their infants. Patients were excluded from analyses if their child was over 13 months old (n=2), if the mother was aged under 18 years (n=14), or if they were readmitted and had completed the questionnaires more than once within a 12 month period (n=88). Patients who had not completed any of the questionnaires at either admission or discharge (n=103) were also excluded from analyses.

The final sample consisted of 663 consecutive admissions to the WAMBU. Of these 663 admissions, 597 (77.9%) patients had completed all questionnaires at

admission and 577 (75.3%) at discharge. Four hundred and seventy-eight (75.1%) patients had completed the questionnaires at both time points.

Patients were assigned a primary diagnosis by their treating psychiatrist, according to ICD-10-AM criteria (National Centre for Classification in Health Publications, 2002). The majority of patients (99.6%) had at least one diagnosis recorded. The predominant primary diagnoses were unipolar mood disorders (32.0%); mixed anxiety-depressive disorders (19.3%); anxiety disorders (9.7%); bipolar disorders (12.9%); adjustment and acute stress reactions (7.5%); psychotic disorders including schizophrenia, schizotypal and delusional disorders (7.1%); and personality disorders (3.9%).

Descriptive statistics for the self-report measures completed at admission are presented in Table 1. Patient ages ranged from 18-49 years old (M=31, SD=6.01). Infant ages ranged from 0-13 months (M=2.82, SD=3.02). Other demographic characteristics are presented in Table 2.

Table 1

Descriptive Statistics for Self-Report Questionnaires Completed at Admission

Self-report measure	Mean	SD	Range
EPDS	19.0	6.5	0-30
DASS-Depression	22.7	12.4	0-42
DASS-Anxiety	17.5	10.5	0-42
DASS-Stress	26.0	10.9	0-42
BDI-II	28.7	13.8	0-59
BAI	23.7	13.4	0-60

Note. BAI = Beck Anxiety Inventory; BDI-II = Beck Depression Inventory-II; DASS = Depression Anxiety Stress Scales; EPDS = Edinburgh Postnatal Depression Scale.

Table 2

Demographic Characteristics of Patients at the WA Mother and Baby Unit

Variable	N	%
Western Australia residential location		
Metropolitan	526	79.3
Rural-remote	137	20.7
Aboriginal or Torres Strait Islander		
Yes	28	4.2
No	609	91.9
Missing	26	3.9
Marital status		
Married/defacto	507	79.7
Divorced/separated	21	3.3
Single	79	12.4
Widowed	1	0.2
Missing	28	4.4
Country of birth		
Australia	468	70.6
New Zealand/Oceania	22	3.3
NW Europe	66	10.0
SE Europe	7	1.1
Africa	23	3.5
Asia	36	5.4
America	6	0.9
Missing	35	5.3

Measures

Edinburgh Postnatal Depression Scale (Cox et al., 1987). The EPDS is a 10-item self-report measure designed to screen for postnatal depression. The EPDS comprises 10 four-level ordinal items scored from 0 to 3, with total scores ranging from 0 to 30. The EPDS has demonstrated acceptable internal consistency and has high correlations with other depression measures and moderate-to-high correlations with anxiety measures (Boyd et al., 2005). However, the factor structure has been found to vary across samples (Nadia K Cunningham et al., 2014).

Depression Anxiety Stress Scales (DASS; S. H. Lovibond & P. F. Lovibond, 1995). The DASS is a 42-item self-report measure, consisting of three 14-item scales

assessing depression, anxiety, and stress over the past week. The DASS has demonstrated excellent internal consistency and sound construct validity in clinical and non-clinical populations (Brown et al., 1997; Crawford & Henry, 2003; P. F. Lovibond & S. H. Lovibond, 1995; Page et al., 2007), and in a postpartum inpatient sample (Nadia K Cunningham et al., 2013).

Beck Depression Inventory-II (BDI-II; Beck et al., 1996). The BDI-II is a 21-item self-report measure that assesses severity of depression over the past two weeks. The BDI-II has previously demonstrated good reliability and is highly correlated with other measures of depression (Beck et al., 1996).

Beck Anxiety Inventory (BAI; Beck, Epstein, et al., 1988). The BAI is a 21-item self-report measure that assesses anxiety severity over the past week. The BAI has been well validated in clinical samples, and has demonstrated good internal consistency, convergent and discriminant validity (Beck, Epstein, et al., 1988; Steer et al., 1993).

Procedure

Participant recruitment. As aforementioned, patients completed a battery of self-report questionnaires at admission and discharge from the unit. Patients gave informed consent prior to questionnaire completion. The research was approved by the Women and Newborn Health Service Ethics Committee and the University of Western Australia Ethics Office.

Item selection. The scales provided a 94-item pool containing items related to various symptom domains. It was evident that the scales of the DASS and EPDS did not exhibit a one-to-one correspondence to the constructs of the tripartite model (other than the DASS Anxiety scale, which has previously been validated as an indicator of the construct autonomic arousal; Brown et al., 1998). As a result, the analyses in Chapter 4 were not conducted at the scale level (i.e., using scales as indicators), but at the item level (i.e., using individual items as indicators). That is, items were drawn from self-

report anxiety and depression measures completed by the psychiatric inpatients at hospital admission. These items were mapped on to the hypothesised tripartite model factors of positive affect (PA), negative affect (NA), and autonomic arousal (AA). The item level approach allowed for examination of the significance and strength of the relationships between the tripartite model factors and individual items.

Items were selected using multiple criteria. The methods for item selection were driven by previous literature, and were similar to those used by Marshall et al. (2003) in their test of the tripartite model in depressed and hypertensive patients. Firstly, items were organised and classified as indicators of the tripartite model constructs. These items were mapped against items from the Mood and Anxiety Symptom Questionnaire (MASQ; Watson & Clark, 1991; Watson, Clark, et al., 1995), which was developed for testing the tripartite model (Table 3). Classification was therefore based on tripartite model theory (L. A. Clark & Watson, 1991), as well the findings of previous research (e.g., Brown et al., 1998; Joiner et al., 1999). Items that were found to vary in their placement in previous literature were excluded from analyses, because it was unclear which construct these items reflected in other populations (i.e., they lacked validity as indicators of the tripartite model constructs). Seventy-seven of the 94 items could be classified with reference to the tripartite model. Furthermore, in order to ensure maximum distinctiveness from other items being selected, items were excluded if they were similar (i.e., reflected the same symptom) – this was to prevent overrepresentation of specific symptoms (and the potential emergence of minor factors reflecting specific symptoms; Marshall et al., 2003). Where there were multiple items, the item that most closely resembled the content of the MASQ item was selected. Thus, 44 items were included in the measurement models (Table 3).

Based on previous research and theory: (a) items from the DASS-Anxiety and BAI reflecting physiological symptoms of anxious arousal were used as indicators for

the factor AA (Brown et al., 1998; Joiner, 1996); (b) items from the BDI-II and DASS-Depression reflecting core, specific symptoms of depression (e.g., loss of interest or pleasure, apathy, amotivation, lethargy) were reverse-scored and used as indicators for PA (Brown et al., 1998; L. A. Clark & Watson, 1991); and (c) items from EPDS, DASS, BDI-II and BAI reflecting non-specific general distress (e.g., worry, irritability, tension) were used as indicators for NA (Brown et al., 1997).

Negative affect. Of the item pool, 27 items from BAI, BDI-II, EPDS, and DASS were identified as indicators of NA. These items reflected various negative emotional states including stress, irritability, sadness, pessimism, and nervousness/fear; as well as non-specific somatic and cognitive symptoms (e.g., sleep disturbance, confusion, appetite changes; L. A. Clark & Watson, 1991). Clark and Watson (1991) originally suggested that depressed mood was a complex presentation of PA and NA. Recent research has suggested that it relates more closely to NA (Marshall et al., 2003; Watson, Clark, et al., 1995). Consequently, items representing depressed mood/sadness were included as indicators of NA.

Autonomic arousal. Thirteen items from BAI and DASS-Anxiety scale were selected as indicators for AA. Numerous studies have supported the BAI and DASS-Anxiety as measures of AA (Brown et al., 1998; Brown & McNiff, 2009). Joiner et al. (1999) showed that six BAI items were strong indicators of physiological hyperarousal associated with anxiety. An item representing nausea/indigestion was removed because its placement within the tripartite model (whether it is indicative of AA or NA) was unclear from previous studies (Marshall et al., 2003; Watson, Clark, et al., 1995)

Positive affect. Seven items from EPDS, BDI-II and DASS-Depression reflecting loss of interest, amotivation, and anhedonia were selected as indicators of low PA. These items were reverse-scored so that higher scores reflected greater PA.

Table 3

Hypothesised Placement of Self-Report Items Within the Tripartite model (Clustered According to Items in Watson et al., 1995)

Item from Watson, Clark, et al. (1995)	Item in present sample	Abbreviated item description in present sample	AA	NA	PA
Felt dizzy, lightheaded	BAI 6	Felt dizzy/lightheaded	+		
Felt faint	BAI 19	Faint	Repeated		
	DASS 15	Had a feeling of faintness	+		
Hot or cold spells, sweating	BAI 2	Feeling hot	+		
	BAI 20	Face flushed	+		
	BAI 21	Sweating	Repeated		
	DASS 19	I perspired noticeably	+		
Dry mouth	DASS 2	Aware of dryness of mouth	+		
Was trembling, shaking; twitching or trembling muscles; shaky hands	DASS 7	I had a feeling of shakiness	Repeated		
	DASS 41	Experienced trembling e.g. in the hands	+		
	BAI 3	Wobbliness legs	Repeated		
	BAI 8	Unsteady?	Repeated		
	BAI 12	Hands trembling	Repeated		
	BAI 13	Shaky	Repeated		
Felt numbness or tingling	BAI 1	Numbness/tingling	+		
Racing or pounding heart	DASS 25	Aware of action of my heart in absence of physical exertion	+		
	BAI 7	Heart pounding/racing	Repeated		
Short of breath	DASS 4	Experienced breathing difficulty	Repeated		
	BAI 15	Difficulty breathing	+		
Felt like I was choking	BAI 11	Feelings of choking	+		
Trouble swallowing	DASS 23	Difficulty in swallowing	+		
Afraid I was going to die	BAI 16	Fear dying[3]	+		

[3] Watson, Clark, et al. (1995) found that this item loaded on AA rather than NA.

Item from Watson, Clark, et al. (1995)	Item in present sample	Abbreviated item description in present sample	AA	NA	PA
Upset stomach	BAI 18	Indigestion/discomfort in abdomen[4]		Uncertain	
Felt "afraid", "nervous", worried a lot about things	BAI 9	Terrified		Repeated	
	BAI 17	Scared		+	
	EPDS 4	Anxious or worried for no good reason		+	
	EPDS 5	Scared or panicky for no good reason		Repeated	
	BAI 10	Nervous		+	
	DASS 20	I felt scared without any good reason		Repeated	
	DASS 36	I felt terrified		Repeated	
	BAI 5	Fear worst happening		+	
Afraid I was losing control	BAI 14	Fear of losing control		+	
Unable to relax	DASS 8	I found it difficult to relax		+	
	DASS 22	I found it hard to wind down		+	
	BAI 4	Unable to relax		Repeated	
	DASS 29	I found it hard to calm down after something upset me		Repeated	
Felt irritable; tense; high strung; keyed up; on edge	BDI 17	Felt irritable		+	
	BDI 11	Agitation		+	
	DASS 6	Tended to overreact to situations		+	
	DASS 27	I found that I was very irritable		Repeated	
	DASS 33	I was in a state of nervous tension		Repeated	
	DASS 39	I found myself getting agitated		Repeated	

[4] Found to vary in its placement across studies; refer to text.

Item from Watson, Clark, et al. (1995)	Item in present sample	Abbreviated item description in present sample	AA	NA	PA
	DASS 1	I found myself getting upset by quite trivial things		Repeated	
	DASS 11	Found myself getting upset rather easily		+	
	DASS 12	Felt that I was using a lot of nervous energy		+	
	DASS 18	Felt I was rather touchy		Repeated	
Impatient	DASS 32	I found it difficult to tolerate interruptions to what I was doing		+	
	DASS 14	Found myself getting impatient when delayed		Repeated	
	DASS 35	I was intolerant of anything that kept me from getting on with what I was doing		Repeated	
Trouble falling asleep; trouble staying asleep	EPDS 7	I have been so unhappy I've had trouble sleeping		+	
	BDI 16	Changes in sleep		Repeated	
Appetite	BDI 18	Changes in appetite		+	
Felt slowed down? Tired or sluggish; got fatigued easily	BDI 15	Loss of energy		Repeated	
	BDI 20	Tired/fatigue		+	
Trouble making decisions	BDI 13	Indecisiveness		+	
Had trouble concentrating	BDI 19	Concentration difficulty		+	
Blamed myself for things	EPDS 3	I blamed myself when things went wrong		+	
	BDI 5	Guilty feelings		Repeated	
Felt sad; felt depressed; blue	EPDS 8	Sad or miserable		Repeated	
	BDI 1	Sadness		+	
	DASS 13	I felt sad and depressed		Repeated	

Item from Watson, Clark, et al. (1995)	Item in present sample	Abbreviated item description in present sample	AA	NA	PA
	DASS 26	I felt down-hearted and blue		Repeated	
Felt like crying	EPDS 9	So unhappy crying		Repeated	
	BDI 10	Felt like crying		+	
Thought about death, suicide	EPDS 10	The thought of harming self has occurred to me		Repeated	
	BDI 9	Suicidal thoughts or wishes		+	
Pessimistic about the future	BDI 2	Pessimism		+	
Felt unattractive; disappointed in myself; worthless; inferior; felt like a failure	BDI 7	Self-dislike		+	
	BDI 3	Past failure		Repeated	
	BDI 8	Self-criticalness		Repeated	
	BDI 14	Worthlessness		Repeated	
	DASS 17	Felt I wasn't worth much as a person		+	
Felt hopeless	DASS 10	Felt I had nothing to look forward to		Repeated	
	DASS 21	I felt that life wasn't worthwhile		Repeated	
	DASS 37	I could see nothing in the future to be hopeful about		+	
	DASS 38	I felt that life was meaningless		Repeated	
Able to laugh easily; nothing was interesting or fun; nothing was enjoyable; no enthusiasm	EPDS 1	Laugh and see funny side of things			+
	EPDS 2	Looked forward with enjoyment to things			+
					+
	DASS 3	I couldn't seem to experience any positive feeling at all			+

Item from Watson, Clark, et al. (1995)	Item in present sample	Abbreviated item description in present sample	AA	NA	PA
	DASS 24	I couldn't seem to get any enjoyment out of the things I did			+
	DASS 16	I felt that I had lost interest in just about everything			Repeated
	DASS 31	I was unable to become enthusiastic about anything			+
	BDI 4	Loss of pleasure			Repeated
	BDI 12	Loss of interest			+
Took extra effort to get started	DASS 5	I just couldn't seem to get going			Repeated
	DASS 42	I found it difficult to work up initiative to do things			+

Analytic procedure

Confirmatory factor analyses (CFAs) were conducted using Mplus Version 7.1 (L.K Muthén & Muthén, 2012). A means- and variance-adjusted weighted least squares (WLSMV) estimator was used for CFAs, given its robustness with non-normal and ordered-categorical data (B. O. Muthén, 1984). Cases with missing data were adjusted using full information maximum likelihood estimation.

Model fit was evaluated using multiple fit indices including the chi-square statistic (χ^2), Comparative Fit Index (CFI), Tucker-Lewis Fit Index (TLI), and Root Mean Square Error of Approximation (RMSEA). χ^2 is a traditional measure of overall model fit, with a non-significant χ^2 suggesting good fit. However, its utility is limited by its sensitivity to sample size (i.e., its tendency to reject models when larger sample sizes are used; Bentler & Bonett, 1980). Thus, model fit was primarily assessed using CFI, TLI, and RMSEA. Model fit was considered acceptable when RMSEA $\leq$0.08, CFI $\geq$0.90 and TLI $\geq$0.90 (Hu & Bentler, 1999).

In addition to examining overall fit indices, statistical significance ($p < .05$) and magnitude and interpretability of the factor loadings were considered in assessing

goodness of fit (Brown, 2006). When competing measurement models were nested, fit was compared using chi-square difference tests (χ^2_{diff}) using the DIFFTEST procedure in Mplus.

Upon finding the best fitting measurement model, path analyses were conducted using Mplus. The diagnosis variables were included in the tripartite measurement models, and were regressed on the tripartite factors. The significance, magnitude and direction of the beta (standardised YX) weights were examined.

Measurement models

Tripartite factors. A measurement model consistent with the tripartite model was developed and tested. In this model, the factors postpartum negative affect (NA), positive affect (PA), and autonomic arousal (AA) were specified. Factors were permitted to correlate, in line with previous findings (e.g., Watson, Weber, et al., 1995). An alternative measurement model was also developed and tested: a one-factor model, whereby all symptoms were theorised to load onto a single factor reflecting a general neurotic syndrome.[5]

Diagnosis variables. Next, models were tested with predictors of diagnostic variables. Dummy variables were used to indicate presence/absence (1/0) of ICD-10 depression, anxiety, mixed anxiety-depression diagnoses. These variables were used as nominal predictors of tripartite factors. 'Depression' was defined as an ICD-10 diagnosis of depressive episode, recurrent depressive disorder, or persistent mood disorder (dysthymia) (n=236). 'Anxiety' was defined as a diagnosis of GAD, social phobia, OCD, panic disorder/agoraphobia, posttraumatic stress disorder, or anxiety

[5] A two factor (depression-specific vs. anxiety-specific) model was not specified because there was not a clear theoretical rationale for a two-factor model, unlike the one- and three-factor models; in particular, there were uncertainties regarding the placement of particular symptoms in a two-factor model (e.g., are irritability items anxiety-specific or depression-specific?).

disorder unspecified (*n*=85). 'Mixed anxiety-depression' was defined as a diagnosis of mixed anxiety-depressive disorder or adjustment disorder (*n*=192).

Results

Model comparisons

Descriptive statistics for each of the self-report questionnaires are presented in Table 1. Fit statistics for the CFA models are presented in Table 4. The first model was a one-factor model, in which all items loaded onto a single factor representing general nonspecific distress. Whilst all indicators showed moderate to high loadings on the single factor, all fit indices suggested that the one-factor model was a poor fit.

Next, a three-factor model was tested whereby items loaded onto three factors representing NA, PA, and AA. This tripartite model provided an acceptable fit according to RMSEA, CFI and TLI. The tripartite model provided a better fit than the one-factor model, $\chi^2_{diff}(2)=236.03$, $p<.001$. All item loadings were significant, with all items showing moderate to high loadings on their specified factors (Table 5). The factors were all significantly correlated (NA with AA=.68, NA with PA=-.88, PA with AA=-.53), *p*s<.001.[6]

Table 4

Fit Indices for CFA Models of Affect

Model	χ^2	df	*p*	RMSEA	CFI	TLI
Admission						
One factor	4931.042	902	<.001	0.086	0.865	0.859
Three factor	2847.977	899	<.001	0.060	0.935	0.931

[6] Given the high correlation between NA and PA, the analyses were rerun with these factors collapsed, but this significantly worsened model fit, χ^2diff (2) = 123.745, *p* <.001.

Table 5

Item Factor Loadings for Tripartite Measurement Model

Scale	Item summary	Hypothesised factor	Factor loading		
			NA	AA	PA
EPDS 7	So unhappy I've had trouble sleeping	NA	.65		
BDI 18	Changes in appetite	NA	.62		
BDI 20	Tired/fatigued	NA	.69		
BDI 13	Indecisiveness	NA	.76		
BDI 19	Concentration difficulty	NA	.79		
EPDS 3	Blamed myself when things went wrong	NA	.67		
BDI 1	Sadness	NA	.78		
BDI 10	Felt like crying	NA	.64		
BDI 7	Self dislike	NA	.68		
BDI 9	Suicidal thoughts or wishes	NA	.54		
DASS 17	Felt I wasn't worth much as a person	NA	.78		
DASS 37	I could see nothing in the future to be hopeful about	NA	.75		
BAI 17	Scared	NA	.68		
EPDS 4	Anxious or worried for no good reason	NA	.76		
BAI 10	Nervous	NA	.77		
BAI 5	Fear of the worst happening	NA	.72		
BAI 14	Found myself getting impatient	NA	.72		
DASS 8	I found it difficult to relax	NA	.77		
BDI 17	Felt irritable	NA	.69		
BDI 11	Agitation	NA	.66		
DASS 6	Tended to overreact to situations	NA	.70		
DASS 11	Found myself getting upset rather easily	NA	.76		
DASS 12	Felt that I was using a lot of nervous energy	NA	.69		
DASS 32	I found it difficult to tolerate interruptions to what I was doing	NA	.62		
BAI 6	Felt dizzy/lightheaded	AA		.74	
DASS 15	I had a feeling of faintness	AA		.67	
BAI 2	Feeling hot	AA		.71	
BAI 20	Face flushed	AA		.69	

Scale	Item summary	Hypothesised factor	Factor loading		
			NA	AA	PA
DASS 19	I perspired noticeably	AA		.74	
DASS 2	Aware of dryness of mouth	AA		.54	
DASS 41	I experienced trembling e.g. in the hands	AA		.79	
BAI 1	Numbness tingling	AA		.65	
DASS 25	Aware of action of my heart in the absence of physical exertion	AA		.76	
BAI 15	Difficulty breathing	AA		.72	
BAI 11	Feelings choking	AA		.65	
DASS 23	I had difficulty in swallowing	AA		.68	
BAI 16	Fear dying	AA		.54	
EPDS 1	Laugh and see the funny side of things	PA			.83
EPDS 2	Looked forward with enjoyment to things	PA			.86
DASS 3	I couldn't seem to experience any positive feeling at all	PA			.87
DASS 24	I couldn't seem to get any enjoyment out of the things I did	PA			.90
DASS 31	I was unable to become enthusiastic about anything	PA			.92
BDI 12	Loss of interest	PA			.84
DASS 42	I found it difficult to work up the initiative to do things	PA			.81

Associations of tripartite factors with ICD-10 diagnosis variables

The second aim was to examine whether the tripartite symptom factors were differentially related to anxiety, depression, and mixed anxiety-depression diagnoses. Additional paths were added to the model in which the diagnosis variables were regressed on the tripartite factors. The standardised (STDYX) regression coefficients are presented in Table 6. NA had strong positive associations with mixed diagnoses, but

was unrelated to depressive diagnoses and anxiety diagnoses. AA had moderate positive association with anxiety disorders, and negative associations with depressive disorders. PA had strong negative associations with depressive disorders, and was unrelated to anxiety diagnoses and mixed diagnoses.

Table 6

Standardised (STDYX) Regression Coefficients Between Diagnoses and Tripartite Model Symptom Factors

	NA	PA	AA
Depression	.00	-.57***	-.32***
Anxiety	.10	.30	.30*
Mixed anxiety/depression	.52***	.25	-.14

Note: *** $p < .001$, * $p < .05$. NA = negative affect; PA = positive affect; AA = autonomic arousal.

Discussion

The objective of the present study was to examine the latent structure of anxiety and depression symptoms in a sample of postpartum psychiatric inpatients. In particular, it had two aims: (a) to determine whether the tripartite model adequately described the pattern of affective symptoms in the postpartum period; and (b) to examine the relations of tripartite factors to binary variables reflecting presence/absence of anxiety disorders, depressive disorders, and mixed anxiety-depression diagnoses.

Given support for the tripartite model across various populations, and the high prevalence of anxiety disorders, depressive disorders, and comorbid presentations in postpartum, it was predicted that a measurement model consistent with the tripartite model would provide the best fit to self-report anxiety/depression data in a postpartum sample. A three-factor model consistent with the tripartite model was expected to fit better than a single-factor model consistent with a general neurotic syndrome. It was

further hypothesised that these tripartite factors would show differential relations to postpartum depressive, anxiety, and mixed anxiety-depression diagnoses.

In relation to the first aim, CFAs revealed that a model consistent with the tripartite model provided the best fit to the anxiety/depression data in the postpartum sample. Three factors were identified: (a) NA, characterised by symptoms reflecting non-specific general distress common to both anxiety and depressive disorders (e.g., irritability, sadness, nervousness, indecisiveness, difficulty relaxing, changes in appetite and sleep); (b) PA, characterised by anhedonia, low motivation, and loss of interest; and (c) AA, characterised by somatic arousal symptoms, including shortness of breath, increased heart rate, trembling, and perspiration. The content of the three factors obtained in the postpartum sample matched the hypothesised tripartite model factors (L. A. Clark & Watson, 1991). The three-factor model provided a superior fit to the alternative one-factor model, which tested the theory that postpartum negative emotional symptoms could be collapsed into a single distress factor rather than three differentiable factors.

These findings provide support for a tripartite structure of postpartum negative emotional states. Whilst several studies have provided evidence for the existence of one or two tripartite symptom clusters in postpartum samples (Buttner et al., 2012), to the authors' knowledge, this is the first study to examine whether a three-factor structure consistent with the tripartite model is evident in a postpartum sample. In the perinatal mental health literature there has been debate as to whether postpartum emotional disorders are distinct from emotional disorders occurring at other life stages, and proponents of this view have argued that postpartum emotional disorders have a distinct clinical presentation (Whiffen, 1992). The present findings suggest that postpartum emotional symptoms have a similar structure to other non-postpartum populations

(Joiner, 1996; Joiner & Lonigan, 2000), which is consistent with other recent studies (Buttner et al., 2012; Nadia K Cunningham et al., 2013).

In relation to the second aim, the tripartite factors were differentially associated with anxiety, depressive, and mixed anxiety-depressive diagnoses. As expected, depression diagnoses were predicted by the presence of symptoms reflecting anhedonia and absence of positive emotional experiences. This finding is consistent with the tripartite model, in which symptoms reflecting reduced PA are theorised to be specific to depression (L. A. Clark & Watson, 1991). Depression diagnoses were also predicted by reduced AA. This is also consistent with expectations: as depression is characterised by apathy, psychomotor retardation, and reduced motivation, a reduction in symptoms reflecting physiological arousal would be expected. Depression diagnoses were not predicted by presence/absence of symptoms reflecting NA. This finding was unexpected as various core depressive disorder symptoms were included as indicators of NA (e.g., sadness, suicidal ideation, worthlessness, hopelessness).

Anxiety diagnoses were significantly predicted by high AA, and were unrelated to PA and NA. The finding that anxiety diagnoses were predicted by the presence of somatic arousal symptoms was consistent with expectations, as AA is theorised to be uniquely related to anxiety (L. A. Clark & Watson, 1991). It was expected that high NA would predict anxiety diagnoses, as indicators of NA included symptoms characteristic of anxiety disorders (e.g., feeling worried and scared). However, the path between NA and anxiety diagnoses was not significant. The finding that neither anxiety nor depressive diagnoses were significantly associated with NA in the postpartum sample was contrary to predictions, as NA is theorised to be common to both anxiety and depressive disorders. This finding was inconsistent with previous studies (Brown et al., 1998; Brown & McNiff, 2009), and may suggest that postpartum anxiety and depressive disorders are distinct in their symptom features compared to non-postpartum anxiety

and depressive disorders. In contrast, mixed anxiety-depressive presentations were predicted by high NA and were not associated with PA and AA, which is consistent with Zinbarg et al.'s (1994) observations in a non-postpartum clinical sample.

One possible interpretation of these findings is that different emotional disorders are characterised (and are differentiable) by different symptom clusters. That is, postpartum depressive disorders are characterised primarily by reduced PA as well as reduced arousal symptoms; postpartum anxiety disorders are primarily characterised by AA symptoms, with or without the presence of NA symptoms; and mixed anxiety-depressive presentations are primarily characterised by NA symptoms, and are not necessarily characterised by PA or AA.

Another possibility is that the relationships observed reflect the tendencies for psychiatrists within the WAMBU to assign different diagnoses based on the presence/absence of certain symptom features. That is, when NA symptoms are predominant psychiatrists may be more likely to assign a diagnosis of mixed anxiety-depressive disorder or adjustment disorder, regardless of whether AA or PA symptoms are present. Furthermore, psychiatrists may be more likely to be assign depressive disorder diagnoses when symptoms reflecting anhedonia and reduced PA are evident; and when AA symptoms are absent it may further increase the likelihood of assigning this diagnosis, regardless of the pattern of NA symptoms. Similarly, anxiety disorders may be most likely to be diagnosed when high AA symptoms are evident.

Overall, the present findings have potential implications for assessment and treatment of postpartum emotional disorders. If postpartum emotional disorders are characterised by NA, PA and AA, then postpartum assessment measures should attempt to assess these three symptom clusters. Furthermore, if these factors are separable as suggested in the present study, they may represent specific targets for treatment. There is some evidence that the tripartite factors differentially respond to various treatments in

other non-postpartum populations (e.g., Kring et al., 2007). If postpartum depressive disorders are characterised by reduced PA, empirically-supported depression treatments theorised to increase PA may be indicated (e.g., interpersonal psychotherapy, tricyclic antidepressants, specific components of cognitive-behavioural therapy such as scheduling pleasant activities and reducing social withdrawal). Moreover, if postpartum anxiety disorders are characterised by high AA, and arousal reduction techniques (such as exposure to feared stimuli and relaxation training) may be indicated. As NA was associated with mixed presentations but unrelated to anxiety and depressive diagnoses, postpartum mixed anxiety-depressive presentations may respond to treatments theorised to target NA (e.g., transdiagnostic treatment approaches; Barlow, 2004). Further research is required to determine the degree to which tripartite factors are affected by various treatment components in both non-postpartum and postpartum populations.

The present study had several potential limitations. Whilst the tripartite model was supported, a clinical postpartum sample was used, and the generalisability of findings to other postpartum samples is unknown. Further research is required to determine whether the tripartite model is applicable in other clinical postpartum samples as well as non-clinical postpartum samples. Furthermore, a larger sample would allow examination of the associations between specific anxiety disorders (e.g., OCD, panic disorder) and the tripartite factors.

Another limitation of the present study is that diagnoses were assigned based on patient report and observation, whereas the items used to test the tripartite model were obtained from self-report questionnaires completed by patients. Whilst previous studies have typically reported strong convergence between self-report and clinician-reported symptoms in non-postpartum populations (L. A. Clark & Watson, 1991), it might be beneficial for future studies to utilise dimensional or clinician-rated symptom measures and to examine their convergence in postpartum populations.

Overall the current findings support a tripartite structure of emotional symptoms in the postpartum period. Further examination of the influence of specific treatments on the tripartite model factors may potentially improve assessment and treatment of emotional disorders during, and outside of, the postpartum period.

Chapter 5: General Discussion

General Discussion

Aims and findings

The present thesis set out to

- examine the psychometric integrity in a postpartum inpatient population of two measures, , the Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987) and the Depression Anxiety Stress Scales (DASS; S. H. Lovibond & P. F. Lovibond, 1995);
- examine whether the tripartite model of anxiety and depression provided an optimal fit to self-reported anxiety and depression data in a postpartum clinical sample; and to
- examine the relationship of the factors underlying postpartum anxiety and depression symptoms to ICD-10 diagnoses of unipolar mood disorders, anxiety disorders, and disorders characterised by mixed anxiety and depressive symptoms (adjustment disorder, mixed anxiety-depressive disorder).

These aims were tested using self-report anxiety and depression data from questionnaires completed by inpatients with postpartum psychiatric disorders. Previous research has attempted to shed light on the clinical presentation of postpartum depression and anxiety, and their relationship to non-postpartum depression and anxiety, by comparing symptoms of postpartum and non-postpartum samples (e.g., Eberhard-Gran et al., 2003). Other studies have compared the underlying (i.e., factor) structure of anxiety and depression symptoms in postpartum samples to that of non-postpartum samples (Buttner et al., 2012). Previous research has also questioned whether self-report questionnaires developed for use in non-postpartum populations are suitable for measuring anxiety and depression. New instruments have been developed specifically to assess anxiety and depression in postpartum samples, but little is known

about the performance and factor structure of these instruments in postpartum inpatient samples. The present thesis sought to examine the psychometric properties of several self-report measures of anxiety and depression in a postpartum inpatient sample. It also aimed to test whether a conceptual model of anxiety and depression previously supported across various non-postpartum populations (L. A. Clark & Watson, 1991) provided an optimal fit to anxiety and depression data in the postpartum inpatient sample. The use of an inpatient postpartum sample allowed for coverage of a greater range of anxiety and depression symptoms, and also allowed for the examination of the relationships between tripartite model symptom dimensions and ICD-10 diagnoses of anxiety, depressive, and mixed presentation disorders.

Prior to testing the tripartite model of anxiety and depression, preliminary studies were conducted in order to clarify several outstanding conceptual issues. Firstly, it was necessary to determine which self-report questionnaires were suitable to measure anxiety and depression symptoms in the postpartum inpatient sample. The Edinburgh Postnatal Depression Scale (EPDS; Cox et al., 1987) was considered given previous research suggesting that the scale measures both anxiety and depression – however, a review of previous factor analyses of the EPDS in Chapter 2 revealed that its factor structure has varied across studies. Given its inconsistent factor structure in the existing literature, it was unclear whether it was appropriate to use the EPDS to measure depression and anxiety symptoms in the postpartum inpatient sample. Chapter 2 therefore examined the factor structure of the EPDS in the postpartum inpatient sample at hospital admission and discharge. Exploratory factor analyses (EFAs) revealed that the factor structure of the EPDS was different at admission compared to discharge: at admission, the best fitting model was a two-factor model comprising depression and anxiety factors; whereas at discharge, a three-factor model emerged, comprising anhedonia, depression, and anxiety factors.

The finding that the EPDS factor structure was not invariant across the two testing occasions was in line with the observation that the scale's factor structure varies across samples. Most studies have reported two-factor (e.g., Matthey, 2008) or three-factor (Reichenheim et al., 2011) models, but the factors have often comprised different items across studies. The findings of Chapter 2 extended previous research by demonstrating that the EPDS not only lacks factorial invariance across samples, but also within a single sample across two testing occasions. A lack of longitudinal measurement invariance suggests that patients may have interpreted and responded to the EPDS items differently across the time points. If this is the case, then EPDS scores and subscale scores may not reflect the same constructs across testing occasions (Millsap & Kwok, 2004). An examination of previous factor analyses of the EPDS in Chapter 2 revealed that the studies that had found a two-factor structure had a somewhat higher average EPDS score than those that had obtained a three-factor structure. Along with the results of Chapter 2, it is possible that the EPDS factor structure may vary as a function of symptom severity. That is, individuals may interpret and respond differently to EPDS items depending on their levels of distress.

Overall, the analyses did not support the validity of the EPDS as a measure of anxiety and depression in the present sample. The results of Chapter 2 suggested the need to also include other measures of depression and anxiety in addition to the EPDS to measure anxiety and depression in the postpartum inpatient sample. However, these findings raised a question regarding the factor structure of self-report measures in the postpartum sample: was the issue of non-invariance of the factor structure specific to the EPDS, or was it characteristic of the postpartum inpatient sample more generally? That is, do the postpartum inpatients respond differently to self-report measures when their symptoms are more severe? This conceptual issue related to a longstanding debate as to whether postpartum emotional disorders (anxiety and depression) have a unique

clinical presentation compared to non-postpartum emotional disorders (Phillips, Sharpe, et al., 2009; Riecher-Rössler & Rohde, 2005). If the clinical presentation is different, then it could be expected that the underlying structure of depression and anxiety symptoms in a postpartum clinical sample would also differ.

In order to explore this issue, the second study (Chapter 3) aimed to examine the factor structure of the Depression Anxiety Stress Scales (DASS; S. H. Lovibond & P. F. Lovibond, 1995) in the postpartum inpatient sample at hospital admission and discharge. The DASS is a self-report measure previously observed to have a robust, replicable factor structure (three factors reflecting depression, anxiety, and stress) across clinical and non-clinical populations (Crawford & Henry, 2003; Page et al., 2007). Confirmatory factor analysis (CFA) revealed that the three factor structure identified previously in previous studies provided the best fit in the postpartum sample (Crawford & Henry, 2003; Page et al., 2007), suggesting that the DASS reflected the same constructs in the postpartum sample as in non-postpartum samples. Further, the factor structure was invariant across hospital admission and discharge, suggesting that DASS reflected the same constructs across the two testing occasions (Millsap & Kwok, 2004).

These findings gave strength to the position that the variability of the EPDS factor structure observed in Chapter 2 was due to the measurement properties of the EPDS, rather than due to the nature of distress in the postpartum sample. As the factor structure of anxiety and depression symptoms (as measured by the DASS) was similar to that observed in non-postpartum populations, it was possible to be more confident in using existing self-report questionnaires developed for use in the general population to measure anxiety and depression in the inpatient psychiatric sample, and to test the tripartite model of anxiety and depression.

Chapter 4 turned to the second objective of the thesis: to test whether the tripartite model provided an adequate fit to self-report anxiety and depression data in a sample of postpartum psychiatric inpatients. Given a lack of robust evidence for a distinct symptom profile of postpartum versus non-postpartum anxiety and depression (C. Cooper et al., 2007), as well support for a similar factor structure of a self-report measure of depression and anxiety symptoms in postpartum inpatients (Chapter 3), it was hypothesised that the tripartite model would provide an adequate fit to the data, and would provide a superior fit to alternative models tested. Items were drawn from self-report anxiety and depression measures completed by the psychiatric inpatients at hospital admission. These items were mapped on to the hypothesised tripartite model factors of positive affect (PA), negative affect (NA), and autonomic arousal (AA).

CFAs revealed that the tripartite model provided an adequate fit to the data. The model comprised three factors: (a) NA, characterised by symptoms reflecting non-specific general distress common to both anxiety and depressive disorders (e.g., irritability, sadness, nervousness, indecisiveness, difficulty relaxing, changes in appetite and sleep); (b) PA, characterised by anhedonia, low motivation, and loss of interest; and (c) AA, characterised by somatic arousal symptoms, including shortness of breath, increased heart rate, trembling, and perspiration. The content of the three factors obtained in the postpartum sample matched the hypothesised tripartite model factors (L. A. Clark & Watson, 1991; Watson, Clark, et al., 1995). The three-factor model provided a superior fit to an alternative one-factor model, which tested the theory that postpartum negative emotional symptoms could be collapsed into a single distress factor rather than three differentiable factors (Andrews et al., 1990); as well as a model with NA and PA collapsed into a single factor.

The findings of Chapter 4 provided support to the view that postpartum emotional symptoms have a similar structure to that of non-postpartum emotional

symptoms (Brown et al., 1998; Joiner, 1996), and that anxiety and depression have a similar relationship in the postpartum period as observed at other life stages (L. A. Clark & Watson, 1991). These findings are consistent with recent studies revealing separate NA and PA factors underlying postpartum mood symptoms (Buttner et al., 2012; V. J. M. Pop et al., 2015). The present research built on these studies by examining the structure underlying both anxiety and depression in a postpartum sample, and demonstrating separate NA, PA, and AA factors. The findings of Chapter 4 extended the tripartite model of anxiety and depression to a postpartum clinical sample, suggesting that postpartum anxiety and depression symptoms can be distinguished into three separate but related symptom dimensions.

Following analyses indicating that the tripartite model provided an adequate fit to the data, the relationships between the tripartite model factors and variables indicating the presence/absence of ICD-10 anxiety, depressive, and mixed anxiety-depressive presentation (adjustment disorder, mixed anxiety-depressive disorder) diagnoses were examined. The factors NA, PA, and AA were differentially related to the diagnosis variables: depression diagnoses were predicted by reduced PA as well as reduced AA; anxiety diagnoses were predicted by high AA; and mixed diagnoses were predicted by high NA. The patterns of these relationships were largely consistent with expectations based on the tripartite model and previous research in that PA uniquely predicted depressive disorders (Watson, Clark, & Carey, 1988), high AA uniquely predicted anxiety disorders (Brown et al., 1998), and high NA predicted mixed diagnoses (Zinbarg et al., 1994). These results may indicate that postpartum anxiety, depressive, and mixed diagnoses reflect distinct entities (from one another) that are characterised by elevated levels of AA, PA, and NA respectively. Alternatively, they may indicate that particular diagnoses are more likely to be assigned by psychiatrists in the mother and baby unit based on the presence or absence of certain symptom features.

The finding that NA did not predict anxiety or depressive diagnoses was not consistent with previous findings in non-postpartum populations (Brown et al., 1998; Brown & McNiff, 2009; Watson, Clark, & Carey, 1988). A possible explanation is that high NA does not affect the likelihood of being assigned a diagnosis of an anxiety or depressive disorder in the postpartum inpatient sample, possibly because symptoms of NA/general distress are common across the sample.

There are several key ideas to be drawn from these results: (a) the structure of postpartum anxiety and depression symptoms in inpatients is similar to that observed in previous studies of non-postpartum populations; and (b) postpartum anxiety and depression can be conceptualised as overlapping but distinguishable syndromes. The following sections will expand on these points before discussing the implications of the results in terms of classification, measurement, and treatment of postpartum depression and anxiety.

Summary of findings in relation to the clinical presentation of postpartum depression and anxiety

In the postpartum emotional disorders literature there has been longstanding debate as to whether postpartum depression and (more recently) anxiety are distinct from depression and anxiety occurring at other life stages. One argument proposed for this view is that postpartum anxiety and depression have a distinct symptom profile compared to non-postpartum anxiety and depression (Whiffen, 1992). To test this assertion, previous studies have compared the frequency and intensity of anxiety and depression symptoms in postpartum and non-postpartum samples (e.g., Eberhard-Gran et al., 2003; Whiffen & Gotlib, 1993). Several recent studies have also aimed to identify differences in the symptom profiles of postpartum versus non-postpartum samples by examining the factor structure of postpartum depression and/or anxiety symptoms (Buttner et al., 2012; Segre et al., 2014; Williamson et al., 2015). In line with these

previous studies, Chapters 3 and 4 set out to examine the factor structure of anxiety and depression symptoms in a postpartum sample. However, Chapter 4 took a different approach by using CFA to test whether the tripartite conceptual model of anxiety and depression (L. A. Clark & Watson, 1991) that has previously been obtained in non-postpartum populations (Watson, Clark, et al., 1995) provided an optimal fit to anxiety and depression symptoms in a postpartum clinical sample.

The studies within the present thesis provided evidence that the broad structure of postpartum anxiety and depression symptoms in postpartum psychiatric inpatients is similar to that reported in non-postpartum populations. In Chapter 3, the factor structure of the DASS, a self-report measure of depression, anxiety, and stress symptoms, was the same in the postpartum inpatient sample as reported in previous studies of non-postpartum populations (Crawford & Henry, 2003; Page et al., 2007). These results are in line with previous studies that have shown factorial invariance of other depression measures across postpartum and non-postpartum samples (e.g., Williamson et al., 2015), and provide support to the assertion that the symptom profiles of postpartum depression and anxiety are not different from non-postpartum depression and anxiety (C. Cooper et al., 2007).

In Chapter 4, the factor structure underlying symptoms drawn from multiple self-report anxiety and depression questionnaires completed by postpartum inpatients was examined and a three-factor model consistent with the tripartite model of anxiety and depression provided the best fit over simpler models. The content of the three factors obtained in the postpartum sample matched the hypothesised tripartite model factors of NA, PA, and AA that have been found to underlie depression and anxiety symptoms in non-postpartum samples (L. A. Clark & Watson, 1991). Given support for a similar structure of anxiety and depression, these results provide further evidence for

the view that postpartum anxiety and depression have a similar symptom profile to non-postpartum anxiety and depression.

To the author's knowledge, this is the first study to explicitly test the tripartite model of anxiety and depression in a postpartum sample. The findings of Chapter 4 (demonstrating the existence of separate NA, PA, and AA factors) are consistent with previous factor analyses of depression measures in postpartum samples that have shown separate NA and PA factors underlying depression symptoms (Buttner et al., 2012; V. J. M. Pop et al., 2015). These previous studies provided evidence for a two-factor structure of depression symptoms that is posited by the tripartite model (L. A. Clark & Watson, 1991; Watson, Clark, et al., 1995). Chapter 4 extended these previous studies by concurrently examining the factor structure of anxiety and depression symptoms, and providing support for a three-factor structure consistent with the tripartite model of depression and anxiety (L. A. Clark & Watson, 1991). Whilst other studies have supported alternative factor structures underlying symptoms of anxiety and depression in postpartum samples (Segre et al., 2014), these studies have not explicitly tested the goodness of fit of the tripartite model. However, these analyses have generally provided support for separate anxiety, depression, and general distress/NA factors.

It is noted that previous studies of the tripartite model using non-postpartum samples have varied in terms of the relationships between the three symptom dimensions. The tripartite model originally posited that NA, PA, and AA were orthogonal (uncorrelated) dimensions (L. A. Clark & Watson, 1991). Previous studies have largely supported the tripartite model factors as correlated (Marshall et al., 2003; Watson, Weber, et al., 1995), whereas some studies have found that certain factors are uncorrelated – for example, Joiner (1996) reported that only NA and AA were correlated; whereas Brown et al. (1998) reported that only NA and AA, and NA and PA were correlated. In the present thesis the factors NA, PA, and AA were all substantially

correlated. The directions of the relationships between factors were in line with several previous studies of non-postpartum samples: higher NA was associated with higher AA; higher NA was associated with lower PA; and lower PA was associated with higher AA (Marshall et al., 2003; Teachman et al., 2007; Watson, Clark, et al., 1995). Consistent with tripartite model theory (L. A. Clark & Watson, 1991) and the results of previous studies (Watson, Clark, et al., 1995), the factors theorised to represent depression- and anxiety-specific symptoms (PA and NA respectively) had the lowest intercorrelations. The present research supports the tripartite model factors as three correlated factors underlying postpartum depression and anxiety symptoms.

In addition to the strength of their relationships, previous studies of the tripartite model have also varied in the hierarchical arrangement of the symptom dimensions. Some studies have reported that NA (Steer et al., 1995), or NA and PA (Brown et al., 1998), are second order factors – that is, they have causal relationships with the other tripartite model factors. Other studies have obtained support for three first order factors (Marshall et al., 2003). The present thesis set out to specifically test whether a three-factor model (with three correlated symptom dimensions: NA, PA, and AA) provided an acceptable fit to postpartum anxiety and depression data. Whilst there are numerous other models that could be tested, the present thesis set out to test a model that was most consistent with the original conceptualisation of the tripartite model (L. A. Clark & Watson, 1991), albeit with three correlated factors as supported by other studies in non-postpartum samples (Marshall et al., 2003; Watson, Clark, et al., 1995). Further research should aim to further clarify the nature of the relationships between the tripartite model factors using both postpartum- and non-postpartum samples. CFA may be useful for this purpose in future studies as it would allow comparison of goodness of fit of alternative models.

In addition to examining the underlying dimensions of postpartum anxiety and depression symptoms, the present thesis also set out to explore the relationships between the tripartite model dimensions and anxiety, depression, and mixed disorders in the postpartum sample. Several studies have examined the relations between the tripartite model symptom dimensions and anxiety and depressive diagnoses in non-postpartum samples (Brown et al., 1998; Brown & McNiff, 2009; Watson, Clark, & Carey, 1988). As expected, depression diagnoses were predicted by low PA. This finding is consistent with the tripartite model, in which symptoms reflecting reduced PA (e.g., anhedonia, loss of interest/enthusiasm) are theorised to be specific to depression (L. A. Clark & Watson, 1991); and is also consistent with previous findings in non-postpartum samples (Brown et al., 1998; Watson, Clark, & Carey, 1988). Thus, similar to depressive diagnoses in non-postpartum samples, postpartum depressive diagnoses appeared to be predicted by the presence of symptoms reflecting anhedonia and the absence of positive emotional experiences.

Depression diagnoses were also predicted by reduced AA. Whilst Brown et al. (1998) did not support an association between depression diagnoses and AA in their non-postpartum clinical sample, these findings are not incongruent with the tripartite model: as depression is characterised by apathy, psychomotor retardation, and reduced motivation (i.e., reduced arousal), it follows that a reduction in symptoms reflecting physiological arousal might be obtained. Other possibilities are that postpartum depressive disorders are more strongly characterised by reductions in arousal than non-postpartum depressive disorders; or that depression diagnoses are more likely to be assigned when there is a combination of anhedonia/reduced positive emotional experiences and symptoms of arousal are not prominent.

Depression diagnoses were not predicted by presence/absence of symptoms reflecting NA/general distress. This finding was unexpected as various core depressive

disorder symptoms were included as indicators of NA (e.g., sadness, suicidal ideation, worthlessness, hopelessness). Similarly, and also contrary to expectations, anxiety diagnoses were not predicted by NA (which contained a number of core anxiety symptoms such as feeling scared, fear of losing control). Previous studies of non-postpartum samples have found that diagnoses of anxiety and depressive disorders are predicted by high NA (Brown et al., 1998; Brown & McNiff, 2009; Watson, Clark, & Carey, 1988). A possible explanation is that high NA does not affect the likelihood of being assigned a diagnosis of anxiety or depressive disorder in the postpartum inpatient sample, perhaps because symptoms of NA and general distress are common across the sample. This would be consistent with the tripartite model, as NA is theorised to be nonspecific and would therefore be expected to lack predictive ability, particularly in a sample characterised by elevated levels of distress.

Anxiety diagnoses were significantly predicted by high AA, and were unrelated to PA. The finding that anxiety diagnoses were predicted by the presence of physiological arousal symptoms was consistent with expectations, as AA is theorised to be uniquely related to anxiety (L. A. Clark & Watson, 1991). Previous studies of non-postpartum samples have suggested that AA is specifically related to PTSD (Brown & McNiff, 2009) and social phobia (Brown et al., 1998), rather than being a common component across all of the anxiety disorders. The present study clustered anxiety disorders together rather than examining the relationships between individual anxiety disorders and the tripartite model symptom dimensions. This was due to low rates of particular diagnoses (for example, there were no cases of social phobia, and only 10 cases of PTSD, in our sample). The findings are consistent with the originally proposed tripartite model in that anxiety disorders as a group were predicted by AA. It would be beneficial to replicate the present study with a larger sample size with higher rates of

specific anxiety disorders in order to examine whether specific diagnoses are differentially related to AA in postpartum samples.

Few previous studies have examined the symptom profiles of disorders characterised by a mixture of anxiety and depression symptoms (e.g., adjustment disorder, mixed anxiety-depressive disorder), and the nosological status and construct validity of mixed anxious-depressive syndromes is a subject of ongoing debate within the general anxiety and depression literature (Andreescu & Lenze, 2012; Baumeister & Kufner, 2009; Semprini, Fava, & Sonino, 2010). In Chapter 4, mixed anxiety-depressive diagnoses (including adjustment disorder and mixed anxiety-depressive disorder) were predicted by high NA and were not associated with PA and AA. The finding that mixed diagnoses were predicted by high NA and had non-significant associations with PA and AA is consistent with Zinbarg et al.'s (1994) observations that subthreshold cases of anxiety and depression (i.e., not meeting full criteria for anxiety or depressive disorder) were characterised primarily by NA/general distress symptoms and were differentiable from anxiety and depressive disorders by the lack of prominence of PA and AA.

Overall, the findings of the disorder-based analyses were broadly consistent with the tripartite model and previous studies of non-postpartum samples (Brown et al., 1998; Brown & McNiff, 2009; Watson, Clark, & Carey, 1988). It should be noted that the disorder-based analyses had some potential limitations. Firstly, unstructured diagnostic interviews were used by psychiatrists assigning diagnoses to the postpartum inpatients. Unstructured interviews have previously been found to have less validity, more bias and lower diagnostic accuracy compared to structured interviews (Miller, Dasher, Collins, Griffiths, & Brown, 2001). The present research used a clinical sample, and structured interviews are generally not feasible in routine clinical practice due to time constraints (Miller et al., 2001). However, it is acknowledged that the use of

unstructured interviews may have impacted on the replicability and validity of the disorder-level analyses.

Future studies may benefit from using structured clinical interviews to ensure higher reliability and accuracy of diagnosis. In their analyses of the relations between the tripartite model dimensions and anxiety and depressive disorders, Brown et al. (1998) used structured dimensional assessments of DSM-IV diagnoses which allowed them to form latent variables for each of the diagnostic variables. This provided stronger analyses in that the dimensional nature of psychopathology was retained, and the influence of measurement error could be accounted for (Brown et al., 1998). A replication of the study in Chapter 4 using dimensional measures of anxiety and depressive disorder diagnoses may allow for a more comprehensive understanding of the relations between the tripartite model symptom dimensions and postpartum anxiety and depressive disorders. This would require the administration of a dimensional assessment tool, or the use of other instruments theorised to measure symptoms of specific anxiety or depressive disorders (e.g., a self-report measure of obsessive compulsive symptoms might be used as an indicator of obsessive compulsive disorder). Structural equation modelling could be used to examine the relations between the factors reflecting the tripartite model symptom dimensions and factors reflecting specific anxiety and depressive disorders. The inclusion of diagnoses as latent variables (instead of binary variables as in the present research) would allow for the estimation of measurement error in the analyses, which would allow for stronger conclusions regarding the

It is also noted that previous studies examining the relations between disorders and tripartite model symptom dimensions have primarily used the DSM (American Psychiatric Association, 2000; Brown et al., 1998; Brown & McNiff, 2009; Watson, Clark, & Carey, 1988), whereas the present study used the ICD-10 (World Health

Organization, 1992) classification system. These classification systems show varying levels of concordance across individual mood and anxiety disorders (Andrews, Slade, & Peters, 1999), and concordance rates are likely to be lower when using unstructured interviews. Nevertheless, the findings of the disorder-based analyses were largely consistent with previous studies, supporting the robustness of the basic premises of the tripartite model.

Whilst the present thesis focused on examining the broad structure of postpartum emotional symptoms, it has been argued that there are subtypes of postpartum depression and anxiety: for example, those with a history of depression and those who only experience depression in the postpartum period (P. J. Cooper & Murray, 1995; Jones & Cantwell, 2010; Phillips, Sharpe, Matthey, & Charles, 2010). Some researchers have argued that individuals who only experience postpartum episodes may have a distinct syndrome (with unique causal mechanisms) to individuals who also experience depression outside of the postpartum period (e.g., Phillips et al., 2010), and hence argue that these patient groups should be examined separately. In the present research, information was not available about patients' psychiatric histories and time of symptom onset. As a result, the research examined the postpartum inpatients as a single group, and the examination of specific subtypes of anxiety and depression (with different psychiatric histories and onset periods) was beyond the scope of the present research. Whilst evidence for this view is equivocal, this issue pertains to the nature and aetiology of postpartum emotional disorders, and it is important for future studies to resolve this question. If the symptom profile is different across subgroups of postpartum women, then assessment and treatment might differ within postpartum samples. Future research might aim to determine whether the structure of symptoms underlying postpartum anxiety and depression is similar across all postpartum women, or whether particular structural models such as the tripartite model provide a better fit to specific

subgroups of postpartum women. These objectives could be examined using multi-group CFA, which would allow the comparison of goodness of fit across subgroups of postpartum women.

To summarise, the findings of Chapters 3 and 4 supported a structure of anxiety and depression symptoms in a postpartum sample that has previously been observed in non-postpartum samples. Although the present research elected to focus on the tripartite model of anxiety and depression, it should be noted that the tripartite model is one of several existing conceptual models of the relationship of anxiety and depression, and whereas there is broad support for the model, alternative models have been proposed, including models that have extended or modified the tripartite model (Mineka et al., 1998; Watson, 2009). For example, the integrative hierarchical model posits that NA is associated with all anxiety and mood disorders, but is more strongly associated with some disorders than others; reduced PA is associated with not only depression but also social phobia; and autonomic arousal is a lower order symptom dimension specifically associated with panic disorder (Mineka et al., 1998). Whilst it was not possible to test all of the alternative conceptual models of anxiety and depression, by using CFA it was possible to demonstrate that the tripartite model provided an adequate fit to the data, and show that it provided a better fit than several alternative models, such as a unitary (single factor) model of postpartum distress, and a two-factor model with NA and PA collapsed into a single factor. Future research should aim to test the goodness of fit of these alternative and more complex models of distress in the postpartum period to determine whether they provide a more comprehensive description of postpartum anxiety and depression symptoms than the tripartite model. One approach might be to use CFA to test measurement models consistent with these alternative models in a postpartum sample. The goodness of fit of each of the models could then be examined and compared to determine which model best captures the underlying structure of

postpartum anxiety and depression symptoms, and to examine their relations to specific disorders. Such analyses would benefit from increased sample size in order to model the individual anxiety disorders.

Summary of findings in relation to the relationship between postpartum depression and anxiety

Until recently, research has primarily focused on the concept of postpartum depression, and postpartum anxiety was mostly viewed as a feature of postpartum depression (Ross et al., 2003). However, given increasing evidence that anxiety disorders are common in the postpartum period, researchers have expressed the importance of distinguishing postpartum depression from postpartum anxiety (Matthey et al., 2003), and have begun to delineate the clinical presentation, course, prevalence, and risk factors associated with anxiety in the postpartum period (Phillips, Sharpe, et al., 2009; Ross & McLean, 2006). A potential obstacle to the measurement and differentiation of postpartum anxiety and depression is that they have been found to overlap, both at the symptom level (Ross et al., 2003) and disorder level (Austin et al., 2010). The present thesis set out to examine the underlying structure of anxiety and depression symptoms in a postpartum clinical sample.

The factor analyses in Chapters 3 and 4 provide some insight into the relationship between postpartum depression and anxiety. The findings of Chapter 3 supported separate depression and anxiety factors underlying the DASS in the postpartum clinical sample, as well as a stress factor reflecting irritability and tension. These factors and their intercorrelations were similar to those observed in other samples. The results of Chapter 4 shed further light on the relationship between postpartum anxiety and depression by demonstrating that symptoms drawn from multiple self-report measures could be grouped into three symptom dimensions: NA, comprising symptoms nonspecific to either anxiety or depression; PA, comprising

symptoms uniquely associated with depression; and AA, comprising symptoms uniquely associated with anxiety. These symptom dimensions showed moderate to strong correlations but were statistically distinguishable. Support for an NA factor (comprising symptoms of both anxiety and depression) in a postpartum sample may account for the overlap of anxiety and depression symptoms observed in previous studies (Ross et al., 2003; Stuart et al., 1998). That is, anxiety and depression overlap not because anxiety is a feature of postpartum depression, as previously hypothesised (Pitt, 1968), but because postpartum anxiety and depression have a shared underlying component, NA. However, these results also suggest that postpartum anxiety and postpartum depression have their own unique symptom components (AA and PA, respectively).

Previous studies attempting to delineate the characteristics of, and the relationship between, postpartum anxiety and depression have often relied on the EPDS (Ross et al., 2003; Stuart et al., 1998). The EPDS was developed when anxiety was largely viewed as a feature of postpartum depression, and the inclusion of anxiety symptoms in the scale reflects this conceptualisation. Given evidence that the EPDS does not contain stable anxiety and depression factors (Chapter 2), it could be contended that the EPDS is not useful in understanding the relationship between postpartum anxiety and depression because of its psychometric weaknesses. It could also be argued that reliance on the EPDS has contributed to confusion regarding the relationship between depression and anxiety in the postpartum period (Matthey et al., 2003). Studies using the EPDS to examine postpartum depression and/or anxiety should be cautious in their interpretations as it is not clear that the EPDS is a valid measure of these constructs.

Summary. Overall, the present research suggests that depression and anxiety in a postpartum clinical sample have a similar underlying structure to that observed in other

populations, and that depression and anxiety within this clinical population have shared and unique features. The implications of these findings for the classification, measurement, and treatment of postpartum anxiety and depression are described below.

Implications for classification of postpartum emotional disorders

The present thesis emerged amongst ongoing debate as to whether postpartum emotional disorders (anxiety and depression) represent unique clinical entities that should be included in diagnostic classification systems as separate categories (Jones & Cantwell, 2010; Riecher-Rössler & Hofecker Fallahpour, 2003). One argument by proponents of this position is that postpartum depression and anxiety have a different symptom profile to non-postpartum depression and anxiety. The findings of Chapters 3 and 4 do not support this view; rather, they support a similar structure of anxiety and depression symptoms in a postpartum inpatient sample to that observed in non-postpartum samples. If the argument for a separate diagnostic category for postpartum emotional disorders is based on the premise that postpartum depression and/or anxiety differ in their symptoms, then the present findings do not support such a distinction. Rather, the findings of the present research provide support to the view that depression and anxiety occurring in the postpartum period should be classified according to the standard diagnostic categories for depressive and anxiety disorders (Jones & Cantwell, 2010; Riecher-Rössler & Rohde, 2005).

Despite these conclusions, it is important to note that symptom similarity is only one line of evidence considered in the classification of syndromes. For example, in DSM-5, symptom similarity was 1 of 11 indicators used to determine the boundaries of diagnostic groupings. These 11 indicators included “shared neural substrates, family traits, genetic risk factors, specific environmental risk factors, biomarkers, temperamental antecedents, abnormalities of emotional or cognitive processing, symptom similarity, course of illness, high comorbidity, and shared treatment process”

(American Psychiatric Association, 2013a, p. 12). Whilst the present thesis provides evidence of symptom similarity across postpartum and non-postpartum samples, this indicator alone is likely to be insufficient to draw definitive conclusions about the relationship of postpartum emotional disorders to non-postpartum emotional disorders. Rather, a breadth of data need to be synthesised to draw conclusions about diagnostic grouping. Future studies should aim to examine multiple indicators (e.g., course, risk factors, symptomatology) in order to draw more solid conclusions about the nosological status of postpartum anxiety and depression.

Furthermore, whilst postpartum emotional disorders may not have a unique symptom profile, it is acknowledged that there are specific issues which may require special consideration when assessing and treating postpartum mood disorders, including (but not limited to) the impact of maternal depression on the infant, family, and the mother-infant relationship; the effect of psychotropic medication on breast milk; and the impact of psychosocial role changes in the onset/exacerbation of symptoms (Riecher-Rössler & Hofecker Fallahpour, 2003). Thus, regardless of whether the symptom profiles differ, it may still be useful to continue flagging disorders as having onset in the postpartum period. In line with this, the DSM-5 includes a peripartum onset specifier, which can be used if mood disorder onset occurs during pregnancy or in the four weeks following delivery. However, the rationale for including this specifier needs to be made clearer (Austin, 2010). Furthermore, there is lack of agreement regarding the time criterion (within four weeks postpartum) of the specifier (Austin, 2010; Jones & Cantwell, 2010). Future research is required to identify whether there are specific and measurable benefits associated with using a peripartum onset specifier, and should also determine the optimal time criterion.

Implications for measurement of postpartum anxiety and depression

Research into postpartum emotional disorders has arguably been hindered by a lack of clarity and consistency in the measurement of postpartum depression, and more recently, anxiety (Matthey, 2008). With increasing recognition that anxiety is also common in the postpartum period, several approaches have been taken to detect and measure depression and anxiety in postpartum samples: using the EPDS; using existing depression and anxiety measures developed for use in the general population; and developing new postpartum specific measures. The present thesis has implications for each of these measurement approaches.

Firstly, researchers have tested the ability of the EPDS to measure anxiety and distinguish it from depression, and have obtained mixed results (Matthey, 2008; Rowe et al., 2008). Chapter 2 did not support the EPDS as a reliable and valid measure of anxiety and depression, in that it lacked factorial invariance across two separate testing occasions in the postpartum clinical sample. Previous studies have also indicated that the EPDS has an unclear factor structure (see review in Chapter 2). The possibility that individuals respond differently to EPDS items depending on situational context and/or levels of distress is problematic, particularly as the scale is used to screen for probable depression in a variety of perinatal populations and in a wide range of contexts (including hospitals, research settings, during routine child health nurse visits). A lack of measurement invariance of the EPDS may account for inconsistent findings regarding its screening abilities (e.g., variation in sensitivity, specificity, and positive predictive value of cut-off scores in previous studies; see Gibson et al., 2009, for review). Thus, the findings of Chapter 2 suggest that the EPDS is in need of revision if it is to be used as a reliable and valid depression screening instrument in perinatal populations. Moreover, the item content of the EPDS largely reflects NA and PA. If the

EPDS is to be used to measure anxiety in addition to depression, then it should be refined to include symptoms reflecting AA (Chapter 4; L. A. Clark & Watson, 1991).

Another approach to measuring postpartum depression and anxiety has been to use anxiety and depression measures developed for use in non-postpartum populations. In support of this approach, Chapter 3 demonstrated that the DASS, an existing self-report measure of anxiety and depression, had adequate reliability and validity in the postpartum clinical sample. These findings suggest that the DASS is an appropriate tool for assessing and differentiating depression, anxiety, and stress in the postpartum clinical sample. However, the generalisability of the findings to postpartum samples are unclear and it would be beneficial to validate the DASS in other postpartum samples to strengthen the conclusions of the present research.

A third approach in the measurement of postpartum depression and anxiety has been to develop postpartum specific measures. The rationale for using postpartum specific measures is that the presentation of anxiety and/or depression is different in postpartum period: for example, that certain symptoms are not reliable indicators in this population, or there are additional symptoms that need to be assessed in the postpartum period. The findings of Chapter 4 do not support the omission of items reflecting fatigue, irritability, changes in sleep and appetite from self-report, as these items loaded as expected onto NA. Rather, it should be recognised that these symptoms reflect nonspecific general distress/NA and are likely to be poor indicators of depression both within the postpartum period and outside of the postpartum period (L. A. Clark & Watson, 1991).

The findings of Chapter 4 (support for a tripartite structure of postpartum depression and anxiety symptoms) have implications for the development of new measures of postpartum anxiety and depression. Given evidence that postpartum anxiety

and depression are characterised by NA, PA and AA, assessment measures should attempt to assess these three symptom clusters. More specifically, measures of postpartum depression should aim to include symptoms of PA, whereas postpartum anxiety measures should include symptoms of AA. It is also important to detect individuals with elevated NA as these individuals are likely to be highly distressed, however, these symptoms are less useful in differentiating anxiety and depression (L. A. Clark & Watson, 1991).

Overall, the present findings have the potential to guide refinement of existing measures (e.g., the EPDS), the selection of measures for use in postpartum samples, and the development of new measures. It may also be useful to measure these symptom dimensions across treatment to determine whether they are differentially impacted by particular interventions.

Implications for treatment of postpartum emotional disorders

Whilst the present research did not examine treatment of postpartum psychopathology, the findings have potential implications for the treatment of postpartum emotional disorders. For example, as Chapters 3 and 4 did not provide support for the view that postpartum depression and anxiety are different from depression and anxiety occurring at other times, it could be argued that the broader literature on treatment of depression and anxiety is applicable to postpartum women (Whiffen, 1991). The findings of Chapter 4 supported the existence of tripartite model symptom dimensions in a postpartum sample, and these dimensions may represent specific targets for treatment. There is some evidence that the tripartite model factors differentially respond to various treatments in other non-postpartum samples (e.g., Kring et al., 2007; Mausbach et al., 2009).

Treatment of postpartum disorders could be refined by focusing interventions on the predominant symptom dimensions. The findings of Chapter 4 suggested that postpartum depressive disorders are characterised by reduced PA, and hence empirically-supported depression treatments theorised to increase pleasurable engagement (e.g., interpersonal psychotherapy, specific components of cognitive-behavioural therapy such as scheduling pleasant activities and reducing social withdrawal; Dimidjian, Barrera Jr, Martell, Muñoz, & Lewinsohn, 2011) may be indicated for postpartum depressive disorders over anxiety and mixed disorders. Nutt et al. (2007) reviewed preliminary evidence suggesting that antidepressants that enhance noradrenergic and dopaminergic activity may be more effective over serotonergic antidepressants for symptoms of low PA. In Chapter 4, postpartum anxiety disorders were predicted by high AA. These findings may indicate the role of arousal reduction techniques (such as exposure to feared stimuli and relaxation training) in treating postpartum anxiety disorders.

Given that mixed anxiety-depressive diagnoses were predicted by high NA, treatments theorised to target NA may be particularly indicated in such disorders (Chapter 4). For example, transdiagnostic treatment approaches are theorised to have their effect by targeting the common component of anxiety and depression, NA (Barlow, 2004). It has also been theorised that treatments that are broadly effective across the emotional disorders (e.g., cognitive-behavioural therapy, selective serotonin reuptake inhibitor antidepressants) may primarily act by decreasing NA, or may target more than one dimension (Shelton & Tomarken, 2001). Further research is required to determine the degree to which tripartite factors are affected by various treatment components in both non-postpartum and postpartum samples. It may be possible that the tripartite model factors can account for patterns of change in anxiety and depression during treatment. In line with the tripartite model, it could be expected that treatments

applicable across disorders would lead to changes in NA, whereas treatments that show specificity to anxiety or depression may act by modifying AA and PA respectively. Evidence in support of these premises could lead to the refinement of treatments, allowing practitioners to target the presenting symptom dimensions of anxiety and depression. If there are similar patterns of treatment response in both postpartum and non-postpartum samples, then this may indicate similar factors underlying depression and anxiety in both groups. Thus, treatment approaches may be similar across postpartum and non-postpartum samples. If, on the other hand, the patterns of change in the underlying symptom dimensions are different in postpartum versus non-postpartum samples, then treatments may need to be modified or tailored to postpartum samples.

Limitations and future directions

The present thesis has several limitations that should be noted. Firstly, patients from the same hospital were used across the studies. Use of the same sample potentially increases the risk of a type I error, and there may be nuances associated with the inpatient sample that may have influenced the results. As aforementioned, the generalisability of the findings to postpartum women more generally is unclear, and replication using other postpartum samples is necessary to strengthen confidence in the conclusions of the present research. That is, it is possible that the latent structure of mood and anxiety symptoms may be different in other postpartum samples to that of the postpartum psychiatric inpatients examined in the present research. If this is the case, then the self-report instruments examined in the present research may not demonstrate similar psychometric properties in other postpartum samples. Furthermore, the inclusion of a postpartum community sample may have been beneficial to test for invariance across clinical and non-clinical samples, and increase confidence in generalising the present findings to other groups of postpartum women. However, it is noted that there are difficulties associated with recruitment of postpartum samples that are

representative of a group of postpartum women drawn from the community (Appleby & Whitton, 1993). Replications of the present study are recommended in order to draw more solid conclusions regarding the symptom profiles of postpartum samples.

The present research could have also have benefited from the inclusion of a non-postpartum comparison sample. The inclusion of such a comparison sample would have allowed a direct test of measurement invariance between postpartum and non-postpartum groups, rather than drawing conclusions by indirectly comparing results to previous studies of non-postpartum groups. For example, whilst we were able to demonstrate the same broad factors underlying postpartum anxiety and depression symptoms as in non-postpartum samples of previous studies (Chapter 3), using a non-postpartum sample would have allowed the examination of more stringent levels of invariance, such as equality of factor loadings and thresholds. This would have allowed testing of more specific differences between postpartum and non-postpartum samples. It would be beneficial to replicate the findings of Chapters 3 and 4 using both postpartum and non-postpartum samples. Firstly, examination of the reliability, validity, and factor structure of the DASS in other postpartum samples would provide further evidence regarding its utility in assessing anxiety and depressive symptoms in the postpartum period. In addition to the DASS, it would be beneficial to test for factorial invariance of other anxiety and depression measures across postpartum and non-postpartum samples. Such analyses would provide further evidence that the structure of depression and anxiety symptoms is similar in postpartum and non-postpartum samples. Finally, further tests of the tripartite model in other postpartum samples would provide strength to the conclusions of the present research. Multiple group CFA could be used to compare goodness of fit of the tripartite model across postpartum and non-postpartum samples. Such an analytical approach would allow for examination of differences in specific symptoms across postpartum and non-postpartum groups.

The diagnoses were assigned based on patient report and observation, whereas the items used to test the tripartite model were obtained from self-report questionnaires completed by patients. The possibility of biases associated with patient's responses, or with psychiatrists' assignment of diagnoses, cannot be ruled out. Whilst previous studies have typically reported strong convergence between self-report and clinician-reported symptoms in non-postpartum populations (L. A. Clark & Watson, 1991), it might be beneficial for future studies to utilise dimensional or clinician-rated symptom measures and to examine their convergence in postpartum populations.

Whilst the present research has implications for the conceptualisation and measurement of postpartum anxiety and depression, the limitations of the present thesis highlight the need for replication and extension of the research in order to further understand the phenomenology of postpartum anxiety and depression, and their relationship to depression and anxiety occurring at other life stages.

Summary

Postpartum depression and anxiety are serious and common clinical concerns, yet their clinical presentation, and their relationship to depression and anxiety at other life stages, is poorly understood. This lack of clarity has hindered efforts to classify, assess, and treat postpartum depression and anxiety. The present thesis demonstrated that the structure of postpartum depression and anxiety symptoms is similar to that at other life stages, providing support for the view that postpartum depression and anxiety are the same clinical entities as non-postpartum depression and anxiety. These findings increase our confidence in using assessment and treatment methods developed for anxiety and depression in the general population in postpartum women.

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