

Early Childhood Predictors of School Readiness: A Multilevel Linked Data Study

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by

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Thesis Declaration

I, Megan Bell, certify that:

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The research involving human data reported in this thesis was assessed and approved by the University of Western Australia Human Research Ethics Committee [Approval No. RA/4/1/6651]; the Western Australian Department of Health Human Research Ethics Committee [Approval No. 2013/65]; and the Western Australian Aboriginal Health Ethics Committee [Approval No. 551].

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

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Date: 29/03/2017

Abstract

It is widely accepted that academic success in later life has its roots in the early childhood period. As such, efforts to improve educational outcomes should focus on preventing or mitigating factors that can adversely affect early child development, and ideally be implemented before children enter school (Young & Richardson, 2007). However, a key challenge in providing such interventions is identifying the children and families most in need of intensive services (Lynch, Law, Brinkman, Chittleborough, & Sawyer, 2010). Linked administrative data present an opportunity to address this issue by merging population-level information from a variety of sources, enhancing the potential to identify groups at risk of poor outcomes, across all socioeconomic strata (Jutte, Roos, & Brownell, 2011). This often highly-sensitive information from sources including health services, criminal justice, and child welfare can be combined with child-level data on developmental and educational outcomes to help identify which groups may benefit from intensive early childhood and family services. The aim of this thesis is therefore to utilise administrative data to identify child- and parent-level factors that may adversely affect early child development, and which could be targeted by services aimed at improving developmental outcomes.

This thesis uses population-based linked data, merged across multiple government agencies, to investigate the relationship between high-risk events in the early childhood period and children's developmental level at the start of school ("school readiness"). The study population includes all children born during 2003-2004, and who attended pre-primary (the year prior to grade 1) in Western Australia in 2009. School readiness is measured by the Australian Early Development Census (AEDC), a population-level school readiness measure based on the Canadian Early Development Instrument (Janus et al., 2007). The AEDC evaluates children's development at school entry in the domains of: 1) physical health and wellbeing, 2) social competence, 3) emotional maturity, 4)

communication skills and general knowledge, and 5) language and cognitive skills.

Children's AEDC scores are merged with administrative data on child and parent physical health, parental mental health, child maltreatment, and parental criminal justice involvement.

The first aim of this thesis is to evaluate the relationship between school readiness and later school outcomes, in an attempt to conceptualise how early developmental difficulties may be associated with educational trajectories. The first study reported in this thesis (Chapter 3) examines the association between children's school readiness scores and early indicators of school disengagement: academic test scores, school suspensions, and attendance rates. Results of multi-level logistic regression models show that children with lower school readiness in any developmental domain are more likely to achieve below national minimum standards on academic tests of reading, numeracy, and writing three years later. Furthermore, children experiencing socio-emotional difficulties at school entry are 3-times more likely than their peers to be suspended at least once by grade 3; and children experiencing physical, communicative, and/or cognitive difficulties at the transition to school are at risk of poor school attendance. The findings indicate that developmental vulnerabilities at school entry are associated with poor school outcomes which, if not mitigated, may lead to school disengagement. Identifying factors which may lead to such vulnerabilities in early childhood is therefore an important focus for prevention and intervention strategies.

Having established that scores on the AEDC predict later school outcomes, the subsequent investigations focus on risk factors at the child and parent level which are hypothesised to be associated with poorer school readiness, but which have been historically difficult to research due to the sensitive and complex nature of the information. The first factor studied is chronic illness occurring in early childhood (Chapter 4). The results of this study show that children experiencing chronic illness early

in life are at increased risk of developmental vulnerability on all school readiness domains. This effect is found for chronic conditions that would not ordinarily be included in eligibility lists for intervention services, supporting recommendations that provision of school support services should be based on a child's level of functioning, rather than their diagnosis.

The thesis also investigates the association between parental chronic physical illness (Chapters 5) and parental psychiatric illness (Chapter 6) and children's school readiness. In Chapter 5, results show that maternal chronic illness, but not paternal chronic illness, is associated with an increased risk of developmental vulnerability in children, across multiple developmental domains. In Chapter 6, results show that psychiatric hospitalisation of either the mother or father is associated with a risk for children's lower school readiness, regardless of the duration of the hospitalisation. The results support assertions that child-sensitive methods should be included in assessment and treatment planning for adults experiencing serious physical and/or mental illness, in order to address the needs and wellbeing of dependent children.

Child maltreatment is another factor known to cause considerable disruption to healthy development. Chapter 7 reports the results of a study investigating the association between school readiness and the type, timing, and chronicity of maltreatment. Children with child welfare contact are found to be at risk of poor school readiness on all domains, regardless of whether the allegation of maltreatment was substantiated or unsubstantiated. Results suggest that substantiated maltreatment is consistently associated with an increased risk of socio-emotional difficulties regardless of type of maltreatment; but the association between different types of unsubstantiated maltreatment and school readiness is more variable. Furthermore, children with substantiated or unsubstantiated allegations of maltreatment are at increased risk of lower school readiness, irrespective of the timing or frequency of maltreatment. The results of this study suggest that all children in contact

with child welfare services should be assessed on first contact, in order to determine if there is a need for intervention services.

Chapter 8 presents the final empirical study of this thesis, which is an investigation of the school readiness of children whose parents have had criminal justice system involvement. Results show that, compared to children whose parents had no recorded convictions, children whose parents had been convicted are at increased risk of developmental vulnerability on all domains. This effect is similar regardless of whether the parent had been incarcerated or not. Currently, there is no coordinated approach for identifying these children, or evaluating their wellbeing and safety or need for support services. The results highlight the importance of addressing this gap in services.

A general discussion of the findings is provided in Chapter 9, along with a discussion of the clinical, theoretical, and policy implications of the findings. The results of all research studies emphasise the importance of inter-agency collaboration, as well as the provision of family-centred services, in efforts to promote positive child development. Intervention and prevention strategies that fail to recognise the influence of the child's developmental context are likely to result in sub-optimal outcomes. This final chapter also includes a discussion of the strengths and limitations of the research, and presents a number of suggestions regarding future steps for advancing the research field.

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Authorship Declaration

This thesis contains work that has been published and/or prepared for publication. All studies in this thesis were designed by the candidate in collaboration with her supervisors: Dr Donna Bayliss, Dr Rebecca Glauert, and Dr Jeneva Ohan. Dr Amanda Harrison also provided supervisory input for the studies reported in Chapters 4 and 6. The candidate was responsible for data applications; ethics applications; data merging, cleaning and coding; statistical analysis and interpretation; and preparation of manuscripts. The co-authors of publications and manuscripts included in this thesis provided intellectual input on study design; advised on analyses and interpretation of results; and assisted with editing manuscript drafts.

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Preface

When children experience less-than-optimum conditions in their early developmental settings, it is possible that there will be disruption to the development of skills and abilities considered important for positive school adaptation (Tayler, 2015). Previous investigations have established that there is a range of child-, parent-, and neighbourhood-level factors that put children's early development at risk. However, for topics of a sensitive nature, particularly those that are seen as the domain of the family, obtaining first-hand information from people impacted by these factors can be difficult (Lee, 1993). Children and families may be concerned that disclosure of such sensitive information may result in stigma, threats to confidentiality, or castigation. These factors, including child and parent illness, child maltreatment, and parental incarceration, have been historically difficult to examine in developmental studies that rely on individuals to opt-in to the research. Longitudinal investigations into the outcomes of children exposed to these factors are particularly difficult, due to issues with retaining individuals in research. Existing evidence may therefore be limited by biased responding and/or samples that are not representative of the population. Accordingly, there is a need to investigate these sensitive topics using a method that protects the privacy and anonymity of the individuals involved.

The studies presented in this thesis used population-level administrative, registry, and census data linked across multiple government agencies. These data included information on demographic characteristics, health, child welfare, and developmental and school outcomes for children; demographic, criminal justice, and health information for their parents; and indicators of socioeconomic disadvantage and geographic remoteness for children's neighbourhoods of residence. Data are de-identified, thus enabling the examination of outcomes of groups historically difficult to recruit and retain in research due to the sensitive nature of the information being examined, whilst protecting the

anonymity of those individuals. These data also enhance the capability to identify the occurrence of risk factors across the child's entire life-course, as the data are collected in 'real time.' This methodology therefore has the potential to increase the evidence base regarding the children and families who may be most in need of intensive interventions that address risk factors for early child development. Using this methodology, this thesis aimed to examine the association between child- and parent-level risk factors and children's early developmental outcomes, and to investigate how vulnerabilities in development at school entry relate to children's later school outcomes.

The studies included in this thesis found that children who experience adverse events in early childhood (chronic illness, parental physical and mental illness, child maltreatment, parental criminal convictions) are at risk of starting school without a strong foundation of skills and abilities to support their continuing growth in the school context. Furthermore, developmental vulnerabilities at school entry were found to predict three poor school outcomes up to grade 3: low academic achievement, poor attendance, and out-of-school suspensions. These school outcomes have previously been identified as early indicators of disengagement from school (Balfanz, Herzog, & Mac Iver, 2007; Cratty, 2012), which in turn is associated with school dropout (Alexander, Entwisle, & Horsey, 1997). Therefore, early childhood experiences and conditions that disrupt children's developing skills and capacities have the potential to negatively impact children's educational trajectories. Intervening early to address developmental difficulties is likely to be of greater benefit to children than waiting until developmental vulnerabilities become established academic, social, or behavioural problems.

This thesis is presented as a series of papers, and includes both published manuscripts and manuscripts prepared for publication. As such, there is some repetition of content across chapters, particularly in the 'Method' sections. Chapters are presented in the same form as they were prepared for publication, in order to maintain completeness

and clarity of each study, and to limit the need to refer back to content in earlier chapters. Chapter 4 has been published, Chapters 3 and 8 have been submitted for peer review; and Chapters 5, 6, and 7 have been prepared for publication. Formatting of individual chapters has been altered for consistency.

Chapter 1 presents a review of the literature on the links between early child development and later academic achievement, providing background to, and a rationale for, the studies presented in this thesis. Chapter 2 presents the overarching methodology for the studies, and includes an overview of data linkage in Western Australia. Chapter 3 investigates the relationship between children's scores on a measure of school readiness, and their later school outcomes, namely, academic test scores, attendance, and suspensions. The following five chapters detail investigations into different factors which may be associated with developmental vulnerabilities at school entry: child chronic illness (Chapter 4); parental chronic illness (Chapter 5); parental psychiatric illness (Chapter 6); child maltreatment (Chapter 7); and parental incarceration (Chapter 8). Finally, Chapter 9 provides a summary of the findings of this thesis, and a critical review and analysis of the findings in the context of other research, as well as the theoretical, clinical, and policy implications of the findings.

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Chapter 1 - General Introduction

The development that occurs during early childhood is a process of interactions between a child's biology and the environments in which they develop (Bronfenbrenner & Ceci, 1994; Fox, Levitt, & Nelson III, 2010; Lerner, 1991). Early life experiences can influence the timing and pattern of gene expression, consequently driving the development and maturation of brain structure and function (Fox et al., 2010; Lerner, 1991). This early development of the brain lays the foundation for future brain development, and thus, experiences that shape development early in life – whether adverse or enriching – can influence lifetime trajectories for health, achievement, and wellbeing (Fox et al., 2010; Hertzman & Wiens, 1996; Sroufe, Coffino, & Carlson, 2010). For instance, it is now widely acknowledged that educational achievement in adulthood has its origins in the early childhood period (Shonkoff & Phillips, 2000). The transition from home to school is particularly influential in setting the child's educational trajectory (Rimm-Kaufman & Pianta, 2000). It is therefore crucial to understand the processes of early development that impinge on a child's readiness for school.

During early childhood – defined here as the period from birth to school entry – children experience a rapid development of skills and abilities that lay the foundation for future achievement (Bracey, 2003; Forget-Dubois et al., 2009; Garon, Bryson, & Smith, 2008; Irwin, Siddiqi, & Hertzman, 2010). It is also during this period that inequalities in development emerge, due to a confluence of environmental and biological factors (Hertzman & Williams, 2009; Maggi, Irwin, Siddiqi, & Hertzman, 2010). Inequalities in development can mean that some children start school behind their peers in important developmental capacities. Due to the cumulative nature of school-based learning, gaps in achievement that exist at school entry are difficult to close over time (Heckman, 2008). Rather, children often struggle to catch up to their peers, falling further behind as they progress through subsequent years of schooling (Entwisle & Alexander, 1993, 1999;

Stipek & Ryan, 1997). By grade 3, children's educational achievement trajectories are largely established (Entwisle & Alexander, 1993). Low educational achievement in childhood is associated with low self-esteem, psychological and social problems, unemployment, and poverty in adulthood (Abbott-Chapman et al., 2014; Coltheart & Prior, 2006; Fiscella & Kitzman, 2009; Reynolds, Temple, & Ou, 2010). Thus, efforts to improve children's chances of success in the early years of schooling may have important implications for their lifetime health and wellbeing. Development and implementation of early childhood interventions for improving educational outcomes requires both the identification of risk and protective factors that influence early child development, and a theoretical understanding of how developmental processes drive continuity and change in trajectories (Sroufe et al., 2010).

This thesis investigates features of the developmental environment hypothesised to influence children's readiness for school, with the aim of identifying vulnerable populations that may benefit from ameliorative interventions. The research included in this thesis uses linked administrative data to examine the developmental outcomes of a population sample of 5- to 6-year-old children, as well as the life-course factors that may influence children's readiness for school, in addition to how developmental vulnerabilities at school entry may impact on children's later school outcomes. This first chapter starts with a discussion of theories of child development, followed by a review of the literature documenting different risk factors for child development. There is then a discussion of school readiness, and a review of research linking school readiness to later school outcomes. Finally, the benefits of using linked data for research into antecedents and consequences of poor school readiness are discussed.

A Theoretical Perspective on Child Development

Bronfenbrenner's bioecological theory (Bronfenbrenner & Ceci, 1994; Bronfenbrenner & Morris, 2007; Bronfenbrenner, 1974, 1994) provides a framework for

the study of human development over the life-course. The four defining properties of the theory, *process*, *person*, *context*, and *time*, encapsulate the notion that human development is the product of bi-directional interactions (processes) between an individual (person) and the many developmental settings (context) to which the child is exposed over the life-course (time). These developmental settings are collectively referred to as ‘the ecology,’ which is conceived as a set of nested structures. The child is positioned at the centre-most layer of the ecology, termed the *microsystem*, which includes the many settings in which the child engages in activities, social roles, and interpersonal relations (Bronfenbrenner, 1994). The linkages between the different settings in the microsystem, such as between home and school, are referred to as the *mesosystem* (Bronfenbrenner, 1994). The *exosystem* incorporates linkages between two or more settings, at least one of which does not include the developing child, but in which events occur that can indirectly influence interactions between the child and the people and objects in the ecology (Bronfenbrenner, 1994). For instance, events at a parents’ workplace may influence events in the home. The uppermost structure of the ecology is the *macrosystem*, which incorporates the broader cultural, structural, socioeconomic, political, and ideological characteristics of the micro-, meso-, and exosystems within which the child develops. These features influence the conditions and processes occurring in the microsystem, and thus, indirectly influence developmental pathways (Bronfenbrenner, 1994). For example, the resources parents have available to support their children’s development can be influenced by distal factors such as public policies that influence health, employment, wealth, and availability of services (Bradbury, Corak, Waldfogel, & Washbrook, 2011).

Overlaying all levels of the ecology is the *chronosystem*, which describes the continuity and discontinuity that occurs over time for both the developing individual and the environment/s in which the person develops. At the micro-level, influences may include both normative (e.g., school entry) and non-normative (e.g., the death of a family

member) life-stage transitions (Bronfenbrenner, 1994). At the macro-level, these conditions involve socio-historical factors that may indirectly affect an individual's developmental pathways, such as technological advances, breakdown of the traditional family model, or increasing urbanisation. The chronosystem illustrates the notion that the ecology is not static. For instance, as children progress through developmental stages, so too do their friends and siblings; their parents experience life stage transitions; the political or social structures of their community or country may change; and technology may alter ways of living.

Within the microsystem, bi-directional interactions of increasing complexity take place between the developing individual and the persons, objects, and symbols within his/her immediate setting/s (Bronfenbrenner, 1994). These bi-directional interactions are termed 'proximal processes.' Although genes are seen as the basis of human development, proximal processes are posited to be the engines of development that drive the actualisation of genetic potential (Bronfenbrenner & Ceci, 1994). Proximal processes are influenced by features of each system within the ecology, from the genetics of the individual, to the characteristics of other individuals within the ecology, to the social structures of the community in which the developing individual lives. The features of the developing individual, his/her ecology, and the proximal processes that take place between the individual and the ecology over the life-course, are all posited to shape developmental pathways (Bronfenbrenner & Morris, 2007; Bronfenbrenner, 1994).

Characteristics of the developing individual are thought to exert powerful influences on the form and context of proximal processes. While genes provide the framework upon which development occurs (Bronfenbrenner & Ceci, 1994), from very early on in life, it is hypothesised that proximal processes drive the development of cognitive, physical, and socio-emotional abilities (Bronfenbrenner & Morris, 2007). In turn, these abilities influence the nature of successive proximal processes, including both

interpersonal (e.g., peer relationships) and person-object interactions (e.g., learning a new skill), thus influencing later development. Furthermore, personal characteristics such as age, gender, and ethnicity are all thought to influence proximal processes in that they assign the developing individual to a particular environmental niche, putting constraints on the proximal processes that take place (Bronfenbrenner & Morris, 2007). If, how, and when proximal processes occur is largely determined by the behavioural dispositions of both the developing individual and other significant people within the ecology. It is postulated that characteristics such as emotional or behavioural dysregulation, avoidance, or disinterest inhibit or disrupt proximal processes in that they are not conducive to sustained engagement in interpersonal or person-object interactions, nor do they facilitate the progression of complexity of these interactions over time (Bronfenbrenner & Morris, 2007). Conversely, dispositions characterised by curiosity, responsiveness, engagement, and behavioural and emotional self-regulation are thought to invite and sustain proximal processes (Bronfenbrenner & Morris, 2007). Of critical importance within this framework, however, is the nature of the ecology in which proximal processes take place. The conditions and experiences provided by the ecology can invite, permit, or inhibit the developing individual's engagement in proximal processes (Bronfenbrenner & Ceci, 1994; Bronfenbrenner, 1994).

The effective operation of the different systems within the ecology is hypothesised to depend upon the degree of stability, consistency, and predictability of the system/s over time (Bronfenbrenner & Morris, 2007). The more predictable, safe, and nurturing the ecology is, the greater the probability of positive developmental outcomes (Bronfenbrenner, 1974, 1986). Physical environments that provide structure and invite exploration encourage developmental processes (Bronfenbrenner & Morris, 2007). Conversely, developmental settings characterised by instability and unpredictability are not conducive to the effective development of relationships and mastery of skills

(Bronfenbrenner & Morris, 2007). Chaos within developmental settings interrupts and undermines the formation and stability of relationships and activities that are essential for developmental growth. Furthermore, disruption in one developmental setting tends to be reinforced by disruption in interconnected settings (Bronfenbrenner & Morris, 2007). For example, a chaotic home environment may impact on a child's ability to pay attention in class, disrupting the child's interpersonal and person-object interactions at school. However, for children living in disadvantaged environments, developmentally generative features of the microsystem, such as positive parenting practices or social support networks, can buffer against the disruptive influences of adversity (Bronfenbrenner & Ceci, 1994). Furthermore, children who are exposed to environments that provide developmental resources to a degree not afforded to them in other developmental settings may still experience positive outcomes (Bronfenbrenner & Ceci, 1994). The influences of proximal processes on developmental pathways are thus seen as probabilistic, not deterministic. In other words, exposure to risk factors in early childhood may influence, but not necessarily determine, developmental pathways.

In sum, the bioecological model proposes strong connections between a child's physical, cognitive, emotional and social development, and the functioning and development of his/her external context. Influences on both child and context are described as complex, dynamic, and multifactorial, and are thought to vary as a function of the personal characteristics of the child, as well as the characteristics of the people and physical features that make up the developmental context. Therefore, to understand variation in developmental pathways, the bioecological framework would emphasise the importance of understanding factors that influence how a child behaves and interacts within the different settings of his/her microsystem, as well as factors that influence the structure and functioning of the exo- and macro-systems. Investigation of influences on early child development and school readiness should therefore include consideration of

child- and parent-level factors, the characteristics of the neighbourhoods within which families live, and the services and resources available to support families in raising their children.

Influences on Early Child Development

Contemporary perspectives on human development emphasise that any disruption to normative development early on in life can have long-lasting impacts on future life outcomes (Bronfenbrenner & Morris, 2007; Keating & Hertzman, 1999; Shonkoff & Phillips, 2000; Sroufe et al., 2010). This is thought to be, in part, due to the cumulative nature of skill development: acquisition of one skill influences the development of related skills, or alternatively, failure to develop one skill reduces the probability of future skill acquisition (Bailey, 2002). As new developmental challenges arise, children draw upon available personal and environmental resources to help them navigate these transitions, and the degree to which their adaptation is successful sets the foundation for future development (Sroufe, 1979). Thus, the development that occurs in early childhood sets a critical foundation for taking on the challenge of fulltime schooling. Ideally, during this time, children develop the capacity to self-regulate emotions, behaviours, and attention; social competencies such as conflict-resolution, empathy, and reciprocal communication; mastery of fine- and gross-motor skills; and capabilities for learning such as language, reasoning, and problem-solving (Shonkoff & Phillips, 2000). School makes many demands on children; hence, competence in a broad range of these capacities is important for positive adaptation to school.

According to bioecological theory, not only are child characteristics important for determining school readiness, but so too are the characteristics of the settings in which development takes place. Prior to school entry, the family is the child's primary developmental context. At this young age, the influence of other settings, such as the neighbourhood and broader social structures, are likely to be mediated through family

attributes (Hertzman, Brooks-Gunn, & Kohen, 1999). This is because young children are not independently mobile, and therefore, their level of exposure to these factors depends on their parents. Consequently, strategies to support positive adaptation to school require a focus on the functioning of both the child and his/her family, as well as an examination of how well communities, schools, and broader social structures are supporting families in raising their children. The following sections present a review of the literature relating to factors that can influence developmental and educational outcomes. Although it is recognised that the middle childhood and adolescent years are also important for determining educational outcomes into adulthood (e.g., Anderman & Maehr, 1994; Dotterer & Lowe, 2011; Jackson, 2009), this thesis focuses on factors that contribute to poor adaptation during the transition to school. Thus, the focus of the literature review pertains to early childhood.

Child-level Factors

At the child level, factors that shape early development include children's personal dispositions and abilities that influence the form and content of the bi-directional interactions they have with people and objects in their developmental settings (Bronfenbrenner & Morris, 2007). For instance, temperament is an important influence on both the nature of the transition into formal schooling, and the probability of later school success (Entwisle, Alexander, & Olson, 2005). Competence in the regulation of emotion, attention, and behaviour is important for effective interpersonal relationships, classroom adaptation, and mental wellbeing (Eisenberg, Valiente, & Eggum, 2010; Li-Grining, Votruba-Drzal, Maldonado-Carreño, & Haas, 2010; Shields et al., 2001). Children rated by teachers as enthusiastic, willing to express ideas, happy, creative, socially competent, and independent tend to score higher on tests of academic abilities (Entwisle et al., 2005). Conversely, children who have difficulties with emotion regulation, exhibit high levels of dependence and inappropriate behaviours, and are generally disagreeable and resistant to

authority tend to perform poorly on academic tests (Hart, Atkins, Fegley, Robins, & Tracy, 2003). In addition, children with high levels of expressed negative emotion (e.g., sadness, anger, fear) have more social difficulties than children who express more positive emotionality (Neal, Durbin, Gornik, & Lo, 2017). These temperamental characteristics are reasonably stable from preschool onwards (Caspi, Roberts, & Shiner, 2005; Durbin, Hayden, Klein, & Olino, 2007; Neal et al., 2017), and appear to lay the foundation for subsequent development (Entwisle et al., 2005). Children who have an overall positive affect, interpersonal skills, and the capacity to cope with change and challenges are likely to experience success in a range of contexts, and to have effective relationships with peers and adults. Thus, early-emerging dispositions are important predictors of outcomes across the lifespan (Caspi et al., 2005; Shiner & Masten, 2012).

Bioecological theory proposes that cognitive, physical, and social abilities are both products and producers of development (Bronfenbrenner & Morris, 2007). This idea is supported by a range of findings documenting the interconnectedness of early abilities. For example, cognitive abilities such as flexibility, attention regulation, planning, and problem solving are important skills for both learning and developing friendships (Shonkoff & Phillips, 2000). Furthermore, the nature of interpersonal relationships can be influenced by a child's emotional and behavioural regulation abilities (Ladd, Birch, & Buhs, 1999).

Difficulties with emotion regulation and behavioural monitoring can lead to peer rejection and teacher-initiated disciplinary actions (Eckenrode, Laird, & Doris, 1993; Pears, Fisher, Bruce, Kim, & Yoerger, 2010). In turn, relationships with peers and teachers can have a strong influence on children's participation and achievement in school (Ladd et al., 2017, 1999; Ladd, Herald, & Kochel, 2006). Children who experience peer rejection early on in school have been found to have poorer perceptions of school, more frequent school avoidance, and lower levels of academic achievement (Ladd, 1990). Moreover, gross- and fine-motor skills, such as hand-eye coordination, object manipulation, grasping, and

independence in movement are key to adaptation both in the classroom and the playground (Doherty, 1997), and are highly related to cognitive development and academic achievement (Grissmer, Grimm, Aiyer, Murrah, & Steele, 2010; Pagani, Fitzpatrick, Archambault, & Janosz, 2010; Pagani & Messier, 2012). Motor skills are also associated with language abilities (Viholainen et al., 2006; Visscher, Houwen, Scherder, Moolenaar, & Hartman, 2007). In turn, language and communication skills are vital in the school context, as children must effectively converse with both peers and adults, and understand and interpret activity-based instruction (Doherty, 1997). Thus, social, cognitive, emotional, communicative, and physical abilities are both outcomes and drivers of development, and the interconnectedness of these abilities highlights the importance of a range of capabilities for school readiness. Developmental difficulties in one area are likely to have a negative influence on other related skills.

The development of these abilities may be disrupted by early childhood experiences that alter children's interpersonal and person-object interactions. For example, childhood chronic illness can limit a child's exposure to beneficial learning activities, result in stress and fatigue, and alter the child's relationships with parents and others in a way that influences their development (Currie, 2005). Such difficulties have been shown to impact on children's educational progress (Lê, Roux, & Morgenstern, 2012). Similarly, early-onset mental illness is associated with difficulties in peer, teacher, and parent relationships (Harpin, 2005; Nijmeijer et al., 2008), and adverse educational outcomes later in life, including lower academic achievement and reduced rates of school completion (Breslau, Lane, Sampson, & Kessler, 2008; Case, Fertig, & Paxson, 2005; Mcleod & Kaiser, 2004). Early childhood experiences that create significant upheaval for the child can therefore have detrimental impacts on children's immediate and long-term outcomes.

Demographic characteristics may also have an influence on early development,

through the constraints these factors place on children's interactions within the ecology (Bronfenbrenner & Morris, 2007). For instance, at young ages, girls, on average, experience better educational outcomes relative to boys in all areas but math achievement (Downer & Pianta, 2006; Hair, Halle, Terry-Humen, Lavelle, & Calkins, 2006; Kurdek & Sinclair, 2001). There is some evidence that this is due to greater self-discipline exerted by girls compared to boys, which facilitates orientation to learning activities in the classroom (Spinath, Eckert, & Steinmayr, 2014). In addition, language proficiency is associated with children's social and cognitive development. Children from non-English speaking backgrounds attending English language-dominant schools are at risk of deficits in English language expression and comprehension, and social difficulties (Brinkman, Sayers, Goldfeld, & Kline, 2009; Thomson, Hillman, & Wernert, 2012). Moreover, children from ethnic minority groups are often found to underperform on assessments of academic and social abilities relative to their majority-group peers (Downer & Pianta, 2006; Hair et al., 2006). Differences between ethnic groups in academic achievement may be due to a racial bias on the part of teachers: there is evidence that, from as early as first grade, children from ethnic minorities are more likely to be awarded lower marks than their majority-group peers (Entwisle et al., 2005), potentially creating or reinforcing ethnic differences in achievement. Alternatively, differences may stem from the fact that children from minority backgrounds are more likely to be exposed to a range of sociodemographic risk factors at the parent- and neighbourhood-level (e.g., poverty, residential instability, neighbourhood disorganisation; De Bortoli & Thomson, 2010; McLoyd, 1998), which may constrain children's exposure to developmentally generative conditions in the ecology (Oxford & Lee, 2011; Petterson & Albers, 2001). Thus, demographic characteristics may affect children's developmental pathways by influencing the interactions children have within their developmental contexts.

Parent-level Factors

Parent-level influences on early child development are those that influence the bi-directional interactions between parents and children, including the ways in which parents support or hinder their children's development. In the early childhood period, parents are the primary figures in children's lives. From infancy, children begin to form attachment relationships with their primary caregiver. The nature of this attachment can either encourage or discourage the child's exploration of their immediate environment, depending on the child's sense of safety and security in the responsiveness and availability of their caregiver (Ainsworth, 1979). Exploration of the environment is seen as fundamental to learning and development in early childhood (Ainsworth, 1979). Children who are confident in the responsiveness and availability of their caregiver are more likely to be self-confident and socially competent, have higher levels of self-esteem, and exert more emotional and behavioural self-regulation than children who have a pattern of anxious attachment with their primary caregiver (Sroufe et al., 2010; Sroufe, 2005). Children with a history of secure attachment are also more likely to have the cognitive, social, and emotional resources to be able to recover from adversity than those with anxious or disorganised attachment histories (Sroufe, 2005). Parents' physical or emotional unavailability (e.g., due to stress, illness, or prolonged absence) may adversely affect attachment patterns (Armsden & Lewis, 1993), increasing the risk of cognitive, social, emotional, and behavioural difficulties (Fraley, Roisman, & Haltigan, 2013; Sroufe, 2005).

Parent-child relationships are thought to be the most important environmental factor shaping early development (Sanders, 2012; Shonkoff, 2003). Sensitive and responsive parenting behaviours encourage both autonomy and compliance, and support the development of academic and social competence (Dallaire & Weinraub, 2005). Ideally, parents provide a stable, safe, and nurturing home environment that supports their

child's learning opportunities, development of interpersonal relationships, and independence in seeking out new and positive environments and resources to further their development (Pianta & Stuhlman, 2004). For young children, parents also facilitate access to materials and experiences to stimulate development; monitor appropriate behaviours and provide discipline when necessary; and manage and coordinate day-to-day activities (Brooks-Gunn & Markman, 2005). Parents who facilitate access to stimulating and varied learning experiences in the home can not only help their child's skill development, but boost their child's interest in learning, generally (Melhuish et al., 2008). Any factors that impinge on parenting ability or quality are therefore likely to have collateral consequences for children's development. For example, chronic physical illness may limit a parent physically, financially, emotionally, and/or cognitively, meaning they have fewer resources and are less available to care for their child (Romer, Barkmann, Schulte-Markwort, Thomalla, & Riedesser, 2002). Similarly, parental mental illness and general parenting stress have been shown to negatively impact on child-parent relationships, children's access to stimulating experiences in the home, and socialisation experiences (Baker & Iruka, 2013). Parents' emotional resources are critically important for children's emotional development. At very young ages, children rely on their parents for co-regulation of their emotions (Johnston et al., 1992; Thompson & Calkins, 1996). Parents who are experiencing emotional distress themselves may be less able to support children in emotion regulation, meaning children are confronted with the challenge of managing confusing and overwhelming emotions on their own (Shonkoff & Phillips, 2000), leading to emotional maladjustment (Rolland, 1999; Thompson & Calkins, 1996). Parenting stress can decrease parents' capacity to respond sensitively to their children and to provide conditions within the home that support developmental growth (Oxford & Lee, 2011).

The conditions parents create in the home also exert an independent influence on children's developmental outcomes. Family relationships characterised by stress and/or

support affect family functioning, and consequently, children's adjustment (Belsky, Woodworth, & Crnic, 1996a, 1996b; McHale, Kuersten, & Lauretti, 1996). Family disruption due to parental death, divorce, employment demands (e.g., military service, international migration), or incarceration have all been associated with declining academic achievement and poor social and emotional adjustment for young children (Amato & Anthony, 2014; Gorman, Eide, & Hisle-Gorman, 2010; Jampaklay, 2006; Paris, DeVoe, Ross, & Acker, 2010; Wakefield, Lee, & Wildeman, 2016). In addition, children from high-conflict homes often exhibit greater behaviour problems, and lower cognitive abilities (Cummings, Zahn-Waxler, & Radke-Yarrow, 1981; Pendry & Adam, 2013). Children from maltreating home environments often display behaviour patterns towards others that reflect the relationships they have with their parents (Herrenkohl & Herrenkohl, 1981). These interactions may be characterised by either physical and verbal aggression, or social withdrawal. Moreover, maltreatment is associated with either an absence of appropriate stimulation or the presence of traumatic stimulation, which can negatively impact on children's brain development (Cowell, Cicchetti, Rogosch, & Toth, 2015; Teicher et al., 2003). Child maltreatment has repeatedly been shown to adversely affect children's development of social competence, emotion regulation, and cognitive abilities (Cowell et al., 2015; Perlman & Fantuzzo, 2010; Shonk & Cicchetti, 2001). Thus, functioning of the home environment can significantly affect children's proximal interactions, ultimately influencing social, emotional, behavioural, and academic outcomes.

Family socioeconomic status (SES) is also associated with early childhood outcomes (e.g., Brownell et al., 2016). Low family SES is associated with increased levels of stress, adversity, and instability (Isaacs, 2012), which can impact on parents' resources for supporting positive child development (Oxford & Lee, 2011). Higher-income parents are often more involved in their children's schooling experiences, and have higher

expectations for their children's academic achievement (Entwisle & Alexander, 1999). Parental involvement in school during the early elementary school years has been associated with positive outcomes in later school, such as higher achievement, and lower rates of high school dropout (Barnard, 2004; Greenman, Bodovski, & Reed, 2011). Parents with higher SES are also more likely to have the financial, physical, material, and psychological resources to invest in their children's development and education (Entwisle & Alexander, 1999). Conversely, parents with limited financial resources may be less able to provide stimulating conditions within the home environment, and less able to supplement home activities with stimulating experiences outside of the home (Hoff, 2003; Linver, Brooks-Gunn, & Kohen, 2002), limiting children's learning opportunities. However, parents who can provide stimulating and varied learning environments, regardless of their SES, assist in the positive development of children's academic, cognitive, social, emotional, and behavioural development (Linver et al., 2002; Melhuish et al., 2008; Potter, Mashburn, & Grissmer, 2013; Sénéchal & Lefevre, 2002). Whilst low family SES may create adversity in the developmental context, parents play a critical role in buffering the effects of socioeconomic disadvantage on children's development.

Low SES is also associated with a number of other sociodemographic risk factors that may influence early child development. Parents experiencing poverty are often unmarried and have low levels of education, and experience poorer physical and mental health than middle- to high-income parents (Isaacs, 2012), further limiting the resources they have available to support their children's development. Moreover, low income is associated with parental distress and authoritarian parenting behaviours, which in turn contribute to the development of behaviour problems in children (Linver et al., 2002). Children born to young, unmarried mothers are often found to be at risk of poor developmental and educational outcomes (Brownell et al., 2016; Cooksey, 1997; Curtis, Dooley, & Phipps, 2004), which is thought to be due to the increased socioeconomic

adversity these mothers tend to experience (Hotz, Williams McElroy, & Sanders, 1997; López Turley, 2003). Parental education level is also frequently linked to child outcomes. Higher parental education level is associated with increased learning opportunities both within and outside the home (K. Christian, Morrison, & Bryant, 1998). Low levels of parental education, particularly for mothers, are associated with lower cognitive abilities in children (Davis-Kean, 2005; Downer & Pianta, 2006; Hair et al., 2006; Konold & Pianta, 2005). Differences in early child-rearing experiences and learning opportunities prior to school commencement can therefore lead to disparities in developmental outcomes between disadvantaged children and their more advantaged peers (Hertzman & Wiens, 1996; Hertzman, 1994, 2013).

Neighbourhood-level Factors

Families also play an important role in brokering children's interactions within the neighbourhood context (Leventhal & Brooks-Gunn, 2000), thus mediating the influence of neighbourhood characteristics on child development. Neighbourhood-level influences on children's development include the resources that are available and accessible to families, and the characteristics of neighbourhoods that impact on family life. These include institutional resources (e.g., learning, social, recreational, medical, and child care facilities), relationships (e.g., social networks), and collective efficacy (e.g., formal and informal community institutions for monitoring behaviour of children and adults; Ellen & Turner, 1997; Leventhal & Brooks-Gunn, 2000). The social capital within a neighbourhood can also provide important support for parents. For instance, people living in socially cohesive communities are more likely to look out for their neighbours and share information about opportunities, resources, and potential risks (Ellen & Turner, 1997). These neighbourhood-based connections may be especially important for parents with limited family and friendship networks. Collective efficacy can also influence perceptions of neighbourhood safety, expectations, and mutual trust (Sampson, Morenoff,

& Gannon-Rowley, 2002). For instance, other adults within the neighbourhood may serve as role models for, and monitors of, appropriate behaviour, for both children and parents (Brooks-Gunn, Duncan, Klebanov, & Sealand, 1993; Ellen & Turner, 1997). Presence or absence of such neighbourhood resources may influence parenting behaviours and family functioning, and thus impact on children's development (Leventhal & Brooks-Gunn, 2000).

Neighbourhoods can offer both risks and resources to children, either compounding or compensating for family characteristics (Byrd & Chavous, 2009). Characteristics of neighbourhoods that have been found to influence child outcomes include low neighbourhood SES, high rates of unemployment, high proportions of single-parent families, ethnic diversity, and residential mobility (Greenman et al., 2011; Leventhal & Brooks-Gunn, 2000; Voight, Shinn, & Nation, 2012). These characteristics often co-occur (Evans, Li, & Whipple, 2013; Prior, 2005), resulting in concentrations of disadvantage within neighbourhoods. Neighbourhood socioeconomic disadvantage may also be associated with increased levels of family risk (e.g., child welfare involvement, income assistance, teenage parenthood), which in turn is associated with poor cognitive development in children (Brownell et al., 2016). A number of studies have demonstrated that neighbourhood SES influences developmental outcomes, independent of family effects (Brooks-Gunn et al., 1993; Curtis et al., 2004; Kohen, Brooks-Gunn, Leventhal, & Hertzman, 2002; Oliver, Dunn, Kohen, & Hertzman, 2007; Vaden-Kiernan et al., 2010). Specifically, children residing in high SES neighbourhoods are found to have better cognitive, language, and physical development, fewer behavioural difficulties, and higher academic achievement than children living in low SES neighbourhoods (Brownell, Roos, & Fransoo, 2006; Kohen et al., 2002; Lapointe, Ford, & Zumbo, 2007; Lloyd & Hertzman, 2009; Vaden-Kiernan et al., 2010).

However, there is also evidence that the effect of neighbourhood SES on children's

outcomes varies depending on the profile of families residing within a community. Some research suggests that children living in neighbourhoods characterised by heterogeneity in family SES demonstrate better school readiness than children living in neighbourhoods characterised by either concentrated disadvantage or concentrated affluence (Carpiano, Lloyd, & Hertzman, 2009). This is thought to be due to increased availability and access to services and amenities, as well as greater social capital in heterogeneous communities as opposed to socioeconomically homogenous communities (Carpiano et al., 2009). Conversely, there is evidence that children from low-SES families derive no greater educational benefit from living in economically advantaged neighbourhoods (Boyle, Georgiades, Racine, & Mustard, 2007), possibly due to an interaction with family SES effects (e.g., children from low-SES families living in high-SES neighbourhoods may not be financially able to access the resources available in their communities). These disparate findings suggest a complex interaction between family and neighbourhood characteristics in shaping developmental outcomes.

Family-oriented services provided in the local community can also provide important support to parents for raising their children. Availability of child-oriented services within the local community, such as libraries and child care, is associated with better developmental outcomes (H. Christian et al., 2015; Hertzman et al., 1999), particularly when these services are of high quality (Barnett, 1998; Dinehart, Manfra, Katz, & Hartman, 2012; Frede, 1995; Melhuish et al., 2013). Children who attend quality early education programs have been found to have better language, motor, and cognitive development than children who do not attend such services (Gialamas, Mittinty, Sawyer, Zubrick, & Lynch, 2014; Li et al., 2013; Melhuish et al., 2013). However, neighbourhood SES can constrain the quality of available services, whereby children from disadvantaged communities may attend services staffed by lesser qualified carers, and where material resources are limited (Ellen & Turner, 1997), resulting in lower quality learning

experiences. Concentration of low-SES children in kindergarten classrooms has been associated with poor pre-academic skill development, irrespective of initial skill level (Miller, Votruba-Drzal, McQuiggan, & Shaw, 2017). Social stratification can also extend to elementary school: children from low SES families generally attend lower quality schools characterised by greater student numbers, fewer resources, and lesser trained teachers (Bracey, 2003; Entwisle & Alexander, 1993). The features of the neighbourhood physical environment can also influence children's developmental outcomes.

Neighbourhoods that are safe, walkable, and have ample green space are associated with behaviours that facilitate early child development, particularly in the areas of social and physical abilities (see H. Christian et al., 2015 for a review). Geographic isolation is another factor that can influence the availability of child-oriented services and activities (Ellen & Turner, 1997). When services are not available within the local area, families may experience barriers to engaging with early childhood services, such as the cost and time associated with traveling long distances to access those services. Indeed, children living in rural areas have been found to be at risk of poorer developmental outcomes compared to children from urban neighbourhoods (Avan & Kirkwood, 2010; Brinkman, Gregory, Goldfeld, Lynch, & Hardy, 2014). This suggests that the physical features, resources, and other people living within the neighbourhood may all influence children's developmental pathways.

Broader Social Structure Factors

At the most distal ecological level, broader social structures can have an indirect influence on developmental outcomes through influences on family and community life (Bronfenbrenner & Morris, 2007; Bronfenbrenner, 1974). Policies regarding welfare provision, paid parental leave, tax concessions, and service eligibility can impact on parents' capacity to provide safe, stimulating, and nurturing environments for their children. Furthermore, government policy and financial intervention in ensuring quality of

child care, safety of communities, and employment opportunities and conditions can all impact on family resources and children's experiences as they develop. Absence of such support from broader social structures can place an added burden on families coping with the demands of child rearing, with families experiencing disadvantage likely to be most adversely affected.

Summary

The preceding review of the literature, although not an exhaustive discussion of influences on early childhood development, clearly outlines the importance of child, parent, neighbourhood, and broader social factors in shaping developmental trajectories. Not only are a child's characteristics and personal experiences important for shaping developmental trajectories, but so too is his/her developmental milieu. Interactions between these developmental settings are also significant. For instance, as outlined in the previous section, the common occurrence of concentrations of low- and high-SES families within different neighbourhoods can lead to socioeconomic stratification of early childhood education services and schools, which can perpetuate and reinforce socioeconomic inequalities in development through differences in the quality of services and the educational expectations of students from parents and teachers. Neighbourhood characteristics can either support or hinder families' efforts to promote the development of children through availability and affordability of services. Parents' characteristics can influence their willingness and capacity to access these services. In addition, parents' social, human, and financial capital can impact on their parenting behaviours, which have a direct influence on children's social, emotional, behavioural, cognitive, and physical development. Children's own stressful experiences can impact on the way they interact with families, peers, neighbourhoods, services, and schools. In turn, the ways in which services, communities, and families support children through these developmental challenges can influence children's developmental trajectories, and consequently, their

readiness for school.

The Relationship Between Child Development and School Readiness

From a developmental perspective, how 'ready' a child is when formal schooling commences can determine how well he/she can meet the task demands of school and benefit from the educational activities provided by school (Guhn, Janus, & Hertzman, 2007). Much of the variation in developmental abilities at school entry can be attributed to variation in the experiences of early childhood (Magnuson, Meyers, Ruhm, & Waldfogel, 2004; Shonkoff & Phillips, 2000; Stipek & Ryan, 1997). As demonstrated by the literature reviewed in the previous sections, the characteristics of the child, family, and neighbourhoods in which the child lives can influence the development of skills and abilities in a multitude of ways prior to the commencement of full-time schooling. The subsequent experiences a child has in the school environment can also have a significant influence on his/her educational trajectory.

At the transition to school, children are generally optimistic, enthusiastic, and motivated to learn (Entwisle & Alexander, 1993; Stipek & Ryan, 1997). However, gaps in abilities can mean that as children progress through school, some will struggle to keep up with their peers (Stipek & Ryan, 1997), leading to inequalities in achievement that are difficult to close without intensive intervention. Furthermore, experiences children have in school can influence their perceptions of their own competence and potential. At the commencement of school, children are quickly confronted by evaluations of their competence by both peers and adults, which can shape the development of academic and social self-concepts (Entwisle & Alexander, 1999). Children who receive positive feedback about their academic, physical, or social competence are more likely to develop a positive self-concept (Ladd, Buhs, & Seid, 2000). Children who receive negative feedback about their competencies are more likely to develop poor perceptions of self-worth and negative attitudes towards school (Rumberger, 2001; Stipek & Ryan, 1997). Thus, a

child's developmental level at school entry is an important predictor of his/her later school success or failure. Enhancing children's preparedness for school is therefore a key factor in improving educational trajectories (Snow, 2006).

School Readiness

The term 'school readiness' can be interchangeably understood to mean readiness of the child to benefit from schooling; readiness of the school to support children's learning; or readiness of families and communities to support the early development of children so that they successfully adapt to school (Keating, 2007). The differences in the definitions stem from different views about the locus of responsibility for ensuring children's success in this important life transition: the family, the school, the community, or all three (Keating, 2007). Central to all of these definitions, however, is an emphasis of the importance of the transition to school in influencing children's later school success. This thesis focuses on a measure of children's readiness for school; however, it also recognises the importance of ready schools and communities in supporting children's successful school transition.

Controversies in the definition of school readiness.

The concept of school readiness has a controversial history, particularly in the United States of America, where some schools used readiness testing to determine children's eligibility for progression from kindergarten into the first grade (Meisels, 1999; Shepard, 1997). Initially, school readiness was generally measured by narrow-band assessments of cognitive abilities, with an emphasis on children's pre-academic skills, such as counting and reciting the alphabet. In some cases, readiness testing was also used to sort children into academic streams at the commencement of school (Shepard, Taylor, & Kagan, 1996). Initial conceptions of school readiness took a maturationist view, in which children were considered ready for school when they had achieved both chronological and maturational thresholds that rendered them eligible for school

commencement (Snow, 2006). The determination of ‘ready’ was therefore based on the child’s performance on tests of pre-academic skills: if the child was unable to achieve above a threshold on these tests, it was deemed that he/she should not commence formal schooling. These early conceptions of school readiness were criticised for the implication that children must achieve a specific level of accomplishment in order to be ready for school, which does not take into account the different opportunities for learning that children have been exposed to in early childhood, or individual differences in skill development (Meisels, 1999). Critics deplored the methods of this approach, which compared children to each other, ignored their different learning experiences, and sorted them into categories based on a threshold that was arbitrarily defined (Powell, 2010). There were suggestions that the maturationist model of school readiness encouraged a mentality that sorted children into “haves” and “have-nots,” which influenced the ways in which children were treated in the school setting (Powell, 2010). These concerns led to a careful rethinking of the concept of school readiness, and how assessments of school readiness can be used to support, rather than hinder, children’s educational trajectories.

Contemporary perspectives of school readiness.

Conceptions of school readiness have evolved over recent decades, and assessment of school readiness has followed suit. Rather than assessing whether a child has met a threshold of competence required for school commencement, assessment now provides a snapshot of the child’s development at the point of school entry, with the aim of evaluating the child’s relative readiness to take on the challenges and opportunities that school presents (Janus & Duku, 2007; Meisels, 1999). As opposed to a strictly maturationist view, contemporary perspectives take an interactionist view of school readiness that emphasises the importance of interactions between the child and his/her developmental context in influencing preparedness for school (Guhn, Gadermann, & Zumbo, 2007; Meisels, 1999; Piotrkowski, Botsko, & Matthews, 2000). Within this

conceptualisation it is also recognised that social, political, educational, and personal resources critically influence the success or otherwise of this important life stage transition.

School readiness is now considered a multidimensional construct, incorporating both cognitive and non-cognitive abilities that are important for positive school adaptation (Guhn, Gadermann, et al., 2007). This holistic view of school readiness reflects the understanding that school success depends on a wide range of abilities (Diamond, 2010). However, exactly what characterises a ‘ready’ child is often still a matter of debate. Opinions on which skills children require to increase the probability of a successful school transition can vary depending on the stakeholder (Snow, 2006). Teachers often view physical health, communication skills, and curiosity and independence in approaches to learning as essential components of being ready for school, with pre-academic skills such as counting, colour knowledge, and alphabet recital seen as less important (Dockett & Perry, 2003; Heaviside, Farris, & Carpenter, 1993). Parents, on the other hand, generally consider counting, colour and shape knowledge, and letter recognition as necessary for school commencement, along with the ability to pay attention and sit still in class (Barbarin et al., 2008; Piotrkowski et al., 2000). Children tend to consider compliant behaviour and school liking as important components of a successful school transition (Dockett & Perry, 2003). Although there is variation in stakeholder opinions, taken together, these definitions of school readiness reflect the need for competency in a number of areas to increase the child’s chances of positive adaptation to school. Therefore, a multidimensional conceptualisation of school readiness is appropriate.

Doherty’s (1997) review of the school readiness literature identified the developmental domains most commonly used to define school readiness: cognition and general knowledge; language use; social knowledge and competence; emotional health; and physical wellbeing and motor development. These domains are commonly accepted

indicators of child development at school entry age (e.g., National Institute of Child Health and Human Development, 2002), and have been linked to health and wellbeing outcomes in later life (e.g., Hertzman, Power, Matthews, & Manor, 2001). These five developmental domains are also reflected in the national school readiness measure used in Australia, the Australian Early Development Census (AEDC). The AEDC is the Australian adaptation of the Early Development Instrument (EDI; Guhn, Gadermann, Almas, Schonert-Reichl, & Hertzman, 2016; Janus et al., 2007), which has been used extensively in Canada over a number of years for population-level assessment of school readiness. The AEDC and the EDI differ from historical assessments of school readiness in that they are population-based and multi-dimensional, and the outcomes of the assessment are not intended for evaluation of the school readiness of individual children. The AEDC is the school readiness measure used in this thesis.

The Australian Early Development Census.

Both the AEDC and the EDI are teacher-reported measures of children's development in the first year of formal schooling, and provide an indication of how well communities (and the families within them) are preparing children for the transition to school. The EDI was first trialled in Australia in 2002 as a tool to assist in policy formulation and program development relevant to improving early childhood outcomes (Sayers et al., 2007). Following this pilot study, a rigorous scientific process was undertaken to determine the applicability of the EDI in an Australian context (see Goldfeld, Sayers, Brinkman, Silburn, & Oberklaid, 2009). Subsequently, the Australian Federal Government committed funding for the census to be undertaken every three years, and the first national collection of the AEDC was carried out in 2009. This first national collection of the AEDC captured 97.5% of the estimated Australian population of children commencing school in that year. The data collected in Western Australia (WA) in the 2009 collection are used in this thesis. Further details on the development and use of the

AEDC/EDI are provided in Chapter 2.

The EDI was explicitly designed as a population measure in order to preclude its use for program, placement, entry, or retention decisions for individual students (Guhn, Gadermann, Hertzman, & Zumbo, 2009; Guhn, Janus, et al., 2007). Likewise, the AEDC is not intended for use as a screening measure; rather, it is intended to provide a population-level snapshot of the developmental ‘health’ of Australian communities. The emphasis of the measure is on assisting communities in preparing children for the transition to school, as opposed to strictly making children ‘school ready’ (Goldfeld et al., 2009). The AEDC evaluates children’s development in the five domains of: 1) physical wellbeing; 2) social competence; 3) emotional maturity; 4) communication skills and general knowledge; and 5) language and cognitive skills. Children who have achieved competence in all five of these developmental domains are considered ‘ready’ to benefit from the opportunities school provides (Guhn & Goelman, 2011; Janus & Offord, 2007). As a population census, the AEDC can be linked with other sources of population-level data to enable analysis of antecedents and consequences of risk events in early childhood, and their associations with school readiness outcomes. As such, examination of the AEDC scores of particular populations can help to build the evidence base on how ready those populations are to benefit from the opportunities, and respond to the challenges, that the school environment presents (Guhn & Goelman, 2011). This information can then be used to stimulate discussion around programs and policies to support child development (Janus & Offord, 2007).

It must be acknowledged that the conceptualisation of school readiness used in this thesis comes from a predominantly Western perspective, in that the abilities included in the school readiness measure are those that are considered important for achieving success in a Western educational context. As such, the measurement and interpretation of school readiness in this thesis is conducted within the context of Western social and cultural

norms regarding what is important for school adaptation. Given that employment prospects for adults in Australia are largely influenced by the education level an individual has achieved within the Western education system, measuring how children are developing in areas necessary for success in a Western educational context is one important litmus test of how well communities are raising their children. However, this is not the only measure of how well communities are raising their children, as the characteristics considered indicative of positive child development may vary across ethnic, cultural, and ideological groups. Although the AEDC is limited in this way, the utility of the measure in capturing a snapshot of the early developmental outcomes of children at the population level is fundamental to informing policy focused on improving early education, development, and care. When merged with other sources of population-level information, investigation of characteristics of particular population sub-groups further enhances the utility of the measure for informing policy. This thesis capitalises on these strengths of the measure, whilst recognising the limitations of the definition of school readiness encompassed by the measure.

Links between School Readiness and School Outcomes

A number of studies have shown that school-entry abilities reliably predict academic achievement in both later elementary school and high school, independent of sociodemographic factors. Consistent with conceptual models of school readiness, a broad range of abilities are associated with later school outcomes. For instance, cognitive school readiness is consistently shown to strongly predict later academic achievement (Davies, Janus, Duku, & Gaskin, 2016; Duncan et al., 2007; Forget-Dubois et al., 2007; Kurdek & Sinclair, 2001; La Paro & Pianta, 2000; Pagani et al., 2010). An association between early motor skills and socio-emotional abilities and later academic achievement has also been reliably demonstrated (Brinkman et al., 2013; Davies et al., 2016; Downer & Pianta, 2006; Oberle, Schonert-Reichl, Hertzman, & Zumbo, 2014; Pagani et al., 2010; Sabol & Pianta,

2012). However, there is some evidence to the contrary, in that the contribution of non-cognitive capacities to academic outcomes becomes non-significant once cognitive factors are taken into account (Claessens, Duncan, & Engel, 2009; Duncan et al., 2007). Thus, although there is strong evidence that early cognitive abilities are related to later academic achievement, there is currently no consensus as to whether non-cognitive abilities also influence educational trajectories.

School success depends on a range of factors (Diamond, 2010), but in the Western educational context there is a tendency to over-emphasise tests of academic abilities. Research indicates that children's social, emotional, and behavioural adjustment at school entry may be as important for future school success as is cognitive and academic readiness (Raver & Zigler, 1997). Social and emotional abilities at school entry predict both later academic and social competence (Davies et al., 2016; Forget-Dubois et al., 2007; Guhn et al., 2016; Webster-Stratton & Reid, 2004). For instance, early social, emotional, and behavioural problems are risk factors for academic underachievement, school dropout, and antisocial behaviour (Brody et al., 2003). Children who have difficulty paying attention in class, following directions, interacting with peers and adults, and regulating their behaviours and emotions do less well in school (Ladd, Kochenderfer, & Coleman, 1997). Evidence also suggests that peer relationships are important for fostering classroom engagement, which in turn is associated with higher achievement (Ladd et al., 1999). Early social and emotional abilities may therefore influence school success through other means besides academic achievement. Fundamentally, there is still much to be learned about how school readiness relates to later school success or failure, in the many ways it can be defined.

There is evidence that any developmental vulnerabilities children are experiencing at the start of school may be compounded by the school environment (Bracey, 2003). In the first year of school children are 'sorted,' that is, they are compared to their peers on

perceived levels of competence in academic, social, behavioural, and physical abilities, and then treated accordingly (Entwisle & Alexander, 1999). Teacher perceptions of children's ability can influence academic trajectories through teacher behaviours and decisions that sustain relative performance levels (Pianta, Rimm-Kaufman, & Cox, 1999; Stipek & Ryan, 1997). Furthermore, children who have a clear understanding of what is expected of them in school, have a belief in their capacity to meet these expectations, and feel a sense of control over their success in school perform better on tests of cognitive ability, are more engaged with school, and achieve higher scores on academic tests (Skinner, Wellborn, & Connell, 1990). On the other hand, children who do not see themselves as competent in the school setting will tend to withdraw from classroom activities, lose motivation, and view school negatively (Alexander, Entwisle, & Horsey, 1997), which may ultimately lead to disengagement from school (Rumberger, 2001). Evidence of variability in trajectories from school entry to later achievement suggests that these associations are probabilistic rather than deterministic (Lloyd, Irwin, & Hertzman, 2009). It is reasonable to assume then, that factors that influence school readiness may be appropriate targets for prevention and intervention strategies for improving long-term educational outcomes.

Using Data Linkage for School Readiness Research

The principle of progressive universalism advocates for the provision of support for all children, with more intensive services provided to those in greater need. One of the key challenges in the provision of targeted interventions to improve early developmental and educational outcomes, however, is the identification of children and families who are most in need of such services (Lynch, Law, Brinkman, Chittleborough, & Sawyer, 2010). Most of the research conducted on early child development has utilised large-scale longitudinal survey methods, or small-scale psychometric testing. These studies have provided important findings on several child, parent, family, and community factors that

are associated with developmental and educational outcomes. However, these findings are limited in their utility for identifying groups to be targeted for intensive services, as they are often based on small and/or biased samples, due to issues with recruiting and retaining participants from the highest risk groups (Jutte, Roos, & Brownell, 2011). Linked administrative data present an opportunity to address this issue by enabling investigations at a population level, rather than relying on opt-in recruitment; thus, enhancing the potential to identify groups in need of intensive services (Jutte et al., 2011).

Administrative data are collected by government agencies for their own practical and clinical purposes, and can then be de-identified and made available for research. Data are primarily collected at the population level, and so, research may be conducted with very large samples, across all socioeconomic strata (Brownell et al., 2016; Jutte et al., 2011). The linking of disparate administrative datasets facilitates the merging of information across a range of domains, such as health, education, and welfare, thus creating the capacity to examine numerous outcomes within the same cohort of individuals (Jutte et al., 2011). As administrative data are collected prospectively, research into life-course factors is also possible. Linked administrative data facilitate research into high risk groups, such as people in contact with child welfare, criminal justice, and mental health services, who are often not adequately captured using survey methods, due to non-inclusion in research or loss to follow-up (Jutte et al., 2011). When these data are merged with population-level measures of developmental outcomes, such as the AEDC, they provide a rich resource of information for examining the antecedents to, and consequences of, poor readiness for school. This methodology, therefore, can greatly enhance our capacity to identify the characteristics of children and families most in need of intensive services. This thesis uses data linkage to merge AEDC data with administrative and registry data from a range of government and non-government agencies, to investigate groups of children who may be at risk of poor school readiness.

Although administrative data provide many benefits, research using this methodology can be limited by a lack of person-level information. In the preceding literature review several child-, parent-, and neighbourhood-level factors were identified as important influences on early child development. Many of these factors are best captured by survey methods and psychometric testing. Factors such as child temperament, parent-child relationships, parenting behaviours, social support networks, and neighbourhood collective efficacy, are not captured by administrative data. Collection of these measures at a population-level would be prohibitively expensive. Consequently, this thesis is restricted to an investigation of factors relevant for early child development and school readiness that can be captured at the population-level. Despite this limitation of data linkage, it is an important method for investigations into the outcomes of relatively “hidden” populations, thus complementing other methodologies for early childhood research.

The Current Research

The review of the literature presented herein indicates that early childhood experiences play a crucial role in shaping educational trajectories. These experiences may come in the form of isolated or repeated events, enduring circumstances, or provision and/or absence of opportunities to learn and grow. When children commence school, they are quickly exposed to lessons regarding what is expected of them in the school environment. Whether children’s interactions with and within their environment are successful will be based on the characteristics of the child, his/her family, and the school context, as well as the community in which the child’s home and school are located (Dockett & Perry, 2009). In turn, schools must be ready to support the development of children who have varied experiences prior to the start of school (Dockett & Perry, 2009), as children’s experiences at school can play a critical role in determining how children and families engage with school (Meisels, 1999).

This thesis uses a family-centred ecological lens to examine the association between adverse events in early childhood and children's developmental vulnerability at school entry. This perspective recognises the importance of the family context in shaping developmental outcomes. Furthermore, this thesis acknowledges the influence of neighbourhood and broader social structure factors on the ways in which families can support the development of their children. The research advances knowledge concerning the risk factors for poor school readiness by investigating experiences occurring in the early childhood period that have the potential to significantly impact on the interactions between the child and the people and objects within his/her proximal context. Each of the factors included in the research was identified from existing evidence on risk factors for child development, and operationalised using administrative data. These include both sociodemographic factors (e.g., child gender, ethnicity; parent age, marital status; neighbourhood SES), and adverse experiences occurring during the early childhood period that are captured by contacts with government agencies. These adverse experiences include topics of a highly-sensitive nature, such as parental criminal involvement and child maltreatment, which are difficult to examine using other methodologies that use opt-in recruitment. The research presented in this thesis, therefore, demonstrates the utility of administrative data to supplement person-level and survey measures to develop a comprehensive understanding of the multi-level influences on early child development.

The overall goal of this thesis was to use linked administrative data to investigate antecedents to developmental vulnerabilities at school entry, to identify groups of children who may benefit from additional support during early childhood to prepare them for the school transition. This goal was broken down into two main aims. The first aim was to investigate the association between school readiness, as assessed by the AEDC, and later school outcomes, to identify the potential consequences of developmental vulnerabilities at school entry. The results of this investigation are reported in Chapter 3. Additionally,

this thesis aimed to examine characteristics of the bioecological environment that may be associated with poor early childhood development, and therefore reduce children's readiness for school. This involved investigation of the relationships between school readiness and: child and parent chronic illness; parental mental illness; child maltreatment; and parental incarceration. These investigations also take into account child-, parent-, and neighbourhood-level sociodemographic characteristics. The results of these analyses are presented in Chapters 4-8. Detailed information about data sources and methodology are presented in Chapter 2. The final chapter of this thesis (Chapter 9) presents a general discussion of the findings, the strengths and limitations of this research, as well as the theoretical, clinical, and policy implications of the research findings, and suggestions for future research.

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Chapter 2 - Methodology

This chapter outlines the overarching methodology for the thesis, including information on data linkage, data sources used, data preparation methods, and sample characteristics.

Overview of the Current Research

The research that comprises this thesis is part of the Developmental Pathways Project (DPP), a collaboration between the Telethon Kids Institute, The University of Western Australia, and thirteen departments and agencies within the Government of Western Australia (WA): the Departments of Health, the Attorney General, Child Protection and Family Support, Local Government and Communities, Corrective Services, Education, Housing, Aboriginal Affairs, and Treasury; the Disability Services Commission; the Mental Health Commission; the School Curriculum and Standards Authority; and the WA Police (Stanley, Glauert, McKenzie, & O'Donnell, 2011). The project has been underway in Western Australia since 2005. The overall aims of the DPP are to facilitate population-level data linkage across the aforementioned departments and other partner agencies; to use these data to describe the socioeconomic, geographic, and racial differences in a range of developmental outcomes; and to investigate inter-generational and socioecological determinants for those developmental outcomes. The collaboration encourages communications between researchers, policy makers, and community members regarding the developmental pathways towards adverse outcomes for children and youth in WA.

The main source of data used for research within the DPP is administrative in nature: each time an individual comes into contact with a particular service, such as a birth, hospital admission, or death, administrative information is captured. This information is routinely collected by government agencies, and although its primary use is not intended for research, when merged across multiple government agencies,

administrative data provide a rich resource of information that can be used to evaluate outcomes over time. The current project uses data made available through the DPP by the WA Data Linkage Branch (DLB) in the WA Department of Health (DoHWA). These population-level administrative data are linked at the individual level and merged across the different departments and agencies to enable investigation of the relationships between early child development and later childhood outcomes. The WA population has been shown to be representative of the Australian national population on key sociodemographic and health economic indicators (Clark, Preen, Ng, Semmens, & Holman, 2010); therefore, results of investigations are considered applicable Australia-wide.

This chapter provides an overview of the data linkage methodology used in this project, as well as a description of the data sets used. Subsequent chapters include ‘Methods’ sections specific to the different research questions of each study comprising this thesis, providing additional information on sample characteristics and variables relevant to each study.

Data Linkage

Data linkage is defined as “the bringing together from two or more different sources, data that relate to the same individual, family, place or event” (Holman et al., 2008 p. 767). It involves the linkage of administrative data that are collected by government agencies for clinical and administrative purposes, such as birth records, hospitalisations, and mortality records. Such records may also be linked to records reflecting access to social services, including, but not limited to, education, child protective services, and participation on the electoral roll. These data are generally collected at the population level, and can be made available for research across a wide range of domains. The next sections describe the method of data linkage employed in WA, and the strengths and limitations of research using linked data.

The Western Australian Data Linkage System

The Western Australian Data Linkage System (WADLS) has been in operation since 1995, and includes the linkage of individuals' records from the WA Government departments and agencies mentioned above, as well as other databases and registries made available for linkage. Linkage is carried out by the DLB. The administrative data available for linking includes records that refer to the same event for the same individual (e.g., records referring to admission, medical procedure, discharge); or they may be records referring to different events for the same individual (e.g., birth record, school attendance). Data in the WADLS are linked based on names, addresses, date of birth, and gender, and if available, the unique medical record number (UMRN) assigned to every individual with a record in the DoHWA data collections. The data linkage procedures employed by the DLB are considered best practice (Kelman, Bass, & Holman, 2002), and involve a probabilistic matching approach, which consists of four steps. In the first step, the data are 'blocked,' whereby records are sorted based on either the UMRN or by alphabetical listing. During this phase, techniques such as phonemic compression of names may also be undertaken to take into account possible misspellings. These techniques allow for the greatest probability of two or more records matching in a later step. The second step consists of 'matching,' where the probability of records referring to the same individual is calculated based on characteristics such as the UMRN, surname, first name, date of birth, gender and address. The probabilities for a match must meet a predetermined threshold before a link between the records is established. Any records that do not result in an exact match are then submitted to clerical review (Holman, Bass, Rouse, & Hobbs, 1999). The process of clerical review has been shown to reduce the error rate of matching to less than 0.1%. Once matches have been established, individuals within the datasets are assigned a unique encrypted identifier ('linkage key'), which can be used to link records across different datasets.

Administrative data in WA are collected without consent, as permitted under national and state-based privacy legislation relating to secondary use of data for monitoring and research (National Health and Medical Research Council, 2000). Obtaining individual consent is impractical for population-level data; consequently, linked data are de-identified to conserve individuals' privacy. This involves separation of personal identifiers (e.g., name, address) from service information (e.g., hospital admissions, academic test scores). Only the responsible data custodians are ever in possession of both individually identifiable information and service details. Personal identifiers are only used in the initial linkage stage to produce the linkage key file, and the individuals responsible for linkage never have access to service information. Personal identifiers are deleted once the linkage key file has been created, as only the encrypted linkage keys are needed for extraction of the data (Kelman et al., 2002). Researchers are provided with the service information and corresponding linkage keys, with all identifying information removed. By default, dates of birth are provided to researchers as month/year only; special application must be made for full date of birth, and are considered on a case-by-case basis. Furthermore, data are only provided to researchers after research proposals have undergone rigorous reviews by institutional ethics committees, and permission for release of data is provided by relevant data custodians. These processes ensure confidentiality and ethical practice by conserving the privacy of individuals whose data have been linked. Investigations using such data have returned a significant number of research findings that have resulted in policy reforms and changes in clinical practice, thus demonstrating the potential public good that may arise through the utilisation of these data (Brook, Rosman, & Holman, 2008).

Once approvals for the project have been obtained, the DLB provides all data custodians with a mapping file, which enables matching of the local identifiers used in each agency's dataset to the newly created linkage key, which is common across all

datasets for the project (Kelman et al., 2002). Data custodians use this linkage key mapping file to extract data that is within the parameters specified in the approved data application. The DLB then facilitates the transfer of data from custodians to researchers. It is the researchers' responsibility to then merge the different datasets together using the linkage keys. Researchers are thus the only people to ever have access to the complete linked data file that includes all information from the disparate agencies (with identifying information removed).

Western Australian Family Connections Genealogical System.

The WA Family Connections Genealogy System stores parent-child links for WA births dating back to 1974. It is a supplementary system to the WADLS, but is governed by the same structures and privacy requirements as the WADLS (Glasson et al., 2008). Parent-child links are made using information from birth registrations and midwife records; consequently, only biological family connections can be made. No information is included on divorce, adoptions, or other care arrangements. Moreover, family connections links cannot be made for individuals born outside of WA and/or those who do not come in contact with any of the aforementioned government agencies that provide their administrative data for linkage. Missing father-child links may also occur when paternal information in the birth registration record is either incomplete or missing (Glasson et al., 2008). Thus, parent-child links are available for children born within WA, and for families who have migrated/immigrated to WA and subsequently came into contact with one of the government agencies included in the WADLS. Researchers are provided with a separate 'mapping file' that includes the linkage key for the child matched to a corresponding parent linkage key (one each for mother and father, where available). These matched linkage keys allow merging of child and parent information across datasets.

Strengths and Limitations of Linked Administrative Data

There are several strengths in using linked administrative data for research

purposes. These data provide large sample sizes and allow population-level analyses of a wide range of research questions (Jutte, Roos, & Brownell, 2011). Administrative data are particularly useful for longitudinal research, as they generally enable tracking of individuals from the pre-natal period until death (except in the case of migration/immigration/emigration). Tracking of individuals over time is enhanced by the use of administrative data, as there is no requirement to locate and contact individuals, then persuade them to maintain engagement in the research (L. L. Roos, Nicol, & Cageorge, 1987). It is a comparatively inexpensive method, as data are already routinely collected by government agencies. When multiple datasets containing whole of population information are linked (e.g. birth registrations, academic testing), it is even possible to identify the characteristics of individuals who are not captured in service events. For instance, linked administrative data have been used to describe the characteristics of students who were eligible for academic testing, but absent on the day of test (N. P. Roos et al., 2006; Wong, O'Donnell, Bayliss, Fletcher, & Glauert, 2016); and the characteristics of families more likely to have missing father information on the birth record (Sims & O'Donnell, 2015). Administrative data, therefore, have significant value in capturing information on high-risk groups that may otherwise be omitted from research.

Administrative data also facilitate research with high-risk groups by enabling investigation of highly sensitive information (e.g., criminal convictions, maltreatment allegations), whilst protecting the anonymity of individuals (Jutte et al., 2011). Administrative data are particularly useful for including individuals from high-risk groups in samples, as these individuals are generally not adequately engaged and/or sustained in research. This method addresses the issue of sample bias that can affect other methodologies that use opt-in recruitment (Jutte et al., 2011). Linking datasets across multiple government agencies also enhances the capability to investigate factors from multiple levels of influence: child, family, and neighbourhood. Although population level

administrative data do not capture the level of detail that may be sourced from survey data, it is a method that is free of some of the biases that typically affect survey data (e.g., socially desirable responding). Linked longitudinal administrative data also facilitate investigations into antecedents and consequences of particular events, and do not have to rely on an individual's recall to capture this information (Jutte et al., 2011). These datasets provide decades-worth of data on entire populations across a range of domains, thus enabling research into factors that can influence development across the life-course. Combining administrative data with person-level outcome measures (e.g., educational achievement) can therefore provide a rich resource of information for investigations into risk factors for poor developmental and educational outcomes.

Despite the strengths of administrative data, some limitations should also be noted. First, individual-level demographic information may not be collected, such as income, education level, or occupation, with area-level estimates of socioeconomic status based on census data more commonly collected (Jutte et al., 2011; L. L. Roos et al., 2008). Ethnicity can also be unreliably recorded in administrative data. For example, previous investigations have found that in the hospital setting, ethnicity is often populated from previous records, meaning that any errors in the recording of ethnicity at the first hospital presentation are carried forward to subsequent presentations (Christensen et al., 2014). Alternatively, judgements of ethnicity may be made by the person completing the form based on physical attributes of the patient; or the information is simply not recorded. As such, adjustments must be made to the data to account for missing, incomplete, or incorrect information. However, this limitation may be addressed by linking multiple datasets containing the same demographic fields, which enables comparison of demographic information from multiple sources, thus increasing the probability of accuracy in determining demographic information (Christensen et al., 2014).

Second, variables within administrative datasets are designed for administrative

and clinical purposes, and information that would be desirable to supplement these data for research purposes may not be available (Jutte et al., 2011; L. L. Roos et al., 2008). Also, variables often have to be re-coded to be meaningful for research. In addition, administrative data do not generally include information on potential mediating or moderating variables, such as parenting behaviours, quality of social supports, or health behaviours (Jutte et al., 2011; L. L. Roos et al., 2008). Causal relationships between variables can generally not be ascertained as administrative data are correlational. Finally, the nature of administrative data means that it is only possible to capture individuals who have come into contact with a service (Brownell & Jutte, 2013). This may mean that study samples contain some selection bias, as the sociodemographic profile of individuals who come into contact with, for example, hospitals or child welfare, may be different to those who do not come into contact with those services. However, this limitation is not unique to administrative data: survey data can also be limited by selection bias in that individuals from particular population groups can be over- or under-represented in study samples. In sum, whilst data linkage facilitates research into high-risk populations utilising population-level longitudinal data, there are some limitations to this method which should be considered when drawing conclusions from research using linked data.

Methodology for the Current Research

Datasets Used in this Thesis

The infrastructure of the WADLS consists of datasets provided by a number of WA and Commonwealth Government Departments, as well as research databases. A description of the datasets used in this thesis follows.

Western Australian Department of Health.

Midwives Notification System.

The Midwives Notification System (MNS) is an extensive record of births of live and still born babies over 400 grams in weight or of at least 20 weeks' gestation, occurring

in WA since 1975. Information is recorded by the attending midwife at all hospital or home births in WA. Data in the MNS are validated by quality checks during data entry and data uploading, as well as periodic audits of random selections of hospital charts (Holman et al., 1999). The MNS collects information about the mother, including demographic details (e.g., age at time of birth, marital status, ethnic origin), details regarding previous pregnancies (e.g., number and outcomes of previous pregnancies, mode of delivery of previous pregnancies), and details of the current pregnancy (e.g., whether the mother smoked during pregnancy, if the mother had any medical treatments for the pregnancy). Information about the newborn includes birth date, birth weight, gestational age, gender, plurality, length of the baby, as well as details of any complications during pregnancy and labour. In this project, data from the MNS were used as the primary source of demographic information on children and parents for all empirical studies (Chapters 3-8).

Hospital Morbidity Data Collection.

The Hospital Morbidity Data Collection (HMDC) contains inpatient hospital records from public and private acute hospitals, public and private psychiatric hospitals, and private day surgeries. Records date back to 1970, and are structured around the notion of a patients' 'episode of care'. Each record consists of information relating to an admission, including any clinical procedures conducted, diagnoses given, and the mode of discharge or separation from hospital. Frequent quality checks and periodic audits of random selections of HMDC data are carried out to enhance the accuracy of data provided by hospitals (Holman et al., 1999).

Clinical codes in the HMDC are coded according to the International Classification of Diseases (ICD; World Health Organization, 1990). Different editions of the ICD have been used over time, however for this project, which utilised data from 2002 onwards, clinical information was classified per the 10th Edition, Australian Modification (ICD-10-AM; National Centre for Classification in Health, 2004), which has been in use in the

HMDC since July 1999. Clinical and procedural codes are available in the form of the principal diagnosis for the episode of care (i.e., the diagnosis that has been identified to be the cause of the hospitalisation), co-diagnosis of that episode of care (i.e., the code representing a condition associated with the principal diagnosis, and which may explain the relationship between principal diagnosis and subsequent additional diagnoses), and up to 20 additional diagnoses (i.e., conditions or complaints that either co-exist with the principal diagnosis, or arise during the current episode of care). The dataset also includes ICD-10-AM codes relating to external causes of injuries and locations injuries were acquired. Admission date, separation date, and total number of days spent in psychiatric care are also captured in this data set. Demographic information collected in the HMDC includes date of birth, gender, Aboriginal status, country of birth, and marital status. In this project, HMDC data were used for identifying child chronic illness (Chapter 4), parental chronic illness (Chapter 5), and parental psychiatric hospitalisations (Chapter 6).

Emergency Department Collection.

The Emergency Department collection includes information on all presentations to emergency departments of public hospitals in WA, as well as emergency department activity in private hospitals under contract with the WA Government. Records in this collection date back to 2002. Information recorded includes primary diagnosis (when applicable), coded per ICD-10-AM; and demographic information including date of birth, gender, Aboriginal status, and country of birth. Emergency Department data were used in this project (in conjunction with data from the HMDC) to identify diagnoses of child chronic illness (Chapter 4), and parental chronic illness (Chapter 5).

Western Australian Cancer Registry.

The WA Cancer Registry has recorded population-based cancer data since 1982. The registry is under the operation of the DoHWA, and information is primarily obtained from pathologists, haematologists, and radiation oncologists. Notification of cancer cases

to the register is mandatory within 30 days of diagnosis. Supplementary information is also included from death registrations and hospital records. The dataset includes details such as cancer type and site, year of diagnosis, and whether the cancer resulted in death. Demographic information is also recorded, including gender, date of birth, Aboriginal status, and country of birth. WA Cancer Registry data were used to identify child and parent cancer diagnoses, relevant to analyses presented in Chapters 4 (child chronic illness) and 5 (parental chronic illness).

Western Australian Register of Developmental Anomalies.

The WA Register of Developmental Anomalies (WARDA) is a DoHWA data collection that brings together the WA Birth Defects Registry and the WA Cerebral Palsy Register to record and monitor developmental anomalies. WARDA contains information on babies and children diagnosed with a developmental anomaly before 6 years of age. These records have been collected since 1980, and the reporting of developmental anomalies has been mandated in WA since 2011. Reports must be made within 6 months of the diagnosis of a developmental anomaly, and are made by the doctor making the diagnosis, or the chief executive officer of the hospital in which the diagnosis is made. Information collected includes details on the type of diagnosis, and demographic information on the child and parents, including date of birth and gender. WARDA data were used to identify children in the study population who had a diagnosed developmental disability. These children were excluded from analyses to limit the potential for confounding developmental outcomes with pre-existing developmental conditions.

Department of the Attorney General.

Birth Registrations.

Registration of births is a statutory requirement for all babies born at least 20 weeks in gestation or over 400 grams in weight. Birth registrations are required if the child was born in WA, if a court has ordered the birth to be registered in the State, or if the child

was born *en route* to WA. The *Births, Deaths and Marriages Registration Act* (The Act; Department of the Attorney General, 1998) states that births must be registered within 60 days by means of a form provided by the hospital or midwife. The Act also requires both parents to sign the form, but accepts forms that are completed by one parent if it is deemed “impractical” for the other parent to sign (for reasons including death, illness, and unwarranted distress caused to obtain both parents’ signatures).

The Birth Registrations data collection contains information regarding all registered births in WA since 1974, including information on the date and place of birth of the child, and demographic information of the mother and father. Parental demographic information includes parental age, occupation, country of birth, marital status, date of marriage, and number of previous children. Data from this collection were used to supplement child and parent demographic characteristics from the MNS, and are therefore used in all empirical studies (Chapters 3-8)

Western Australian Mortality Database.

The WA Mortality Database provides information on all deaths registered in WA since 1969. It is a legal requirement that deaths are registered within 14 days of occurrence, which is usually undertaken by the funeral director. Information captured includes date of death, cause of death, and other conditions present at death. For this thesis, mortality data were only obtained for parents, and were used to identify children whose parents had died during the study period. This information was used as an exclusion criterion for the study sample when the parent-level predictors were used in analyses, to limit confounding with the outcome variable (Chapters 5, 6, and 8).

Commonwealth Department of Education.

Australian Early Development Census.

The Australian Early Development Census (AEDC) is a national census of early childhood development, which is collected on children in Government, Catholic and

Independent schools across Australia. All participating children are evaluated on five developmental domains by their classroom teacher: 1) physical health and wellbeing, 2) social competence, 3) emotional maturity, 4) communication skills and general knowledge, and 5) language and cognitive skills. Throughout this thesis, the phrases ‘school readiness’ and ‘developmental outcomes’ are used interchangeably, as the intention of the AEDC is to provide a snapshot of the developmental level children have reached by the time they commence formal schooling, in domains of development that are considered integral for school success in a Western educational context. The AEDC data collection is managed by the Social Research Centre, Melbourne, and is delivered by a collaboration between the Commonwealth Department of Education, State and Territory governments, the Royal Children’s Hospital Centre for Community Child Health in Melbourne, the Murdoch Children’s Research Institute, and the Telethon Kids Institute in Perth. The AEDC was first collected nationally in Australia in 2009, with additional collections occurring every 3 years since then. The AEDC is undertaken for all children in the first year of compulsory schooling, which in WA is called ‘pre-primary’ (the year prior to grade 1). At the time of the commencement of the current research, only the 2009 AEDC data were available for linkage. Thus, data from the 2009 AEDC collection in WA are used in this thesis.

Originally called the Australian Early Development Index, the AEDC is based on the Canadian Early Development Instrument (EDI; Janus et al., 2007). The development of the EDI was guided by social constructionist theory, which emphasises the influence of the community context on early child development; and interactionist theory, which proposes that early development is influenced by the skills, experiences, and learning opportunities the child has been afforded, as well as the goals and values of the community and school (Janus & Offord, 2007). A rigorous scientific process was undertaken to determine the applicability of the EDI in an Australian context, prior to the

national adoption of the census measure (see Goldfeld, Sayers, Brinkman, Silburn, & Oberklaid, 2009). This process involved adaptations of the EDI for the Australian context (e.g., changing the word “washroom” to “bathroom”), validity testing, and evaluation of the adapted EDI in 60 communities across Australia (Brinkman et al., 2007; Goldfeld et al., 2009; Sayers et al., 2007). There have also been two studies to evaluate the appropriateness of the AEDC for 1) Aboriginal and 2) culturally and linguistically diverse (CALD) populations, which have resulted in improvements to the Teacher Guidelines, such as clarification of questions and inclusion of culturally-relevant prompts and examples to guide teachers in completing the checklist (Brinkman, 2010; Silburn et al., 2009). However, it should be noted that some concerns remain regarding the appropriateness of the AEDC for these populations, due to a lack of validity and reliability analyses specifically conducted with Aboriginal and CALD participants, and an over-emphasis of checklist items on Western cultural concepts and communication in English (Li, D’Angiulli, & Kendall, 2007).

Participation in the AEDC is by means of passive consent, whereby parents may opt to withdraw their children from participation in the national collection. Consequently, there is a very high completion rate: the 2009 collection captured 99.6% of the estimated population of 5-year-old children in WA (97.5% nationally). The 2009 AEDC collection in WA also captured children across all education sectors: 99.5% of eligible Government schools; 100% of eligible Catholic schools; and 95.2% of eligible Independent schools. The AEDC is completed by teachers for all eligible children in their class. Teachers are given temporary relief time during the second half of semester one of the academic year (May – July) to complete the AEDC checklist. Teachers are instructed to complete the checklist items based on their knowledge about, and observations of, children in their class. Checklists can only be completed for children the teacher has known for at least 1 month. Teachers are provided with a comprehensive guide and training video that provide

detailed response criteria for completion of the checklist items. Checklists are completed via a web-based data entry system, which enables rapid data uploading and downloading, ensures security of data, and minimises costs (Goldfeld et al., 2009).

The AEDC checklist includes 104 items in total (Janus, Brinkman, & Duku, 2011; Janus & Offord, 2007). The physical health and wellbeing domain consists of 13 items, measuring preparedness for the school day, physical independence, and gross and fine motor skills. The social competence domain consists of 26 items and measures overall social competence, responsibility and respect, approaches to learning, and readiness to explore new things. There are 30 items in the emotional maturity domain, which measures prosocial and helping behaviour, anxious and fearful behaviour, aggressive behaviour, and hyperactive behaviour. The communication skills and general knowledge domain consists of eight questions, and measures skills including effective communication, symbolic use of language, and age-appropriate knowledge about the world. Lastly, the language and cognitive skills domain includes 26 items, and evaluates children's basic and advanced literacy, interest in learning, memory, and basic numeracy. Example checklist items for each domain are provided in Table 2-1.

Table 2-1

Example Items from the Australian Early Development Census Checklist

AEDC Domain	Example checklist items
Physical Health & Wellbeing	<ul style="list-style-type: none"> • Does the child ever arrive at school hungry? • Is the child well-coordinated? • Over- or under-dressed for school-related activities? • Proficiency at holding a pen, crayon, brush? • Level of energy throughout the school day? • Daily personal hygiene?
Social Competence	<ul style="list-style-type: none"> • Plays and works cooperatively with other children at the level appropriate for his/her age? • Follows rules and instructions? • Demonstrates self-control? • Listens attentively? • Works independently? • Curious about the world?
Emotional Maturity	<ul style="list-style-type: none"> • Offers to help other children who have difficulty with a task? • Comforts a child who is crying or upset? • Gets into physical fights? • Bullies or is mean to others? • Distractible, has trouble sticking to any activity? • Impulsive, acts without thinking? • Seems to be unhappy, sad, or depressed? • Appears worried?
Communication Skills & General Knowledge	<ul style="list-style-type: none"> • Ability to tell a story? • Ability to use language effectively in English? • Ability to take part in imaginative play? • Ability to communicate their own needs in a way understandable to adults and peers? • Ability to articulate clearly without sound substitutions? • Answers questions showing knowledge of the world (e.g. leaves fall in autumn, apple is fruit)?
Language & Cognitive Skills	<ul style="list-style-type: none"> • Interested in reading (inquisitive/curious about the meaning of printed material)? • Able to identify some letters of the alphabet? • Able to write his/her own name in English? • Able to sort and classify objects by common characteristics? • Able to recognise numbers one to ten? • Understands simple time concepts (e.g., today, summer)?

Checklist responses are used to calculate a score for each child, ranging from 0 (minimum) to 10 (maximum), for each of the five domains. The Australian Government has licenced the EDI domain score calculation methods from the Offord Centre of Child Studies at McMaster University, which holds the intellectual property for these methods. Details of calculation methods are not made available to researchers, and thus cannot be detailed here. Domain scores are not calculated for children aged outside the expected age range (younger than 4 years or older than 7 years); for whom teachers have completed less than 75% of the items for a domain; and who teachers have classified as ‘special needs’, based on diagnosed physical and intellectual disabilities (as documented on the child’s school enrolment record). All eligible children are given a continuous domain score (0-10) and a category score (1-4) representing the percentile within which the child’s domain score falls. Percentiles are calculated based on national data, and determine the classification of a child’s domain score as ‘developmentally vulnerable’ (scores in the lowest 10%, category 1), ‘at-risk of vulnerability’ (scores in the lowest 11-25%, category 2) or ‘on track’ (scores in the top 75%, categories 3 and 4). It is the view of the developers of the EDI that children require competence (i.e., an ‘on track’ category score) in all five of the developmental domains to be ‘ready’ to benefit from the opportunities school provides (Guhn & Goelman, 2011; Janus & Offord, 2007).

The EDI domains show strong internal consistency, with alpha values greater than the recommended .70 demonstrated in a number of studies (Andrich & Styles, 2004; Forer & Zumbo, 2011; Janus & Offord, 2007; Janus, Walsh, & Duku, 2005). Furthermore, the EDI and AEDC have been demonstrated to possess good convergent and concurrent validity (Brinkman et al., 2007; Forget-Dubois et al., 2007; Guhn, Gadermann, Almas, Schonert-Reichl, & Hertzman, 2016; Janus et al., 2011; Janus & Offord, 2007); inter-rater and test-retest reliability (Janus & Offord, 2007); and predictive validity (Brinkman et al., 2013; Brinkman, Gregory, Goldfeld, Lynch, & Hardy, 2014; Davies, Janus, Duku, &

Gaskin, 2016; Forget-Dubois et al., 2007). Two studies have found the EDI/AEDC to have good negative predictive validity but poor positive predictive validity (Brinkman et al., 2007; Janus et al., 2011). Thus, the measure is poor at predicting which children have developmental difficulties of a level that would meet criteria for a diagnosis, but adequate at identifying children who would not meet such criteria. This is to be expected, since the EDI/AEDC is not intended as a diagnostic tool for individual children.

De-identified individual-level data are provided in the AEDC dataset, including domain scores (continuous and categorical); sub-domain scores (vulnerable or not on each of the constructs which make up a domain); and individual item responses. The AEDC dataset also provides demographic information on the child (taken from the school enrolment record), including age at the time of test, gender, Aboriginal status, English language status, and country of birth. Information is also recorded on whether a child repeated a grade, if they have been placed in a multi-year class, and if they have a diagnosis of special needs (physical or intellectual disability). Information on the child's community of residence is also included. The child's suburb of residence is matched to the relevant Australian Bureau of Statistics (ABS) State Suburb Code (SSC; Australian Bureau of Statistics, 2011). Each SSC is assigned an index for socioeconomic disadvantage and geographic location, determined by the ABS Index of Relative Socioeconomic Disadvantage (IRSD; Australian Bureau of Statistics, 2011b) and the Australian Standard Geographical Classification (ASGC; Australian Bureau of Statistics, 2011), respectively. The IRSD is derived from census information that reflects area-level disadvantage such as low income, low educational attainment, high unemployment, and jobs in relatively unskilled occupations. Local communities are given a score ranging from 1 (most disadvantaged) to 5 (least disadvantaged). The ASGC classifies a geographical area as metropolitan, inner/outer regional, or remote/very remote, based on the access to goods, services, and opportunities for social interaction in that area. Each child is therefore

assigned an IRSD and an ASGC for their local community of residence. Researchers can also request a school code for the AEDC data, which enables identification of children attending the same schools. This dummy-coded variable does not include any identifying information on the school.

AEDC domain data were used as predictor variables in Chapter 3, and outcome variables in Chapters 4-8. Demographic information from the AEDC dataset was also used to supplement information obtained from the MNS and Birth Registrations, which was relevant to all empirical chapters (Chapters 3-8). School code was used in Chapter 3 to group children for analyses, and to identify children who had moved schools between pre-primary and grade 3.

Western Australian Department of Education.

School attendance and suspensions.

The WA Department of Education collects school attendance data for all students enrolled in Government (public) schools in WA, as well as information on any periods of suspension a child has had. Records date back to 2008. Attendance is recorded as the rate of half-day attendance in semester one of each school year, which is the national reporting standard. Authorised and unauthorised absences are recorded separately. Attendance rates are recorded for each year a child is enrolled in a WA public school. Data on school suspensions includes the year level of the suspended student, the number of days suspended, and the total number of suspensions. Both datasets also include demographic information on the child, including sex, ethnicity, and date of birth. Attendance and suspension data were used as outcome variables in the study reported in Chapter 3.

National Assessment Program – Literacy and Numeracy.

The National Assessment Program – Literacy and Numeracy (NAPLAN) is a series of assessments that are administered nationally in May of each year to school aged children in grades 3, 5, 7 and 9 in five areas: 1) numeracy, 2) reading, 3) writing, 4)

spelling, and 5) language conventions (grammar and punctuation). Records date back to 2008, when Australia moved from State-based assessments of children's academic ability, to the national assessment. Data from the grade 3 NAPLAN conducted in 2012 are used in this project.

NAPLAN is conducted within all Government, Catholic, and Independent schools across Australia. Participation in NAPLAN is expected of all Australian students; however, parents can request that their child be exempt from testing if the child has a significant disability, or if they are from a non-English speaking background and have been residing in Australia for less than 1 year prior to the date of testing. Parents may also make a formal request to withdraw their child/ren from testing based on religious beliefs or philosophical objections. In 2012, the average participation rate in grade 3 NAPLAN was 95% of the total number of enrolled students in WA.

Tests are conducted at school and administered by teachers, school deputies, or principals. Testing is done in short testing sessions over 3 consecutive days. Questions are either multiple-choice or short answer, and are curriculum based. The NAPLAN tests are constructed according to national education standards, and children's standardised scores on each test are compared against national benchmarks according to the age at which they complete the test (grade 3, 5, 7 or 9). A child scoring at or above the national minimum standard has demonstrated the basic literacy and numeracy skills expected of their grade level. An extensive technical report detailing statistical and psychometric methods for classifying NAPLAN data is available online at https://www.nap.edu.au/resources/NAPLAN_2013_technical_report.pdf. This report includes cut-off scores for national benchmarks for each grade level for each test.

The NAPLAN dataset includes students' standardised scores for each of the five tests, as well as information on whether the child participated in each test, and if not, the reason for non-participation (e.g., withdrew, absent, exempt, sanctioned abandonment).

Demographic information is also collected from the school enrolment record, including student gender, date of birth, year that the child completed the assessment, his/her grade level, Aboriginal status, whether they have a language background other than English, and parents' self-reported occupation and highest level of education achieved. Upon special request, researchers may be granted approval to receive a dummy-coded school identifier to group children within the same school. This identifier cannot be linked to any information on the school.

Data from the NAPLAN reading, numeracy, and writing tests were used as academic achievement outcome variables in the study reported in Chapter 4. This study also used the dummy-coded school identifier and parental education details.

Child Protection and Family Services.

The Child Protection and Family Services (CPFS) data collection dates back to 1990, and includes records of child maltreatment allegations, investigations, substantiations of maltreatment, periods of out-of-home care and placement data related to out-of-home care. Reporting of concerns of child sexual abuse is mandatory in WA for individuals in some professions (e.g., doctors, nurses, midwives, teachers) under the *Children and Community Services Act 2004*. Concerns regarding other forms of abuse (physical, emotional, psychological, and neglect) may also be reported to CPFS, but reporting of these other types of abuse is not mandatory. Reports are defined as concerns for a child's wellbeing, which is comparable to a child maltreatment allegation. All allegations undergo an initial assessment, from which a determination is made as to whether to proceed with an investigation into the report. Not all reports are investigated. Following an investigation, allegations are classed as either unsubstantiated or substantiated. Substantiated allegations are those for which the investigation has collected sufficient evidence that the child has suffered harm, or that there is a significant risk of harm occurring to the child (Steering Committee for the Review of Government Service

Provision, 2016). Determinations of the type of maltreatment are also made during an investigation. Although an investigation may determine that multiple types of maltreatment have occurred, only the primary type of maltreatment is provided to researchers accessing the CPFS data.

In the CPFS data collection, information includes details on the allegation, such as date of allegation, type of concern, outcome of the investigation, primary maltreatment category, and details of any placements into out-of-home care (i.e., placement type, relationship, duration). Demographic information is also collected from parents, including the child's gender, date of birth, country of birth, Aboriginal status, and suburb of residence. Data on allegations of child maltreatment were used in the study reported in Chapter 7.

Department of Corrective Services.

Data from the Department of Corrective Services (DCS) includes information on community service orders and custodial sentences for juvenile and adult offenders in WA, with records dating back to 1980. This information includes offence type, sentence type, and sentence duration recorded for all individuals convicted of an offence. Demographic information collected includes gender, age, date of birth, Aboriginal status, and suburb of residence. For this thesis, DCS data were obtained for parents only. Data on parents' adult and juvenile community service orders and prison terms (remand and/or custodial) were used in the study reported in Chapter 8.

Study Population

This study used a cohort consisting of all WA children with a 2009 AEDC record, and who were enrolled in grade 3 in WA in 2012 ($N = 24,348$). These children were born between 1 July 2003 and 30 June 2004. This date range aligns with the current practice of student intake in WA, under which children commence pre-primary in the year they will be 5 years old by June 30 (i.e., children who turn 5 years old between July 1 and

December 31 are eligible for pre-primary enrolment the following year). Children born between 1 July 2003 and 30 June 2004 were of eligible age to attend pre-primary in 2009, when the AEDC collection occurred. Where available, parental information was also linked, including demographics, health service use, and parental incarcerations. The percentage of parental information available for each empirical study included in this thesis is reported in the ‘Method’ section of the corresponding chapter.

A number of exclusion criteria were used to define the study population for all studies. These included: 1) children who were enrolled in pre-primary in 2009 but had missing or incomplete AEDC scores ($n = 390$); 2) children from multiple births, in which case one child from each twin or triplet set was randomly selected to be retained in the study population (excluded $n = 274$); 3) children identified by the pre-primary teacher as ‘special needs’ based on diagnosed physical or intellectual disabilities, for whom AEDC domain scores are not calculated ($n = 753$); or 4) children with a diagnosed developmental disorder (e.g., autism) or cerebral palsy in the Hospital Morbidity or WARDA datasets, but who had not additionally been identified by the teacher as ‘special needs’ ($n = 41$). Furthermore, children born outside of WA were only included for analyses for the studies reported in Chapters 3 and 4; all other analyses were limited to children born in WA. The reason for using this last exclusion criterion was because it could not be determined if children residing outside of WA prior to AEDC collection had or had not been exposed to the predictor variable, and thus, inclusion of these children could have biased the results. There was also no information available on when children had moved into the State, and so, it was determined that all non-WA born children should be excluded. In studies examining parent-level predictors (Chapters 5, 6, and 8), children whose parents had died during the study period were also excluded from analyses to limit the potential for confounding with the predictor. The final sample size used for each study is reported in the ‘Method’ section of the relevant chapter.

Data Preparation

Prior to analysis, each dataset was individually screened for duplicates and cleaned of irrelevant variables. Remaining variables were coded for use in analyses (e.g., grouping ICD-10-AM codes into major diagnostic categories; transforming alphabetic variables, such as gender, into numeric variables). Datasets were then merged using the linkage keys. Because many of the datasets had incomplete information for demographic variables, demographic information was compiled from several separate datasets. Information recorded in the MNS was used as the basis for demographic data, due to the periodic audits of this data collection conducted to ensure the validity of demographic information (e.g., Downey, 2007; Gee & Dawes, 1994). Any demographic information that was incomplete in the MNS was subsequently imputed from the Birth Registrations, and the AEDC, in order. In some cases, demographic information (gender, Aboriginal status) from the different datasets was in conflict. In such instances, determination of the most likely value for child's gender and Aboriginality was made using the method recommended by Christensen and colleagues (2014). This method uses an algorithm that adjusts for the number of different datasets an individual appears in, and in which demographic information is recorded. This algorithm follows a number of steps, first within each dataset and then across combined datasets (step-by-step details are provided in Christensen et al., 2014). In terms of Aboriginal status, each individual with at least one non-missing record for Aboriginal status within all combined datasets is given an Aboriginal status indicator.

The ways in which predictor and outcome variables were coded are outlined in each of the relevant empirical chapters. For all logistic regression analyses, child, parent, and community-level covariates were transformed into binary or continuous categorical variables, with the category representing the lowest risk coded as the reference group. As such, odds ratios can be interpreted as the odds of the outcome occurring for children with a given characteristic, relative to children for whom we would expect the lowest odds.

Determination of the groups with the lowest expected odds was made based on the extant literature on demographic risk factors for children's developmental outcomes. Some covariates were only captured at one time point, and so, were not included in all models. For example, parental education level is only recorded in the NAPLAN dataset (i.e., when the child was in grade 3), and so this covariate is only used in analyses using grade 3 data.

Statistical Analysis

Various combinations of the abovementioned datasets were used for the six studies comprising this thesis, depending on the research question. Information about specific datasets used and methods of data analysis for each project are provided in the corresponding 'Method' section of each chapter.

For all of the studies included in this thesis, AEDC scores are reported as categorical variables. This is because the distribution of the continuous AEDC domain scores was not normal, with all domains negatively skewed (see descriptive statistics in Table 2-2). Transformation of data did not improve the distribution. As such, categorical scores were used instead. This is in accordance with most other research on the EDI/AEDC, which has used the categorical variables as opposed to the continuous variables (e.g., Brinkman, Sayers, Goldfeld, & Kline, 2009; D'Angiulli, Warburton, Dahinten, & Hertzman, 2009; Forget-Dubois et al., 2007; Janus & Duku, 2007; Webb et al., 2017). Contrary to other AEDC/EDI research, however, we chose to collapse the three domain categories into two ('on-track'; 'vulnerable/at-risk'), to capture established and emerging developmental difficulties.

Table 2-2

Descriptive Statistics for Domain Scores from the Western Australian collection of the 2009 Australian Early Development Census (N=19,203)^a

AEDC Domain	<i>M (SD)</i>	Median	Skewness	Kurtosis
Physical Health & Wellbeing	9.02 (1.31)	9.58	-1.64	2.88
Social Competence	8.57 (1.62)	9.17	-1.37	1.57
Emotional Maturity	8.19 (1.54)	8.46	-1.08	1.24
Communication Skills & General Knowledge	8.19 (2.25)	9.38	-1.30	0.95
Language & Cognitive Skills	7.84 (1.80)	8.08	-1.27	1.60

^a Total sample size after exclusion criteria applied (missing domain category scores; non-singleton births; developmental disorders).

Logistic regression was selected as the preferred statistical method for analyses throughout this project, with outcome variables dichotomised to classify children as ‘at risk’ versus ‘on track.’ Treatment of the data in such a way does result in loss of variability in the outcome; however, it also has a number of practical advantages, including ease of communication with government agencies and policymakers as to which groups of children are of concern, and how these groups compare to their peers who are ‘on track.’ This method is commonly used in educational research, where benchmarking of students helps to identify students who do and do not meet minimum achievement standards. Furthermore, many the covariates of interest were either originally or practically categorical (e.g., marital status, gender, ethnicity), and predictors were often limited to a dichotomous representation based on available information (e.g., diagnosis or no diagnosis; criminal conviction or no criminal conviction). Administrative data do not generally capture information on severity of outcomes or predictors, but where feasible, additional information was used as a proxy for severity (e.g., duration of exposure). Analyses are presented as main effect models: due to the large number of covariates included in the models, this improves parsimony and reduces the risk of Type I errors or overfitting the model.

Multi-level modelling was considered for all analyses. Unfortunately, this analytic

technique was not appropriate for studies using AEDC data as the outcome variable, as the intra-class correlation coefficients demonstrated minimal variability between clusters ($r < .10$) when children were grouped by either geographical location or school. Although multi-level modelling could still have been conducted for these studies, previous analysis of the EDI has demonstrated that when using the domain categories (as opposed to the continuous scores), clustering of the data at the classroom or neighbourhood level does not add to the interpretability of the data over that afforded by using the individual-level data (Forer & Zumbo, 2011). As such, it was decided that for clarity in communicating results, non-hierarchical analyses would be used for analyses with AEDC data as the outcome variables. Multi-level logistic regression is used as the method of analysis for the study reported in Chapter 3 (which uses grade 3 NAPLAN, school attendance, and out-of-school suspensions as outcome variables), and all other empirical chapters use multivariate logistic regression.

Ethical Approval

This research received ethical approval from the Western Australian Department of Health Human Research Ethics Committee (2013/65), the University of Western Australia Human Research Ethics Committee (RA/4/1/6651) and the Western Australian Aboriginal Health Ethics Committee (551).

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Preface

The first aim of this thesis was to identify the potential consequences of developmental vulnerabilities at school entry for later school outcomes. Previous research has established that the Australian Early Development Census (AEDC) and the measure from which it is derived, the Early Development Instrument, predicts later academic achievement (Brinkman et al., 2013; D'Angiulli, Warburton, Dahinten, & Hertzman, 2009). However, there is very little research on the relationships between scores on the AEDC and other school outcomes that may influence children's relative school success or failure. Chapter 3 presents the first empirical study of this thesis, which aimed to investigate whether and to what extent children's developmental vulnerabilities at school entry were associated with three important school outcomes in grade 3: academic achievement, attendance, and out-of-school suspensions.

Chapter 3 - Developmental Vulnerabilities at School Entry Predict Early Indicators of Disengagement

Abstract

Evidence suggests that poor academic performance, frequent school absences, and/or a history of school suspensions are early indicators of school disengagement (Balfanz, Herzog, & Mac Iver, 2007; Cratty, 2012). However, it is not clear which factors predict these indicators of disengagement. This study aimed to examine whether children's developmental vulnerabilities at school entry are precursors to these poor school outcomes. We used the Australian Early Development Census scores of 22,890 Western Australian children to examine the association between children's school readiness and their grade 3 academic achievement, average school attendance rates, and out-of-school suspensions. Multilevel logistic regression models were run for each outcome, grouped by school, and adjusted for child-, parent-, and school-level sociodemographic characteristics. Children who experienced physical, social, emotional, communicative or cognitive difficulties at school entry had greater odds of achieving below the national minimum standards on grade 3 reading, numeracy, and writing tests. Furthermore, children who had physical or cognitive difficulties had greater odds of having an average school attendance rate of less than 80% by grade 3. Finally, children vulnerable on social or emotional abilities at school entry were around 3-times more likely to be suspended from school by grade 3. The results suggest that children's developmental level at school entry may influence their early school experiences. If developmental vulnerabilities are associated with low academic achievement, poor attendance, or out-of-school suspensions, children may be at risk of disengaging from school. Interventions aimed at improving children's school readiness may help to decrease the likelihood of these negative school outcomes occurring.

Introduction

The transition into school is a critical stage of a child's life, with the first year of formal schooling establishing a base from which the child cumulatively develops his/her academic and social skills (Entwisle & Alexander, 1993). This transition coincides with a period of rapid development of a broad range of skills and abilities that occurs during early childhood (Forget-Dubois et al., 2009; Garon, Bryson, & Smith, 2008). These skills form the foundation for learning (Forget-Dubois et al., 2009; Garon et al., 2008), and influence a child's prospects of success at school (Bracey, 2003; Duncan et al., 2007; Forget-Dubois et al., 2009). Students who are behind their peers on developmental outcomes at school entry struggle to catch up in later years (Entwisle & Alexander, 1993; Gonski et al., 2011), leading to gaps between educational advantage and disadvantage that are difficult to close without targeted intervention (Heckman, 2008). In recent decades, there has been an increased emphasis on the importance of children's 'readiness' for school, and how a child's developmental abilities at school entry contribute to later school outcomes. A focus on how we can improve children's chances of success in school during this early period is especially important, as it has been shown that academic achievement trajectories are largely established by grade 3 (Entwisle & Alexander, 1993). The early years of schooling are therefore an opportune time to focus efforts on preventing later academic failure.

School readiness is a holistic construct that incorporates the cognitive, behavioural, social, linguistic, physical, and emotional capacities that a child possesses at school entry, and which underlie school success (Guhn, Janus, & Hertzman, 2007). The broad range of skills included in the school readiness concept reflects our understanding that school success depends on a wide range of abilities (Diamond, 2010). For instance, the school environment places many competing demands on children, as they are required to learn, develop friendships, communicate with peers and adults, and master fine- and gross-motor activities. Children's levels of school readiness can influence how well they respond to

these demands and benefit from the opportunities provided by school (Guhn, Gadermann, & Zumbo, 2007). Children who start school with a solid base for future learning are more likely to experience early school success, which fosters school participation and engagement, and, consequently, higher achievement (Entwisle & Alexander, 1993; Finn, 1989). Children who start school not ready to learn are more likely to struggle to meet school demands (Guhn, Gadermann, et al., 2007), and may therefore become disengaged from school, reducing the likelihood of future positive school experiences (Finn, 1989). School success and school engagement are therefore unquestionably linked (Finn & Rock, 1997; Newmann, 1981).

School engagement is generally typified by compliant classroom behaviour, self-motivated learning, and participation in academic, social, and extracurricular aspects of school life (Finn, 1989; Finn & Rock, 1997). On the other hand, school disengagement is characterised by a disregard for school conventions and expectations, reduced effort and involvement at school, and a general detachment from the school community (Balfanz, Herzog, & Mac Iver, 2007). As engagement/disengagement is an internal state, inferences must be made about a student's level of engagement/disengagement based on indirect indicators. Some of the early indicators of school disengagement include poor academic achievement, frequent absences, and receiving one or more out-of-school suspensions (Balfanz et al., 2007; Cratty, 2012). The process of school disengagement occurs over a number of years, and usually culminates in early school dropout (Balfanz et al., 2007). Associations between indicators of disengagement and later school dropout have been identified as early as grade 1 (Alexander, Entwisle, & Horsey, 1997; Ensminger & Slusarcick, 1992), suggesting that children's early school experiences can have long-lasting implications for their future. The school transition is one such experience that can influence children's early engagement with school (Alexander et al., 1997). Therefore, an investigation into how school readiness relates to early indicators of disengagement is

required. Although there is a plethora of research on the association between school readiness and later academic achievement, research on how school readiness is associated with the other important indicators of attendance and suspensions is lacking. This study will be the first to investigate how school readiness relates to all three indicators of school disengagement, within a population-based birth cohort.

School Readiness and Academic Achievement

An abundance of research has demonstrated that children's abilities at school entry predict their later academic achievement. Research on the association between school readiness and later academic achievement consistently points to the importance of early cognitive abilities for educational success (Duncan et al., 2007; Kurdek & Sinclair, 2001; Pagani, Fitzpatrick, Archambault, & Janosz, 2010). It is also recognised that non-cognitive abilities such as socio-emotional competence and early motor skills are important for maximising children's potential for positive academic outcomes (Downer & Pianta, 2006; Grissmer, Grimm, Aiyer, Murrah, & Steele, 2010; McClelland, Acock, & Morrison, 2006; Oberle, Schonert-Reichl, Hertzman, & Zumbo, 2014; Pagani et al., 2010; Sabol & Pianta, 2012; Shields et al., 2001). However, some research suggests that non-cognitive school readiness makes only minimal contribution to later academic achievement once cognitive abilities have been taken into account (Duncan et al., 2007; La Paro & Pianta, 2000). Recognition of the broad range of skills required for school success is reflected in the national school readiness measure used in Australia. This measure, the Australian Early Development Census (AEDC), evaluates children on the five domains of 1) physical health and wellbeing, 2) social competence, 3) emotional maturity, 4) language and cognitive skills, and 5) communication skills and general knowledge (Table 3-1).

Table 3-1

Description of Domains Assessed for the Australian Early Development Census

Domain	Areas Assessed
Physical Health & Wellbeing	Physical readiness for school day (e.g., dressed appropriately, fed) Physical independence Gross and fine motor skills
Social Competence	Overall social competence Responsibility and respect Approaches to learning (e.g., completion of work, following instructions, adaptability) Readiness to explore new things
Emotional Maturity	Pro-social and helping behaviour Anxious and fearful behaviour Aggressive behaviour Hyperactivity and inattention
Language & Cognitive Skills	Interest in literacy/numeracy and memory Basic literacy and advanced literacy Basic numeracy
Communication Skills & General Knowledge	Communication skills and general knowledge (e.g., storytelling, imaginative play, articulation, understanding of others)

The AEDC is based on the Early Development Instrument (EDI; Guhn, Janus, et al., 2007), which has been extensively used in Canada and adapted for use in other countries. Research on the EDI and AEDC has shown that all five of the developmental domains are associated with later academic achievement. For example, one study found that being vulnerable on any one domain of the EDI was associated with lower achievement on tests of literacy and numeracy in grades 3, 5 and 7 (Brinkman et al., 2013). Another study found that each AEDC domain independently predicts grade 3 math, reading, and writing achievement, even after controlling for sociodemographic risk factors (Davies, Janus, Duku, & Gaskin, 2016). Consistent with the broader school readiness literature, scores on the language and cognitive skills domain of the EDI/AEDC have been shown to be the strongest predictor of achievement on tests of academic abilities, with the predictive relationship holding 1 year (Forget-Dubois et al., 2007), 2 years (Davies et al.,

2016), 4 years (D'Angiulli, Warburton, Dahinten, & Hertzman, 2009), and 5 years (Guhn, Gadermann, Almas, Schonert-Reichl, & Hertzman, 2016) later.

These studies have provided important evidence for the association between school readiness and later academic achievement. Although not itself a measure of school disengagement, academic underachievement is one factor associated with school disengagement (Balfanz et al., 2007; Cratty, 2012). School readiness may therefore be linked to school disengagement: if having a lower level of school readiness leads to early difficulties with academic achievement, children may struggle to catch up in later years due to the cumulative nature of the school curriculum (Entwisle & Alexander, 1998). Repeated negative early school experiences, such as underachievement, can adversely influence children's opinions about school and their own academic competence (Alexander et al., 1997), which may ultimately lead to disengagement from school (Rumberger, 2001).

School Readiness, Attendance, and Suspensions

It is also possible that school readiness is associated with later school disengagement through the influence on factors such as school attendance and suspensions. Currently there is a lack of evidence on the relationship between school readiness and these other indicators of school disengagement. This study aims to address this gap in the literature.

Attendance is used as an indicator of both school engagement and disengagement. Regular attendance at school can help sustain or improve a child's level of learning over time (Hancock, Shepherd, Lawrence, & Zubrick, 2013), fostering engagement, whereas repeated absences can have a cumulative negative impact on learning (Hancock et al., 2013), and may be an early sign of school disengagement (Balfanz et al., 2007; Cratty, 2012; Rumberger, 2001). Although preschool attendance has been identified as an important factor for improved school readiness (Magnuson, Meyers, Ruhm, & Waldfogel,

2004; Taylor, Gibbs, & Slate, 2000), the association between school readiness and subsequent attendance has not previously been investigated. It is possible that early social abilities may be associated with attendance rates, as previous research has found that children who have more friends at school develop more positive perceptions of school and consequently attend school regularly (Ladd, 1990). Understanding the reasons for early absenteeism is important, as poor attendance in first grade tends to continue or worsen in subsequent years (Hancock et al., 2013), indicating the critical need for timely intervention. It is therefore important to investigate whether school readiness is related to attendance rates in early school.

Out-of-school suspension has also been identified as an indicator of school disengagement (Balfanz et al., 2007; Cratty, 2012). Suspension from school has a multitude of serious consequences: it results in missed academic content, exclusion from educational opportunities, and disconnection from peers (Haight, Gibson, Kayama, Marshall, & Wilson, 2015), all of which are likely to make school disengagement more probable. Suspension is used for discipline in response to expression of deviant behaviours, which are often the result (or cause) of interpersonal difficulties with peers and teachers (Brantlinger, 1991; Haight et al., 2015). In addition, suspension may indicate serious behavioural issues, with higher rates of suspension for children displaying aggressive behaviours, even as early as grade 1 (Frick et al., 1993; Schaeffer, Petras, Ialongo, Poduska, & Kellam, 2003). However, empirical evidence is limited in terms of the early factors that may make young children more likely to be suspended from school. Research on older children has found that students who are suspended are more frequently those who display aggressive behaviours and are non-compliant with teacher requests (Hemphill, Plenty, Herrenkohl, Toumbourou, & Catalano, 2014). Previous research on school readiness has shown that children's social, emotional, and behavioural capacities at school entry predict later social, emotional, and behavioural competence (Guhn et al.,

2016; La Paro & Pianta, 2000; Ladd & Price, 1987). Together, these findings suggest a possible link between socio-emotional vulnerabilities at school entry and occurrence of out-of-school suspension.

Current Study

The aim of this study is to examine the association between children's school readiness and early indicators of future disengagement, as defined by academic test scores, school attendance, and out-of-school suspensions, measured within the first 4 years of formal schooling. Using children's scores on the AEDC, we first aim to replicate previous studies showing an association between school readiness, as measured by the EDI, and later academic achievement. We then aim to extend this research by examining the association between AEDC scores and attendance and suspensions. Importantly, these analyses will take into account a range of sociodemographic risk factors that may influence the relationship between school readiness and these indicators of disengagement. It is widely acknowledged that children develop within the broader context of their families and communities in which they live, attend school, and interact with other children (Bronfenbrenner, 1986; Guhn & Goelman, 2011). Therefore, we take into account the influence of multi-level characteristics of the child, parent, and school.

Based on previous research using the EDI, we expect that all AEDC domains will independently predict grade 3 academic test scores, even after adjusting for sociodemographic confounders. However, in line with research on the EDI, it is anticipated that the language and cognitive skills domain will show the strongest association with academic abilities (D'Angiulli et al., 2009; Davies et al., 2016; Forget-Dubois et al., 2007; Guhn et al., 2016). Guided by findings of related literature, we further predict that socio-emotional difficulties at school entry, as assessed by the AEDC, will be associated with both occurrence of suspensions and lower rates of school attendance.

Method

Ethics Approval

Ethics approval for this study was granted by the Western Australian (WA) Department of Health Human Research Ethics Committee, the University of Western Australia Human Research Ethics Committee, and the WA Aboriginal Health Ethics Committee.

Data Sources

This study used anonymised administrative data provided by multiple state and federal government agencies (see details below). Datasets were linked by the WA Data Linkage Branch by matching identifiers common to the sets of records (e.g., name, address etc.), using a probabilistic matching approach and clerical review (Holman et al., 2008). Only de-identified records were provided to the researchers.

Study Population

The sample included WA children born in 2003-2004 enrolled in pre-primary (the year prior to grade 1) in 2009 and grade 3 in 2012 ($N = 24,348$). Births were identified from the Midwives Notification System, provided by the WA Department of Health, and from Birth Registrations, provided by the Registry of Births, Deaths and Marriages. These datasets contain pregnancy and birth information for all children born in WA. Children were excluded from the study if they: 1) had missing or incomplete AEDC scores ($n = 390$); 2) were from a multiple birth, in which case one child from each twin or triplet set was randomly selected (excluded $n = 274$); 3) were identified by the teacher as 'special needs' in the AEDC dataset ($n = 753$); or 4) had a diagnosis of developmental disorder (e.g., autism) or cerebral palsy ($n = 41$) in the WA Health Department Hospital Morbidity dataset or the WA Register of Developmental Anomalies. Children classed as 'special needs' have a diagnosed disability (physical, intellectual) and receive special assistance in school. AEDC domain scores are not calculated for these children, since they have already

been identified as having substantial developmental needs. Children with a developmental disorder or cerebral palsy were likewise excluded to limit the potential for confounding school readiness with pre-existing developmental conditions. The final study sample consisted of 22,890 children (mean age 5.5 years, $SD = 0.29$), for whom demographic information was available for 96% of mothers ($N = 22,000$) and fathers ($N = 22,000$).

Children were grouped for analyses according to the school they attended in pre-primary. There were 808 schools with an average of 28 students per school group ($SD = 22.59$). Schools were assigned a dummy-coded alpha-numeric identifier by the WA Data Linkage Branch. All students assigned the same school ID were deemed to be in the same school.

School Readiness Measure

The AEDC has been collected every 3 years across Australia on children in their first year of compulsory schooling (pre-primary in WA, the year prior to grade 1). Children's school readiness was assessed using data from the 2009 collection of the AEDC, provided by the Commonwealth Department of Education. Teachers complete the AEDC in the first half of the academic year for each child in their class. The AEDC consists of 104 checklist items, from which a score (from 0 to 10) is calculated for each of the five developmental domains (Table 3-1). The method of calculating domain scores is the intellectual property of McMaster University in Canada. In accordance with these scoring methods, AEDC domain scores are analysed at the national level and classified into percentiles, with cut-offs based on the data collected in that year. Children who score in the bottom 10% on a domain are considered 'developmentally vulnerable' for that domain; those in the bottom 11-25% as 'at risk'; and those in the top 75% as 'on track'. For this study, these three categories were collapsed into two ('vulnerable/at risk' and 'on track') to capture established and emerging developmental vulnerability.

School Disengagement Indicators

Academic achievement.

The academic achievement data came from the National Assessment Program – Literacy and Numeracy (NAPLAN) provided by the WA Department of Education. The NAPLAN is an annual assessment of children’s academic performance undertaken across Australia in grades 3, 5, 7 and 9, and includes tests of numeracy, reading, writing, spelling, and grammar and punctuation. For this study, children’s scores on the numeracy, reading, and writing subtests were used to assess academic outcomes, as these tests focus on the skills most core to the school curriculum. Children in the study population completed the grade 3 NAPLAN in 2012, and these data were used for analyses.

NAPLAN is conducted within all Government, Catholic, and Independent schools across Australia. All Australian students are expected to participate in NAPLAN testing. Children absent on the day of testing are given an opportunity to complete the test on another day in the same week as the original test was administered. Parents may request that their child be exempt from testing if the child has a significant disability, or if they are from a non-English speaking background and have been residing in Australia for less than 1 year prior to the date of testing. Parents may also make a formal request to withdraw their child/ren from testing based on religious beliefs or philosophical objections.

Tests are conducted at school and administered by teachers, school deputies or principals. Testing is done over three consecutive days in May. Children in grade 3 are given 40-45 minutes for each testing session. Questions are either multiple-choice or short answer, and are curriculum based. Further details regarding tests and assessment are available online at www.nap.edu.au/naplan.

Children’s scores on each test are compared against national benchmarks according to the age at which they complete the test (grade 3, 5, 7 or 9). A child scoring at or above the national minimum standard has demonstrated the basic literacy and numeracy

skills expected of their year level. For the purposes of the current study, children's scores on each of the three NAPLAN tests were converted into a dichotomous indicator (at or above national benchmark; below national benchmark).

School attendance.

School attendance data were provided by the WA Department of Education. Attendance data is available only for children attending Government (public) schools, and includes individual-level information such as year of attendance and attendance rate. Attendance rates were calculated as the percentage of half days attended during the first semester of each school year, which is the national reporting standard. For the current study, attendance was measured as the attendance rate for each child averaged over all the available years of school attended in WA, up to the end of the study period. Attendance rates of less than 80% have been identified as an early risk factor for later school disengagement (Balfanz et al., 2007). As such, children in this study were classified according to whether they had less than 80% average attendance, or 80% or more average attendance.

School suspensions.

School suspension data were also provided by the WA Department of Education, and were only available for students attending public schools. Along with demographic information on the student, information recorded included year level of the suspended student and number of out-of-school suspensions. For this study, numbers of out-of-school suspensions were totalled over the entire study period (pre-primary to end of grade 3). Occurrence of one or more suspensions has been associated with higher rates of school disengagement in primary school children (Balfanz et al., 2007; Cratty 2012). For this study, children were therefore classified as 'no suspensions' or 'one or more suspensions.'

Demographic Characteristics

Selection of demographic characteristics to include as covariates was based on a review of previous literature identifying factors associated with school outcomes. All demographic variables were transformed into binary or continuous categorical variables with the category representing lower risk coded as the reference group, and included as covariates in the logistic regression models (Table 3-2).

Child-level.

Child-level covariates included gender, Aboriginality, English language status, and school mobility. These characteristics were selected based on previous research demonstrating gender and racial differences in academic achievement (De Bortoli & Thomson, 2009; Downer & Pianta, 2006; Hair, Halle, Terry-Humen, Lavelle, & Calkins, 2006; Holliday, Cimetta, Cutshaw, Yaden, & Marx, 2014; Kurdek & Sinclair, 2001; Thomson, Hillman, & Wernert, 2012) and incidence of suspensions (Haight et al., 2015; Hemphill et al., 2014; Nichols, 2004; Petras, Masyn, Buckley, Ialongo, & Kellam, 2011; Raffaele Mendez, Knoff, & Mendez, 2003). Studies have also found that children in ethnic minority groups are more likely to have lower school attendance rates than their majority group peers (Hancock et al., 2013; Romero & Lee, 2007). Lastly, research has shown that children who move schools frequently are at risk of lower educational outcomes (Pribesh & Downey, 1999).

Aboriginality is included as a covariate in the analyses not as an indicator of ethnicity per se, but rather as a proxy variable for a range of unmeasured contextual factors that Aboriginal children and their families may experience as a consequence of their minority status, and which may impact on developmental and educational outcomes (De Bortoli & Thomson, 2010). These experiences include institutional and interpersonal racial discrimination, reduced access to resources and opportunities, racial disparities in socioeconomic status, an increased incidence of psychosocial stressors, and

intergenerational impacts of trauma (De Maio et al., 2005; Priest, Baxter, & Hayes, 2012; Priest, Perry, Ferdinand, Paradies, & Kelaher, 2014; Williams, Priest, & Anderson, 2016). As such, any associations between Aboriginality and school outcomes in this study should be viewed as social rather than racial determinants.

Child-level covariates were obtained from several different datasets. Child gender and Aboriginality were obtained from the Midwives Notification System and Birth Registrations data collections. Additional child-level demographic information was obtained from the AEDC dataset. Teachers identified if children spoke English as a second language (ESL), and any missing information for Aboriginality was imputed from information derived from the child's pre-primary school enrolment record. Children who had moved schools between pre-primary and grade 3 were identified by comparing the school ID recorded for these two school years. Children who had a different school ID in the AEDC dataset compared to the NAPLAN dataset were deemed to have moved schools.

Parent-level.

Parental age (Boyle, Georgiades, Racine, & Mustard, 2007; Chen et al., 2007; Hair et al., 2006; Konold & Pianta, 2005; Romero & Lee, 2008), marital status (Cooksey, 1997; Hair et al., 2006; Romero & Lee, 2008), and education level (Boyle et al., 2007; Davis-Kean, 2005; Downer & Pianta, 2006; Hair et al., 2006; Konold & Pianta, 2005; McWayne, Cheung, Wright, & Hahs-Vaughn, 2012) have all been identified as having an important influence on children's developmental and school outcomes. We obtained parental age and mother's marital status from the Midwives Notification System and Birth Registrations, which record this information at the time of the child's birth. Highest parental education level was obtained from the NAPLAN dataset. Parental education information is recorded in two variables in this dataset: one indicating the highest secondary education level and the other indicating highest tertiary education level achieved by each parent. These

variables were combined to indicate overall highest education level (high school, vocational training, or university). The gender of the parent is not recorded in this dataset, so parents are instead identified as 'Parent 1' and 'Parent 2.'

School-level.

School-level variables were created by aggregating child-level information by school. Both school-level socioeconomic status and geographical location have been shown to be associated with student's academic achievement and attendance rates (Boyle et al., 2007; Chase-Lansdale & Gordon, 1996; Hancock et al., 2013; Okpala, Smith, Jones, & Ellis, 2000; Puchala, Vu, & Muhajarine, 2010; Sirin, 2005; Thomson et al., 2012). In the AEDC dataset, children were assigned local community socioeconomic and remoteness indices, calculated for the child's home address at the time of AEDC completion. These indices are determined by the Australian Bureau of Statistics. The Index of Relative Socioeconomic Disadvantage (IRSD; Australian Bureau of Statistics, 2011b) is derived from census information that reflects area-level disadvantage such as low income, low educational attainment, high unemployment, and jobs in relatively unskilled occupations. Local communities were given a score ranging from 1 (most disadvantaged) to 5 (least disadvantaged). School-level IRSD was obtained by averaging the IRSD for children attending the same school, creating a proxy for school-level socioeconomic status. The Australian Standard Geographical Classification (ASGC; Australian Bureau of Statistics, 2011a) classifies a geographical area as metropolitan, inner/outer regional, or remote/very remote, based on the access to goods, services, and opportunities for social interaction in that area. Due to smaller cohort numbers outside the metropolitan areas, these five categories were collapsed into three (metropolitan, regional, remote). School geographical location was determined by identifying the most prevalent ASGC assigned to students from the same school and assigning that category to the school.

Table 3-2
Sociodemographic Characteristics of the Cohort

Characteristic	Original sample, <i>N</i> (%)	Imputed sample, <i>N</i> (%)
Child's gender		
Female*	11,283 (49.29)	11,283 (49.29)
Male	11,607 (50.71)	11,607 (50.71)
Ethnicity		
Aboriginal/Torres Strait Islander	1,408 (6.15)	1,408 (6.15)
Other*	21,482 (93.85)	21,482 (93.85)
Child speaks English as a second language		
No*	20,790 (90.83)	20,790 (90.83)
Yes	2,100 (9.17)	2,100 (9.17)
Child changed schools between pre-primary and grade 3		
No*	16,916 (73.90)	16,916 (73.90)
Yes	5,974 (26.10)	5,974 (26.10)
Mother's marital status at time of cohort member's birth		
Single/never married	1,421 (6.21)	1,715 (7.49)
Divorced/widowed	224 (0.98)	260 (1.14)
Married*	17,476 (76.34)	20,915 (91.37)
<i>Missing</i>	3,769 (16.47)	-
Mother's age at time of cohort member's birth		
<20 years	1,024 (4.47)	1,202 (5.25)
20-29 years	8,323 (36.36)	9,910 (43.29)
30-39 years*	9,297 (40.62)	11,100 (48.49)
40 years +	569 (2.48)	678 (2.96)
<i>Missing</i>	3,677 (16.06)	-
Father's age at time of cohort member's birth		
<20 years	361 (1.58)	470 (2.05)
20-29 years	5,796 (25.32)	7,264 (31.73)
30-39 years*	10,157 (44.37)	12,537 (54.77)
40 years +	2,138 (9.34)	2,619 (11.44)
<i>Missing</i>	4,438 (19.39)	-

(continued)

Characteristic	Original sample, <i>N</i> (%)	Imputed sample, <i>N</i> (%)
Parent 1 highest education level		
University*	4,913 (21.46)	6,305 (27.54)
Vocational training	6,215 (27.15)	8,264 (36.10)
High school	5,773 (25.22)	8,321 (36.35)
<i>Missing</i>	5,989 (26.16)	-
Parent 2 highest education level		
University*	4,330 (18.91)	5,433 (23.74)
Vocational training	7,372 (32.21)	9,719 (42.46)
High school	5,464 (23.87)	7,738 (33.81)
<i>Missing</i>	5,724 (25.01)	-
School geographic location		
Major city*	15,099 (65.96)	15,099 (65.96)
Regional area	5,564 (24.31)	5,564 (24.31)
Remote area	2,227 (9.73)	2,227 (9.73)
School index for relative socioeconomic disadvantage		
1 (Least disadvantaged)*	6,162 (26.92)	6,162 (26.92)
2	4,792 (20.93)	4,792 (20.93)
3	5,359 (23.42)	5,359 (23.42)
4	4,808 (21.00)	4,808 (21.00)
5 (Most disadvantaged)	1,769 (7.73)	1,769 (7.73)

*Reference group for logistic regressions.

Missing Data

All parent-level covariates had missing data (see Table 3-2) and inspection of frequencies revealed that data were not missing at random, with Aboriginal children and children with English as a second language more likely to be missing parent information. The majority of children missing parental age and maternal marital status information had been born overseas or inter-state, and so they did not have a WA birth record. Children missing parental education were missing this information for both parents 95% of the time. The reason for this missing information could not be determined from the available information, although no systematic patterns were identified regarding non-reporting of

parent education information by school.

Missing values for parent-level covariates were imputed using an unweighted nearest-neighbour hot-deck method in SAS Version 9.3 (SAS Institute Inc, 2010). Hot-deck imputation is a non-parametric method suitable for use with data not missing at random (Reilly, 1993). Sociodemographic characteristics of the imputed dataset are shown in Table 3-2, alongside the characteristics of the original sample. Analyses were performed with both the imputed dataset and a complete-case dataset (where all cases with missing data were deleted list-wise). The complete-case dataset had a total of 13,915 children with complete sociodemographic information. This resulted in a sample size that constituted only 57% of the original sample. Given that data were not missing at random, this sample is unlikely to be representative of the entire WA population (e.g., proportions of Aboriginal children dropped from 6.50% in the imputed sample to 2.90% in the complete-case sample). Results of the complete-case analysis were largely similar to the imputed dataset analyses, however due to the smaller sample size, confidence interval estimates were wider in the logistic regression analyses. Therefore, for completeness of the sample and robustness of odds ratio estimates, results from analyses using the imputed dataset are reported.

There were also missing data on outcome variables. Children missing data on outcome variables were excluded from analyses for the outcome which was missing. As such, each model has a different sample size (see Table 3-4). Attendance data were missing for all years of schooling for 5,551 children (24.30%), primarily because only public school attendance data is available for linking in WA. In addition, there were 1,330 children (5.80%) missing NAPLAN data, of which 672 children were missing scores for all NAPLAN tests. Children missing all NAPLAN test data appeared to be systematically different from children who had complete or partially complete NAPLAN test data. Inspection of frequencies showed that, compared to the sample with complete data, there

was a higher proportion of missing data for Aboriginal children (15% of children with missing NAPLAN data versus 6% with complete NAPLAN data), and children who were vulnerable or at-risk on the AEDC domains than children who had data for both AEDC and NAPLAN. For example, 57% of children missing all NAPLAN scores were vulnerable/at-risk on the AEDC language and cognitive skills domain, compared to 32% of children with data at both time points. Approximately 32% of children missing all NAPLAN test data had been officially withdrawn or exempt from testing. The reason why the remaining 68% of children missing NAPLAN data were absent on all three days of testing is unclear from the available information, but given the sociodemographic characteristics and AEDC profiles of children in this group, it is possible that exclusion of these children from analyses may have introduced some bias. However, the number of cases in this sub-sample is small in comparison to the whole cohort (2.93% of the total sample), therefore any bias is likely to be minimal.

Statistical Analysis

Hierarchical models were constructed for each outcome variable with students nested within schools, to take into account the influence of shared school characteristics on children's school outcomes. Multilevel logistic regression models were fitted with maximum likelihood estimation and Laplace transformation using SAS version 9.3 for Windows (SAS Institute Inc, 2010). Models were analysed separately for each of the five outcome variables. This method modelled the odds of children experiencing each risk event (not meeting the national benchmark for reading, numeracy, or writing; having at least one suspension by grade 3; having an average attendance rate of less than 80%) as an outcome of AEDC vulnerability. Odds ratios (*OR*) were adjusted for the sociodemographic characteristics listed in Table 3-2. Models were built sequentially, with a random intercept model specified first, child-level covariates entered next, followed by parent-level, then school-level covariates. Finally, AEDC variables were entered into the

models simultaneously to estimate the association between each school readiness domain with the outcome variables, whilst taking into account the effect of the other AEDC domains. The results of these final models therefore allow us to draw conclusions about which school readiness domain was the strongest predictor of each outcome, overall. Model fit was evaluated at each stage of the model building process from the 2-Log Likelihood (-2logL), with improvements in model fit determined by a significant chi-square difference test on the deviance value. All chi-square difference tests performed on nested models were significant, indicating that for each stage of the model building process, the more complex model was preferred as a better fit to the data. For brevity, only the -2logL for the random intercept and final (fully adjusted) models are reported, along with the deviance value (see Table 3-4). Details for other models are provided in Appendix I.

Results

Prevalence

Table 3-3 shows the proportions of children experiencing each risk event (i.e., scoring below national benchmarks on NAPLAN tests; having less than 80% average attendance rate; and being suspended at least once). For NAPLAN, around 6% of all children did not meet the national benchmark in numeracy and reading. The proportion of children not meeting the benchmark for writing was lower, at around 3%. These rates are higher than the national percentages reported in the 2012 NAPLAN report, but are in line with the results for WA (Australian Curriculum Assessment and Reporting Authority, 2012). Almost 2% of all children had been suspended from school at least once by grade 3, and almost 5% of children were attending school on average less than 80% of the time.

Table 3-3
Proportions of Children Experiencing Each Risk Event

Outcome	<i>n</i> (%)
NAPLAN score below national benchmark	
Numeracy	1,300 (5.68)
Reading	1,301 (5.68)
Writing	635 (2.77)
One or more suspensions by grade 3	392 (1.71)
Average attendance less than 80%	1,110 (4.85)

Note. NAPLAN = National Assessment Program - Literacy and Numeracy

Multilevel Logistic Regressions

The random intercept model for each outcome variable indicated a significant amount of variation between schools, with all intra-class correlation coefficients (calculated as per Powers & Xie, 2008) exceeding zero (see Table 3-4). Therefore, multilevel modelling was deemed appropriate. Holm's *p*-value correction was applied to account for multiple hypothesis testing (Holm, 1979).

Table 3-4

Parameters for the Multi-level Models Estimated for Each Outcome Variable

Parameter	Outcome				
	Numeracy	Reading	Writing	Suspensions	Attendance
<i>N</i> (% of whole sample)	21,881 (95.59%)	21,977 (96.01%)	21,983 (96.04%)	22,890 (100%)	17,339 (75.75%)
Intra-class correlation coefficient					
Random intercept model	0.29	0.24	0.43	0.45	0.38
Final model ^a	0.11	0.06	0.16	0.27	0.10
Model fit (-2 log Likelihood) ^b					
Random intercept model	9,322.40	9,483.61	5,308.44	3,690.30	7,546.31
Final model ^a	7,624.63	7,990.34	4,047.99	2,843.30	6,271.16
Deviance value ^c	1,697.77***	1,493.27***	1,260.45***	847.00***	1,275.15***

^a Adjusted for all covariates and with all Australian Early Development Census variables entered simultaneously. ^b Smaller values indicate better model fit.

^c Deviance value based on the difference in -2 log Likelihood value for the random intercept and final models. Significance testing based on a chi-square distribution with $df = 29$, at $\alpha = .001$.

*** $p < .001$

Academic achievement.

Table 3-5 shows the results of the fully-adjusted multi-level models estimating the odds of scoring below the national benchmark on NAPLAN tests, as an outcome of being vulnerable/at-risk on the AEDC domains. Being vulnerable/at-risk on the language and cognitive skills domain was the strongest school readiness predictor of all tests of academic abilities, associated with around a 4-fold increase in odds, compared to children who were not vulnerable/at-risk on this domain. Children who were vulnerable/at-risk on the physical, social or communicative domains also had significantly increased odds of scoring below the minimum national standards on all tests after adjusting for sociodemographic characteristics and all AEDC domains. Vulnerability on the emotional maturity domain was a significant predictor of lower achievement on the reading and writing tests, but not for numeracy. For numeracy and reading, vulnerability on the language and cognitive skills domain yielded the highest *OR* of all predictors and covariates for scoring below the national benchmarks.

In terms of sociodemographic characteristics, results of the fully-adjusted models showed that Aboriginal children were more likely than their non-Aboriginal peers to score below national benchmarks on all academic tests, with a 3- to 5-fold increase in odds. Boys also had greater odds than girls of scoring below the national benchmarks on reading (32% increase) and writing (95% increase), but the reverse was found for numeracy (26% decrease). Parent education level was also a significant predictor of children's NAPLAN scores, with anything other than a university education increasing children's odds of scoring below the national benchmarks on all academic tests, by 38-92%. School-level variables were also significant predictors, with children attending schools in the most socioeconomically disadvantaged areas having up to 3-times greater odds of not meeting the minimum academic standards and those in remote or regional locations at up to 2-times increased risk.

Table 3-5

Results of the Fully-adjusted^d Multi-level Logistic Regression Models Estimating Odds of Not Meeting the National Benchmarks on Academic Tests

	Numeracy			Reading			Writing		
	<i>OR</i>	95% CI	<i>p</i> ^c	<i>OR</i>	95% CI	<i>p</i> ^c	<i>OR</i>	95% CI	<i>p</i> ^c
Vulnerable/at-risk on AEDC domain ^b									
Physical Health & Wellbeing	1.33	[1.14, 1.56]	.001	1.28	[1.10, 1.49]	.001	1.57	[1.27, 1.95]	.001
Social Competence	1.35	[1.13, 1.61]	.001	1.24	[1.05, 1.47]	.013	1.35	[1.05, 1.73]	.020
Emotional Maturity	1.14	[0.96, 1.34]	.13	1.31	[1.12, 1.54]	.001	1.34	[1.06, 1.70]	.014
Communication & General Knowledge	1.52	[1.29, 1.78]	.001	1.42	[1.21, 1.66]	.001	1.87	[1.48, 2.35]	.001
Language & Cognitive Skills	4.57	[3.91, 5.35]	.001	3.38	[2.92, 3.92]	.001	3.72	[2.93, 4.73]	.001
Covariates									
	<i>OR</i>	95% CI	<i>p</i> ^c	<i>OR</i>	95% CI	<i>p</i> ^c	<i>OR</i>	95% CI	<i>p</i> ^c
Child's primary spoken language									
English		REF			REF			REF	
Other	0.84	[0.68, 1.05]	.13	0.80	[0.64, 0.99]	.04	0.80	[0.59, 1.09]	.16
Child's ethnicity									
Aboriginal/Torres Strait Islander	3.43	[2.84, 4.14]	.001	2.65	[2.20, 3.19]	.001	4.98	[3.92, 6.32]	.001
Other		REF			REF			REF	

(continued)

	Numeracy			Reading			Writing		
	<i>OR</i>	95% CI	<i>p</i> ^c	<i>OR</i>	95% CI	<i>p</i> ^c	<i>OR</i>	95% CI	<i>p</i> ^c
Child's gender									
Female		REF			REF			REF	
Male	0.74	[0.65, 0.85]	.001	1.32	[1.16, 1.51]	.001	1.95	[1.60, 2.38]	.001
School mobility grade 1-3									
Changed schools	1.12	[0.98, 1.29]	.11	1.04	[0.91, 1.20]	.55	1.34	[1.10, 1.62]	.004
Stayed at same school		REF			REF			REF	
Maternal age at child's birth									
<20 years	1.21	[0.92, 1.59]	.85	1.03	[0.79, 1.36]	.99	1.16	[0.80, 1.67]	.99
20-29 years	1.17	[1.00, 1.38]	.30	1.23	[1.05, 1.43]	.06	1.21	[0.95, 1.53]	.72
30-39 years		REF			REF			REF	
40 years +	1.01	[0.65, 1.58]	.99	0.84	[0.53, 1.31]	.99	0.77	[0.37, 1.59]	.99
Paternal age at child's birth									
<20 years	1.41	[0.99, 2.02]	.29	1.40	[0.98, 1.99]	.37	1.30	[0.82, 2.07]	.99
20-29 years	1.11	[0.95, 1.29]	.48	1.12	[0.96, 1.30]	.64	1.09	[0.87, 1.36]	.99
30-39 years		REF			REF			REF	
40 years +	0.87	[0.68, 1.11]	.48	1.03	[0.82, 1.29]	.97	1.00	[0.70, 1.43]	.99

(continued)

	Numeracy			Reading			Writing		
	<i>OR</i>	95% CI	<i>p</i> ^c	<i>OR</i>	95% CI	<i>p</i> ^c	<i>OR</i>	95% CI	<i>p</i> ^c
Maternal marital status at child's birth									
Married		REF			REF			REF	
Divorced/widowed	1.27	[0.81, 1.99]	.63	1.06	[0.67, 1.70]	.80	1.33	[0.72, 2.45]	.74
Never married	0.93	[0.76, 1.15]	.63	1.22	[1.01, 1.48]	.041	1.64	[1.28, 2.10]	.001
Parent 1 highest education level									
University		REF			REF			REF	
Vocational training	1.16	[0.94, 1.44]	.16	1.38	[1.12, 1.70]	.005	1.23	[0.89, 1.69]	.35
High school	1.41	[1.15, 1.75]	.004	1.54	[1.25, 1.90]	.001	1.43	[1.04, 1.96]	.08
Parent 2 highest education level									
University		REF			REF			REF	
Vocational training	1.78	[1.41, 2.25]	.001	1.91	[1.51, 2.42]	.001	1.21	[0.86, 1.69]	.73
High school	1.62	[1.27, 2.07]	.001	1.92	[1.50, 2.44]	.001	1.23	[0.87, 1.73]	.73
School geographic location									
Metropolitan		REF			REF			REF	
Regional	1.25	[1.02, 1.52]	.07	1.29	[1.08, 1.55]	.001	1.41	[1.05, 1.88]	.021
Remote	1.65	[1.29, 2.11]	.001	2.11	[1.71, 2.61]	.001	2.32	[1.66, 3.24]	.001

(continued)

	Numeracy			Reading			Writing		
	<i>OR</i>	95% CI	<i>p</i> ^c	<i>OR</i>	95% CI	<i>p</i> ^c	<i>OR</i>	95% CI	<i>p</i> ^c
School index of socioeconomic disadvantage									
1 (Most disadvantaged)	3.73	[2.68, 5.19]	.001	2.18	[1.65, 2.90]	.001	3.72	[2.32, 5.97]	.001
2	1.86	[1.40, 2.46]	.001	1.29	[1.01, 1.64]	.12	1.86	[1.22, 2.84]	.004
3	1.71	[1.30, 2.26]	.001	1.33	[1.05, 1.68]	.08	1.91	[1.26, 2.90]	.002
4	1.35	[1.00, 1.83]	.16	0.97	[0.75, 1.26]	.99	1.21	[0.76, 1.95]	.42
5 (Least disadvantaged)	REF			REF			REF		

Note. Significant results at $p < .05$ indicated in bold. AEDC=Australian Early Development Census, *OR*=Odds Ratio, *CI*=Confidence Interval, REF=reference category.

^a Adjusted for all covariates and other AEDC domain variables. ^b The reference category for all AEDC domain variables is ‘on track’. ^c adjusted *p*-values after Holm’s correction applied.

Attendance.

Table 3-6 displays the results of the fully-adjusted model estimating the association between school readiness and average school attendance rate. Children who were vulnerable/at-risk on the physical or language and cognitive skills domains had significantly higher odds of attending school less than 80% of the time, compared to children who were 'on track' on those domains. *ORs* for the other AEDC domains were not statistically significant, indicating that social and emotional difficulties were not significantly associated with attendance rates.

The fully-adjusted model also showed that Aboriginal children had over 7-times greater odds than non-Aboriginal children of having an average school attendance rate of less than 80%, which was the highest *OR* estimated in the model. Other sociodemographic characteristics associated with lower than 80% attendance rate were speaking English as a second language (65% increase in risk), changing schools between pre-primary and grade 3 (134% increase in risk), and being born to a teenage (78% increase in risk) or single (34% increase in risk) mother. Children attending schools in the most socioeconomically disadvantaged areas (59-122% increase) and/or remote locations (97% increase) were also more likely to have an average attendance rate less than 80%.

Table 3-6

Results of the Fully-adjusted^d Multi-level Logistic Regression Models Estimating Odds of Having Less than 80% Average Attendance or One or More Suspensions

	< 80% attendance			One or more suspensions		
	<i>OR</i>	95% CI	<i>p</i> ^c	<i>OR</i>	95% CI	<i>p</i> ^c
Vulnerable/at-risk on AEDC domain ^b						
Physical Health & Wellbeing	1.54	[1.29, 1.84]	.001	1.27	[0.97, 1.67]	.09
Social Competence	0.92	[0.75, 1.13]	.43	2.78	[2.02, 3.84]	.001
Emotional Maturity	1.19	[0.98, 1.44]	.08	3.16	[2.30, 4.35]	.001
Communication Skills & General Knowledge	1.20	[1.00, 1.45]	.05	0.80	[0.60, 1.07]	.14
Language & Cognitive Skills	1.77	[1.49, 2.10]	.001	1.25	[0.95, 1.65]	.12
Covariates						
	<i>OR</i>	95% CI	<i>p</i> ^c	<i>OR</i>	95% CI	<i>p</i> ^c
Child's primary spoken language						
English		REF			REF	
Other	1.65	[1.33, 2.05]	.001	0.73	[0.48, 1.10]	.13
Child's ethnicity						
Aboriginal/Torres Strait Islander	7.28	[6.06, 8.75]	.001	3.12	[2.27, 4.28]	.001
Other		REF			REF	
Child's gender						
Female		REF			REF	
Male	0.94	[0.81, 1.08]	.37	5.38	[3.89, 7.44]	.001

(continued)

	< 80% attendance			One or more suspensions		
	<i>OR</i>	95% CI	<i>p</i> ^c	<i>OR</i>	95% CI	<i>p</i> ^c
School mobility grade 1-3						
Changed schools	2.34	[2.02, 2.71]	.001	1.52	[1.20, 1.92]	.001
Stayed at same school		REF			REF	
Maternal age at child's birth						
<20 years	1.78	[1.35, 2.35]	.001	1.23	[0.78, 1.94]	.99
20-29 years	1.03	[0.86, 1.24]	.99	1.15	[0.85, 1.55]	.99
30-39 years		REF			REF	
40 years +	1.09	[0.68, 1.76]	.99	1.71	[0.84, 3.47]	.83
Paternal age at child's birth						
<20 years	0.94	[0.65, 1.36]	.99	1.58	[0.90, 2.78]	.55
20-29 years	0.88	[0.74, 1.05]	.99	1.43	[1.08, 1.88]	.08
30-39 years		REF			REF	
40 years +	1.06	[0.82, 1.37]	.99	1.03	[0.66, 1.61]	.99
Maternal marital status at child's birth						
Married		REF			REF	
Divorced/widowed	1.59	[0.99, 2.55]	.12	1.06	[0.71, 1.57]	.69
Never married	1.34	[1.09, 1.64]	.015	1.51	[1.03, 2.22]	.004

(continued)

	< 80% attendance			One or more suspensions		
	<i>OR</i>	95% CI	<i>p</i> ^c	<i>OR</i>	95% CI	<i>p</i> ^c
Parent 1 highest education level						
University		REF			REF	
Vocational training	0.86	[0.69, 1.07]	.36	1.06	[0.71, 1.57]	.78
High school	1.06	[0.85, 1.31]	.62	1.51	[1.03, 2.22]	.07
Parent 2 highest education level						
University		REF			REF	
Vocational training	0.93	[0.74, 1.17]	.99	1.80	[1.16, 2.79]	.027
High school	1.01	[0.79, 1.27]	.99	1.64	[1.05, 2.56]	.06
School geographic location						
Metropolitan		REF			REF	
Regional	1.10	[0.88, 1.38]	.41	1.20	[0.82, 1.76]	.68
Remote	1.97	[1.53, 2.53]	.001	1.42	[0.91, 2.22]	.38
School index of socioeconomic disadvantage						
1 (Most disadvantaged)	2.22	[1.58, 3.12]	.001	3.00	[1.59, 5.66]	.001
2	1.59	[1.19, 2.14]	.016	2.98	[1.73, 5.14]	.001
3	1.59	[1.18, 2.14]	.016	2.08	[1.20, 3.59]	.009
4	1.23	[0.88, 1.72]	.45	1.18	[0.63, 2.21]	.60
5 (Least disadvantaged)		REF			REF	

Note. Significant results at $p < .05$ indicated in bold. AEDC=Australian Early Development Census, *OR*=Odds Ratio, *CI*=Confidence Interval, REF=reference category.

^a Adjusted for all covariates and other AEDC domain variables. ^b The reference category for all AEDC domains is ‘on track’. ^c adjusted *p*-values after Holm’s correction applied.

Suspensions.

Table 3-6 displays the results of the fully-adjusted models estimating the association between AEDC scores and suspensions. Children who were vulnerable/at-risk on the social and emotional school readiness domains had around 3-times greater risk of being suspended one or more times by grade 3, compared to children who were ‘on track’ for social and emotional development at school entry. Associations between other AEDC variables and suspensions were non-significant (Table 3-6).

In terms of sociodemographic factors, students who were most likely to have received at least one out-of-school suspension by grade 3 were those who were Aboriginal (212% increase in risk), male (438% increase in risk), had changed schools (50% increase in risk), had parents with lower education levels (51-80% increase in risk), and were attending school in one of the more socioeconomically disadvantaged areas (100-200% increase in risk).

Discussion

This study investigated the association between school readiness and early indicators of a child’s potential disengagement from school (namely, low academic achievement, poor school attendance, and out-of-school suspensions). Developmental vulnerability at school entry was associated with all indicators in grade 3. This suggests that school readiness may play an important role in children’s school success, if poor physical, social, emotional, communicative and cognitive abilities influence children’s early school experiences. In turn, these experiences may affect children’s opinions of school, and ultimately, their level of school engagement.

As expected, vulnerability on the physical, social, emotional, communicative, or cognitive school readiness domains was associated with an increased risk of lower academic performance, with difficulties in language and cognitive skills being the strongest predictor of low academic achievement on tests of all the measured academic

abilities. This finding adds to the existing evidence promoting the importance of a range of abilities for academic achievement (Davies et al., 2016; Diamond, 2010; McClelland et al., 2006; Oberle et al., 2014), but also supports research suggesting that cognitive skills make the largest contribution to academic performance (Duncan et al., 2007; Kurdek & Sinclair, 2001; Pagani et al., 2010). The findings also concur with studies on the EDI showing that, of all the school readiness domains, children's scores on the language and cognitive skills domain had the strongest association with academic test scores (D'Angiulli et al., 2009; Davies et al., 2016; Forget-Dubois et al., 2007; Guhn et al., 2016). The association in this study between language and cognitive skills and grade 3 academic achievement was stronger than that seen for all demographic characteristics, even parental education level. This indicates that children's cognitive school readiness makes an important and independent contribution to their later academic achievement.

A novel finding of this study was that school readiness scores were significantly associated with children's average school attendance rates up to grade 3. Contrary to our expectations, early social and emotional vulnerabilities were not statistically significant predictors of lower school attendance – rather, cognitive and physical difficulties were associated with an increased risk of absenteeism. This is in line with previous studies that have found that children who are struggling academically (Hancock et al., 2013) or those with physical health conditions (Cook, Schaller, & Krischer, 1985; Weitzman, Klein Walker, & Gortmaker, 1986) have lower attendance rates than their peers. The findings extend this literature by demonstrating that this association may be present at school entry, which highlights the importance of identifying children at risk of frequent absenteeism when they first begin school. Regular attendance is associated with higher academic achievement (Hancock et al., 2013; Roby, 2004), and is particularly important for improving academic outcomes for children at socioeconomic risk (Ready, 2010).

Attendance is also necessary for school engagement, as it ensures exposure to learning and

social opportunities and fosters skill development (Finn, 1993; Ladd, Birch, & Buhs, 1999), which in turn helps to develop positive self-esteem and a valuing of school-related goals (Finn, 1989). Interventions targeted at improving attendance rates should therefore be high priority, and should include consideration of the particular developmental vulnerabilities children may be experiencing when they start school.

This study was also the first to examine the association between school readiness and school suspensions. We found that social or emotional vulnerability at school entry was associated with a significantly increased risk of children being suspended from school at least once by grade 3. This finding is in line with research on adolescents, which has shown that poor social competence and behaviour problems are antecedents to school suspensions (Hemphill et al., 2014). The findings extend this literature by showing that social and emotional difficulties evident at the start of school are associated with increased risk of later school suspension. Given that suspension is usually used as discipline for undesirable behaviours (Brantlinger, 1991), that problem behaviours can increase in frequency as children progress through school (Aber, Brown, & Jones, 2003), and that early aggression is a strong predictor of delinquency and later anti-social behaviour (Broidy et al., 2003; Nagin & Tremblay, 1999), this finding is of particular concern, as it suggests an upward trajectory towards future negative life outcomes for young children experiencing social and emotional difficulties. Children who are suspended in elementary school are more likely to become disengaged from school (Butler, Bond, Drew, Krelle, & Seal, 2005), to experience academic failure in high school (Raffaele Mendez, 2003), and to participate in delinquent or criminal behaviour as adolescents (Costenbader & Markson, 1998; Hemphill et al., 2009). Yet, suspension is generally an ineffective means of reducing the incidence of problematic behaviours (Raffaele Mendez et al., 2003), and issues that precede suspensions rarely resolve spontaneously (Balfanz et al., 2007). The findings suggest that more needs to be done to develop the social and emotional competence of at-

risk young children, which may help to prevent a situation where children's social and emotional difficulties result in their exclusion from school. Importantly, this should start very early in their schooling.

Taken together, the results of the study suggest an important role for children's school readiness in shaping their early experiences in school, and further highlight the need to focus efforts on promoting positive early child development. Children generally commence schooling feeling optimistic, engaged, and motivated to learn (Entwisle & Alexander, 1993). The subsequent experiences students have can then influence their ongoing engagement. For example, if children have early school experiences that affirm their academic, physical, and social competence, they are more likely to develop a positive self-concept, leading them to value school participation (Ladd, Buhs, & Seid, 2000). Equally, negative academic and social experiences in early schooling that leave children feeling incompetent or alienated can lead to disengagement (Rumberger, 2001). School disengagement is a process that occurs over a number of years (Anderman & Maehr, 1994) and has been found to predict later school dropout over and above the effects of student sociodemographic factors (Rumberger, 2001). Preventing school disengagement is critical, as adolescents who drop out of school early are at increased risk of poorer life outcomes than their peers who complete secondary schooling (Alexander et al., 1997). The results of this study suggest that promoting a child's level of school readiness may be an important consideration for interventions designed to develop and increase school engagement.

Although children's level of school readiness independently predicted all indicators of disengagement, several sociodemographic characteristics were also found to be important, which concurs with related research. For example, a number of studies have also found an association between male gender, lower parental education, and low school socioeconomic status with poor academic achievement (Kurdek & Sinclair, 2001; Sirin,

2005). Research from Australia has also demonstrated poorer academic outcomes for Aboriginal children and children living in remote areas (De Bortoli & Thomson, 2009; Guthridge et al., 2015; Thomson et al., 2012), which may be due to systemic and geographical barriers to access to learning resources and opportunities. The sociodemographic risk factors for poor attendance and out-of-school suspensions identified in this study have also been identified in previous research. We found that Aboriginality, school mobility, and enrolment at a school in a remote and/or disadvantaged area were all significant predictors of attendance, consistent with findings by other researchers (Hancock et al., 2013; Reid, 2014). A number of previous studies have similarly found that boys, children from ethnic minority groups, and children living in disadvantaged neighbourhoods are more likely to receive out-of-school suspensions (Haight et al., 2015; Hemphill et al., 2010, 2014; Nichols, 2004; Petras et al., 2011; Raffaele Mendez, 2003; Raffaele Mendez et al., 2003). Importantly, however, there were specific contributions of developmental vulnerabilities to all measures of low academic achievement, attendance, and suspensions that were over and above the effects of sociodemographic variables. This information can help families, schools, and communities determine how best to support children during their early school years, taking into account both sociodemographic risk factors as well as any potential specific developmental vulnerabilities.

The findings that both school readiness abilities and family and neighbourhood sociodemographic factors were associated with the selected school disengagement indicators signifies the important role that the child's developmental context plays in shaping children's early school experiences. The influence of a child's family and community context on developmental and academic outcomes has long been recognised (Bronfenbrenner, 1986). There is evidence that students exposed to family and neighbourhood sociodemographic risk factors are more likely to engage in behaviours

which create impediments to school success, such as absenteeism, reduced school participation, and behavioural non-compliance in the classroom (Finn & Rock, 1997). However, school engagement – attending, participating, completing work, and not being disruptive in class – has been demonstrated to provide a protective effect in terms of promoting school success for children experiencing socioeconomic risk (Finn & Rock, 1997). Several early childhood interventions, such as Head Start (Lee, Zhai, Brooks-Gunn, Han, & Waldfogel, 2014; Nix, Bierman, Domitrovich, & Gill, 2013), preschool attendance (Tucker-Drob, 2012), and socio-emotional programs such as Roots of Empathy (Gordon, 2005; Schonert-Reichl, Smith, Zaidman-Zait, & Hertzman, 2012) have shown improved educational and developmental outcomes for children from disadvantaged backgrounds. Although communities and schools can do little to modify a child’s sociodemographic circumstances, the outcomes of these programs demonstrate that efforts to improve children’s chances of success at school have merit.

One limitation of this study is the lack of a direct measure of school engagement. Although academic achievement, attendance, and suspensions are associated with later disengagement (Balfanz et al., 2007; Cratty, 2012), there are clearly other factors that influence the process of a child disconnecting from school. For example, some children may come from a home environment that does not value school participation, and these children may start school predisposed to non-participation and early disengagement (Finn, 1989). It would be interesting to examine the relationship between school readiness, direct measures of student and family school engagement, and early school outcomes in future research. Another limitation is the amount of missing parental demographic information. Use of the hot-deck method to impute missing information ensured completeness of the sample to limit selection bias, however, some bias may have been introduced in estimation of the effects of parental demographics on school outcomes. There are also likely to be several un-measured sociodemographic variables influencing the association between

school readiness and later school outcomes, which could not be controlled for in this study. Furthermore, the characteristics of the sample of children missing all NAPLAN test scores is of concern, as these children were on average more likely to have been classified as vulnerable/at-risk on the AEDC. Research on older children has shown that those absent on the day of compulsory academic testing are more likely to have experienced adverse life events and have a range of sociodemographic risk characteristics (Wong, O'Donnell, Bayliss, Fletcher, & Glauert, 2016). Non-inclusion of these children in the analyses of AEDC and NAPLAN scores may therefore have under-estimated the association between these variables. However, given that the results of the fully-adjusted models were significant across at least four out of five AEDC domains, and that children missing all NAPLAN scores constituted less than 3% of the sample, it is likely that inclusion of data for these children would have not altered the conclusions of this study.

In conclusion, this study demonstrates that developmental vulnerabilities at school entry are not only associated with lower academic achievement in grade 3, but also with the occurrence of other indicators of school disengagement: lower rates of attendance, and occurrence of out-of-school suspensions. The results of this study provide information on specific developmental abilities that may be important areas of focus for interventions aimed at mitigating difficulties that some children experience during the early school years. With evidence that children's academic trajectories are largely established by grade 3, this study provides further support for the need for intervention early on in schooling, or even before the transition to formal school. Supporting children experiencing particular sociodemographic risk factors is critical. However, identifying modifiable factors associated with lower school readiness will also be important for informing prevention strategies to mitigate the risk of these vulnerabilities for children's developmental and academic trajectories.

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Preface

Having established that low scores on the Australian Early Development Census predict low academic achievement, poor school attendance, and the occurrence of out-of-school suspensions, the need to identify antecedents to poor school readiness is highlighted. Intervening early to reduce the risk of these poor school outcomes occurring is more beneficial and cost effective than intervening when developmental vulnerabilities have become established problems. Chapter 4 presents the first of the five empirical studies of this thesis that examine factors in the early childhood period that may predict poor school readiness. These factors are well-suited to the linked data methodology, as they are difficult to capture using other methods due to issues of response and/or sample bias. The factors studied have the potential to significantly impact the interactions the developing child has with the people and/or objects within his/her ecology, thus creating a risk for poor school readiness. Chapter 4 presents an investigation into the school readiness of children who have experienced chronic illness in the early childhood period.

Chapter 4 - Chronic Illness and Developmental Vulnerability at School Entry

Abstract

This study examined the association between chronic illness and school readiness, using linked administrative population data. The sample included children born in 2003-2004 who were residing in Western Australia in 2009 and had a complete Australian Early Development Census record ($N = 22,890$). Health and demographic information was also analysed for 19,227 mothers and 19,030 fathers. The association between child chronic illness and children's development in five domains (social, emotional, language, cognitive, and physical) at school entry was analysed. Analyses examined the association between child developmental outcomes and chronic illness generally, single or multiple chronic illness diagnosis, and diagnosis type. Logistic regression models estimated odds ratios for each outcome, adjusted for child, parent, and community sociodemographic variables. In the adjusted models, children with a chronic illness had an increased risk of being classified as developmentally vulnerable on all domains, compared to children without a chronic illness (20-35% increase in risk). There was no increased risk for children with multiple chronic illness diagnoses over those with a single diagnosis (all $ps > .05$). There was no evidence of a disease-specific effect driving this risk. Regardless of the number or type of conditions, chronic illness in young children is a risk factor for reduced school readiness. These effects were seen for health conditions not traditionally considered detrimental to school readiness, such as chronic otitis media. Thus, the implications of a broader range of chronic health conditions in early childhood on school readiness need to be considered.

Introduction

Chronic illness is a term for physical health conditions that are prolonged in duration, difficult to treat, and associated with impairment or disability (O'Halloran, Miller, & Britt, 2004). If experienced in early childhood, chronic illness has the potential to profoundly influence a child's developmental trajectory. Early childhood is a period of rapid growth in cognitive, linguistic, emotional, social, and behavioural capacities, which form the foundation for future academic success (Keating & Hertzman, 1999). Children who lack a strong foundation in these abilities at school entry have lower academic trajectories than peers who have higher levels of school readiness (Brinkman et al., 2013). Therefore, if chronic illness interrupts the development of the skills necessary for classroom adaptation and academic success, the effects may be long-lasting, persisting even after the child's health has recovered (Quach & Barnett, 2015).

Previous research examining the relationship between academic outcomes and child health has demonstrated that children and adolescents with chronic illnesses have lower achievement trajectories compared to their healthy peers, due to factors such as increased school absences and greater disengagement from school (Case, Fertig, & Paxson, 2005; Jackson, 2009). However, there is little evidence regarding the impact of poor health on the child at the start of school, when school absence and disengagement are unlikely to be implicated. Of the handful of studies available, children with special health care needs are found to be at risk of poorer psychosocial and cognitive outcomes compared to healthy peers (Goldfeld, O'Connor, Quach, Tarasuik, & Kvalsvig, 2015; Goldfeld, O'Connor, Sayers, Moore, & Oberklaid, 2012; Janus & Duku, 2007; Quach & Barnett, 2015). This suggests that ill health in early childhood may influence the development of the skills that underlie academic success, placing children at risk for academic failure (Goldfeld et al., 2015; Quach & Barnett, 2015). To minimise the impact of poor health on achievement trajectories, intervention for chronically ill children should

therefore start early. However, the number of children with enduring medical conditions far outstrips the number of children receiving early intervention (EI) services (Goldfeld et al., 2012). This is due to a traditional approach to determining EI eligibility based on specific diagnosis lists, which do not capture the full range of chronic conditions (Goldfeld et al., 2012; McDowell & O’Keeffe, 2012). However, evidence shows that chronic illnesses share important commonalities in how they impact the lives of the people affected, regardless of type or severity (Stein & Jessop, 1989), leading some to argue that this approach is outdated (McDowell & O’Keeffe, 2012). This study takes a non-categorical approach to defining chronic illness in order to establish whether chronic illness in early childhood is associated with increased risk of developmental vulnerability at school entry.

Previous research on the association between chronic illness and academic outcomes has mostly been based on either specific paediatric samples (Mitchell, Chavez, Lee, & Guzman, 1991; Ott, Webb, Anderson, Kastelic, & Krill, 1982; Wright & Nolan, 1994), or used informant reports of health status (Goldfeld et al., 2015, 2012; Janus & Duku, 2007; Quach & Barnett, 2015). While providing important findings, these two designs have limitations in terms of the generalisability of results, and potential reporting bias, respectively. The current study adds meaningfully to this past research by using linked administrative population data, which enables identification of children with chronic illness across multiple diagnoses, rather than targeting specific disease groups. This study also uses diagnostic health information coded to professional standards, thus minimising reporting bias. Importantly, with evidence that the risk of developmental vulnerability increases with each additional diagnosis (Newacheck & Stoddard, 1994), administrative data also allows for the identification of children who have multiple chronic conditions. We hypothesise that chronic illness experienced between birth and age 5 years will be associated with increased risk of vulnerability across developmental domains.

Further, we expect that having two or more chronic illnesses will elevate this risk compared to a single diagnosis. We will also examine whether the relationship between chronic illness and school readiness is disease-specific or generalised.

Method

Ethics Approval

Ethics approval for this study was granted by the Western Australian (WA) Department of Health Human Research Ethics Committee, the University of Western Australia Human Research Ethics Committee, and the WA Aboriginal Health Ethics Committee.

Data Sources

This study used anonymised administrative data merged across the WA Department of Health, the Commonwealth Department of Education, and the WA Register of Developmental Anomalies (WARDA). Datasets were linked by the WA Data Linkage Branch by matching identifiers common to the sets of records (e.g., name, address etc.; Holman et al., 2008). Only de-identified records were provided to the researchers.

Study Population

The study included WA children born in 2003-2004 with a 2009 Australian Early Development Census (AEDC) record ($N = 24,340$). Children were excluded from the study if they: 1) had missing AEDC domain scores ($n = 382$); 2) were from a multiple birth, in which case one child from each twin or triplet set was randomly selected (excluded $n = 274$); 3) were identified by the teacher as 'special needs' in the AEDC dataset ($n = 753$); or 4) had a diagnosis of developmental disorder (e.g., autism) or cerebral palsy ($n = 41$) in the health or WARDA datasets. 'Special needs' children have a diagnosed disability (physical, intellectual) and receive special assistance in school. AEDC domain scores are not calculated for these children, since they have already been identified as having substantial developmental needs. Children with a developmental

disorder or cerebral palsy were likewise excluded to limit the potential for confounding school readiness outcomes with pre-existing developmental conditions.

The final study sample consisted of 22,890 children (mean age 5.5 years, $SD = 0.29$; 49.30% female; 6.20% Aboriginal), for whom health and demographic information was available for 84.00% of mothers ($N = 19,227$) and 83.10% of fathers ($N = 19,030$).

Outcome Measure

Children's developmental outcomes were assessed using data from the AEDC, which is based on the Canadian Early Development Instrument (Janus, Brinkman, Duku, et al, 2007), and is a school readiness measure that is completed nationally every 3 years by teachers on children in their first year of formal schooling (in WA, the year prior to grade one). Teachers complete 104 checklist items for each child, from which a score (from 0 to 10) is calculated for each of five developmental domains (Table 4-1). The method of calculating domain scores is the intellectual property of McMaster University in Canada. AEDC domain scores are analysed at the national level and classified into percentiles, with cut-offs based on the data collected in that year. Children who score in the bottom 10% of a domain are considered 'developmentally vulnerable', on that domain; those in the bottom 11-25% as 'at risk'; and those in the top 75% as 'on track'. For this study, these three categories were collapsed into two ('vulnerable/at risk' and 'on track') to capture established and emerging developmental vulnerability.

Table 4-1

Description of Domains Assessed on the Australian Early Development Census

Domain	Areas Assessed
Physical Health & Wellbeing	Physical readiness for school day (e.g., dressed appropriately, fed) Physical independence Gross and fine motor skills
Social Competence	Overall social competence Responsibility and respect Approaches to learning (e.g., completion of work, following instructions, adaptability) Readiness to explore new things
Emotional Maturity	Pro-social and helping behaviour Anxious and fearful behaviour Aggressive behaviour Hyperactivity and inattention
Language & Cognitive Skills	Interest in literacy/numeracy and memory Basic literacy and advanced literacy Basic numeracy
Communication Skills & General Knowledge	Communication skills and general knowledge (e.g., storytelling, imaginative play, articulation, understanding of others)

Chronic Illness Measure

The list of chronic illnesses included in this study was adapted from multiple sources, with a focus on physical health: the chronic illness list developed by Feudtner and colleagues (2001); the list of childhood diseases from the National Health Interview Survey checklist as adapted by Newacheck and colleagues (1992); and the list of conditions contributing to 80% of the disease burden in Australia (The Australian Institute of Health and Welfare, 2008).

Diagnoses of chronic illness were obtained from the Emergency Department and Hospital Morbidity databases, which contain information on episodes of care for public and private hospital admissions in WA. In these datasets, diagnoses are recorded using the International Classification of Diseases 10-Australian Modification (ICD-10-AM; National Centre for Classification in Health, 2004) coding (see Appendix II for ICD-10-

AM codes used in this study). Cancer diagnoses were obtained from the WA Cancer Registry.

Children were identified as having a chronic illness if they had at least one record of a diagnosed chronic condition in any of the three datasets during the study period (from birth to the end of 2009). Diagnosis was coded dichotomously, classified as absent (no record of an ICD-10-AM chronic illness code) or present (at least one ICD-10-AM chronic illness code). Additionally, if a child had only one chronic illness diagnosis in the study period, they were considered to have a single diagnosis, regardless of the number of admissions they had for that condition. If a child had two or more different chronic illness diagnoses in the study period, they were considered to have multiple diagnoses.

Control Variables

Since health and developmental outcomes are strongly linked to socioeconomic status (Siddiqi, Kawachi, Berkman, Hertzman, & Subramanian, 2012), child, parent and community sociodemographic characteristics were included as control variables (Table 4-2). Variables were selected based on findings of previous studies documenting an association with developmental outcomes of children (Boyle, Georgiades, Racine, & Mustard, 2007; Chen et al., 2007; Cooksey, 1997; Han, Lee, & Waldfogel, 2012).

Table 4-2
Sociodemographic Characteristics of the Study Cohort

Characteristic	Whole cohort, N (%)	Child chronic illness, n (%)	Child no chronic illness, n (%)
Child's sex			
Female	11,283 (49.29)	1,212 (42.10)	10,071 (50.33)
Male	11,607 (50.71)	1,667 (57.90)	9,940 (49.67)
Ethnicity			
Aboriginal/Torres Strait Islander	1,408 (6.15)	282 (9.80)	1,126 (5.63)
Other*	21,482 (93.85)	2,597 (90.20)	18,885 (94.37)
Child speaks English as a second language			
No*	20,790 (90.83)	2,647 (91.94)	18,143 (90.67)
Yes	2,100 (9.17)	232 (8.06)	1,868 (9.33)
Child's mother has a chronic illness			
Yes	3,053 (13.34)	502 (17.44)	2,551 (12.75)
No*	19,837 (86.66)	2,377 (82.56)	17,460 (87.25)
Child's father has a chronic illness			
Yes	1,611 (7.04)	244 (8.48)	1,367 (6.83)
No*	21,279 (92.96)	2,635 (91.52)	18,644 (93.17)
Mother's marital status at child's birth			
Single/never married	1,421 (6.21)	263 (9.14)	1,158 (5.79)
Divorced/widowed	224 (0.98)	34 (1.18)	190 (0.95)
Married*	17,476 (76.35)	2,324 (80.72)	15,152 (75.72)
<i>Missing</i>	3,769 (16.47)	258 (8.96)	3,511 (17.55)
Mother's age at child's birth			
< 20 years	1,024 (4.47)	166 (5.77)	858 (4.29)
20-29 years	8,323 (36.36)	1,202 (41.75)	7,121 (35.59)
30-39 years*	9,297 (40.62)	1,211 (42.06)	8,086 (40.41)
40 years +	569 (2.49)	61 (2.12)	508 (2.54)
<i>Missing</i>	3,677 (16.06)	239 (8.30)	3,438 (17.18)
Father's age at child's birth			
< 20 years	361 (1.58)	54 (1.88)	307 (1.53)
20-29 years	5,796 (25.32)	865 (30.05)	4,931 (24.64)
30-39 years*	10,157 (44.37)	1,317 (45.75)	8,840 (44.18)
40 years +	2,138 (9.34)	247 (8.58)	1,891 (9.45)
<i>Missing</i>	4,438 (19.39)	396 (13.75)	4,042 (20.20)

(continued)

Characteristic	Whole cohort, <i>N</i> (%)	Child chronic illness, <i>n</i> (%)	Child no chronic illness, <i>n</i> (%)
Local community remoteness index			
Metropolitan*	15,099 (65.96)	1,997 (69.36)	13,102 (65.47)
Regional	5,564 (24.31)	617 (21.43)	4,947 (24.72)
Remote	2,227 (9.73)	265 (9.20)	1,962 (9.80)
Local community index for socioeconomic disadvantage			
1 (Most disadvantaged)	2,784 (12.16)	396 (13.75)	2,388 (11.93)
2	4,537 (19.82)	579 (20.11)	3,958 (19.78)
3	4,389 (19.17)	582 (20.22)	3,807 (19.78)
4	3,819 (16.68)	507 (17.61)	3,312 (16.55)
5 (Least disadvantaged)*	7,359 (32.15)	815 (28.31)	6,544 (32.70)

*Reference group for logistic regressions.

Parent age and mother's marital status (at the time of the child's birth) were obtained from the Midwives Notification System and Birth Registrations. Parental chronic illness was also included as a control variable to account for inter-generational health disadvantage. Parental chronic illness was determined by the same method as child chronic illness, and was also coded as a dichotomous variable (illness present or absent).

Child- and community-level control variables were obtained from the AEDC dataset. Teachers identified if children spoke English as a second language (ESL). Local community remoteness and socioeconomic indices were determined by the Australian Standard Geographical Classification (ASGC; Australian Bureau of Statistics, 2011b) and Index of Relative Socioeconomic Disadvantage (IRSD; Australian Bureau of Statistics, 2011c), respectively, calculated for the child's home address at the time of AEDC completion. The ASGC classifies a geographical area as metropolitan, inner/outer regional, or remote/very remote, based on the access to goods, services, and community resources in that area. Due to smaller cohort numbers outside metropolitan areas, these five categories were collapsed into three (metropolitan, regional, remote). The IRSD is derived from census information that reflects area-level disadvantage such as low income,

low educational attainment, and high unemployment. Local communities are given a score from 1 (most disadvantaged) to 5 (least disadvantaged).

Statistical Analysis

Logistic regression models were fitted with maximum likelihood estimation using SAS version 9.3 for Windows (SAS Institute Inc, 2010). This method modelled the odds of being classified as vulnerable/at-risk on each of the five AEDC domains as an outcome of chronic illness diagnosis. All control variables were entered into the models simultaneously, with the category representing lower risk on each variable coded as the reference group (Table 4-2). Unadjusted and adjusted odds ratios (*OR*) and 95% confidence intervals (*CI*) were estimated for each AEDC domain.

Inspection of frequencies showed that data were not missing at random, with Aboriginal children and children with ESL more likely to have missing data. To account for any potential bias missing data may be introducing to the models, missingness was included as an additional category in all regression models. This method was chosen over excluding cases with missing values, since this would have excluded a large proportion of the target population. Adjusted models were also run excluding cases with missing information ($n = 4,504$). The overall pattern of results was the same; however, *ORs* were slightly inflated. Therefore, the models presented in this paper are more conservative models.

Results

A total of 2,879 (12.60%) children had a diagnosed chronic illness. Of these, 2,667 (92.60%) had one diagnosis in the study period, and 212 (7.40%) had two or more diagnoses. Chronic otitis media was the most prevalent diagnosis, followed by chronic respiratory disease, and epilepsy (Table 4-3).

Table 4-3
Prevalence of Different Chronic Illness Diagnoses

Diagnosis	Prevalence, <i>n</i> (%)
Chronic otitis media	2,038 (70.79)
Chronic respiratory disease	764 (26.54)
Epilepsy	86 (2.99)
Anaemia	80 (2.78)
Musculoskeletal disorders	41 (1.42)
Cardiovascular disease	39 (1.35)
Cancer	22 (< 1)
Diabetes	14 (< 1)
Malnutrition	11 (< 1)
Obesity	7 (< 1)
Chronic renal disease	5 (< 1)
Cystic fibrosis	5 (< 1)
Chronic liver disease	1 (< 1)

Regression Analyses

In the adjusted models, *ORs* were adjusted for the effects of the sociodemographic variables listed in Table 4-2. Holm's *p*-value correction was applied to account for multiple hypothesis testing (Gaetano, 2013; Holm, 1979). Models were initially run separately by gender, however *ORs* were largely equivalent for all AEDC domains (maximum difference between *ORs* for girls and boys was 0.10), so results were combined.

In the unadjusted models, chronic illness was associated with increased odds of developmental vulnerability across all domains (Table 4-4). These effects were attenuated, but still evident, in the adjusted models (see Appendix III for the complete table of results). Children were around 20-35% more likely to be classified as vulnerable/at-risk on all AEDC domains if they had a chronic illness, compared to their well peers.

Table 4-4

Unadjusted and Fully-adjusted^a Odds of Being Classified as Developmentally Vulnerable/At-risk on the Australian Early Development Census as an Outcome of Child Chronic Illness

AEDC Domain	Unadjusted			Fully-adjusted ^a		
	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b
Physical Health & Wellbeing	1.43	[1.31, 1.56]	.001	1.34	[1.22, 1.46]	.001
Social Competence	1.44	[1.32, 1.57]	.001	1.36	[1.25, 1.49]	.001
Emotional Maturity	1.40	[1.29, 1.53]	.001	1.33	[1.22, 1.45]	.001
Communication Skills & General Knowledge	1.33	[1.22, 1.46]	.001	1.30	[1.18, 1.42]	.001
Language & Cognitive Skills	1.27	[1.17, 1.37]	.001	1.19	[1.09, 1.30]	.001

Note. Significant results at $p < .05$ indicated in bold. AEDC=Australian Early Development Census, *OR*=Odds ratio, *CI*=Confidence Interval.

^a Adjusted for parental chronic illness; child ethnicity; parent age; mother's marital status; child's ESL status; and local community socioeconomic disadvantage and remoteness indices. ^b adjusted *p*-values after Holm's correction applied.

To examine whether there was an elevated risk for children with multiple chronic illnesses, analyses were run to determine the odds of being classified as vulnerable/at-risk for children with a single or multiple diagnosis/es, compared to children with no diagnosis. Table 4-5 presents the fully adjusted models. Children with any single chronic illness diagnosis were at increased risk of developmental vulnerability on all AEDC domains compared to children without a diagnosis, with a 17-34% increase in risk. Children with two or more diagnoses during the study period were also more likely to be classified as vulnerable/at-risk on all AEDC domains, with a 53-85% increase in risk. We then modelled the risk associated with multiple diagnoses compared to single diagnoses, with single diagnosis as the reference group (Table 4-5). This did not represent a statistically significant difference (all *ps* > .05).

Table 4-5

Fully-adjusted^a Odds of Being Classified as Developmentally Vulnerable/at-risk on the Australian Early Development Census as an Outcome of Single or Multiple Chronic Illness Diagnosis

AEDC Domain	Single vs no diagnosis			Multiple vs no diagnosis			Single vs multiple diagnoses		
	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b
Physical Health & Wellbeing	1.32	[1.20, 1.45]	.001	1.61	[1.20, 2.16]	.001	0.82	[0.61, 1.11]	.54
Social Competence	1.34	[1.22, 1.47]	.001	1.65	[1.23, 2.21]	.003	0.81	[0.60, 1.10]	.44
Emotional Maturity	1.32	[1.20, 1.44]	.001	1.53	[1.15, 2.05]	.005	0.86	[0.64, 1.16]	.54
Communication Skills & General Knowledge	1.26	[1.14, 1.38]	.001	1.85	[1.38, 2.49]	.006	0.68	[0.50, 0.92]	.08
Language & Cognitive Skills	1.17	[1.07, 1.27]	.001	1.54	[1.16, 2.05]	.006	0.75	[0.56, 1.01]	.28

Note. Significant results at $p < .05$ indicated in bold. AEDC=Australian Early Development Census, *OR*=Odds ratio, *CI*=Confidence Interval.

^a Adjusted for parental chronic illness; child ethnicity; parent age; mother's marital status; child's ESL status; and local community socioeconomic disadvantage and remoteness indices. ^b adjusted p -values after Holm's correction applied.

Follow-up analyses examined whether there were disease-specific risks associated with AEDC scores (Table 4-6). These analyses estimated the odds of being classified as vulnerable/at-risk on the AEDC for children with a single diagnosis of any one of the three most prevalent conditions (chronic otitis media, chronic respiratory disease, and epilepsy), compared to children without a chronic illness diagnosis. An increase in risk of developmental vulnerability was seen on all domains for children with a single diagnosis of otitis media ($n = 1,859$; 15-35% increase) and respiratory disease ($n = 618$; 24-45% increase); however, there was no significant increase in risk for children with a diagnosis of epilepsy ($n = 63$; all $ps > .05$). For otitis media and respiratory disease, overlapping CIs indicated similarity of effect.

Table 4-6

Fully-adjusted^a Odds of Being Classified as Developmentally Vulnerable/At-risk on the Australian Early Development Census as an Outcome of Child Chronic Illness Diagnosis Type

AEDC Domain	Chronic Otitis Media			Chronic Respiratory Disease			Epilepsy		
	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b
Physical Health & Wellbeing	1.30	[1.16, 1.45]	.001	1.37	[1.14, 1.64]	.001	1.11	[0.62, 1.98]	.99
Social Competence	1.35	[1.21, 1.50]	.001	1.45	[1.21, 1.73]	.003	0.79	[0.42, 1.47]	.99
Emotional Maturity	1.34	[1.20, 1.49]	.001	1.30	[1.09, 1.56]	.010	1.00	[0.57, 1.77]	.99
Communication Skills & General Knowledge	1.28	[1.14, 1.43]	.001	1.30	[1.08, 1.57]	.011	1.09	[0.61, 1.96]	.99
Language & Cognitive Skills	1.15	[1.04, 1.28]	.007	1.24	[1.05, 1.47]	.014	0.85	[0.49, 1.48]	.99

Note. Significant results at $p < .05$ indicated in bold. AEDC=Australian Early Development Census, *OR*=Odds ratio, *CI*=Confidence Interval.

^a Adjusted for parental chronic illness; child ethnicity; parent age; mother's marital status; child's ESL status; and local community socioeconomic disadvantage and remoteness indices. ^b adjusted p -values after Holm's correction applied.

Discussion

This study used linked population-level administrative data to examine the association between chronic illness and school readiness. As expected, children with chronic illness were at increased risk of being classified as vulnerable/at-risk on all developmental domains, compared to children without a chronic illness, even after controlling for sociodemographic characteristics. This indicates that chronically poor health in early childhood is a risk for school readiness, over and above the disadvantage conferred by socioeconomic factors. This increased risk was particularly evident for social and emotional capacities. Social and emotional vulnerability in pre-schoolers with chronic illness has been previously documented (Curtis & Luby, 2008; Newacheck & Stoddard, 1994), with the suggestion that children with poor health are more likely to be submissive and excluded from social activities (Meijer, Sinnema, Bijstra, Mellenbergh, & Wolters, 2000) and have low self-esteem (Shiu, 2004). School-based programs targeted at enhancing social and emotional abilities have been shown to lead to improvements in behavioural, social, and academic outcomes (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011). This may therefore be an important focus of intervention for chronically ill children.

Previous research has suggested that the negative impact on development increases with each additional chronic condition (Newacheck & Stoddard, 1994); however, our findings do not support this. Although children with multiple chronic illnesses had an increased risk of being classified as developmentally vulnerable, this was not significantly greater than the risk associated with having a single diagnosis. This suggests that the presence of just one chronic illness is enough to increase a child's risk for lower school readiness. Follow-up analyses also showed that the risk associated with chronic illness was not disease-specific, with similar risk levels seen for both chronic otitis media and respiratory disease. This finding is in line with previous research suggesting

commonalities between chronic conditions in terms of the impact they can have on the lives of the sufferer (Stein & Jessop, 1989). Our results support previous findings which suggest that chronic illness, in general, can interrupt the development of the skills children need for emotional, social, and physical progress (Goldfeld et al., 2015, 2012; Janus & Duku, 2007; Quach & Barnett, 2015).

There was no evidence of a significant association between epilepsy and developmental vulnerability in this study. This is contrary to previous research, which has found an increased prevalence of behavioural and cognitive problems in children with epilepsy compared to those without (Berg et al., 2007; Mitchell et al., 1991). This may be because the majority of epilepsy diagnoses in our cohort were either generalised idiopathic epilepsy, which is suggested to be associated with more mild impairments of social and educational function compared to other forms of epilepsy (Berg et al., 2005), or ‘epilepsy unspecified’ (convulsions, fits, or seizures not otherwise specified), which may capture children with more transient symptoms. Given the large body of research demonstrating adverse outcomes for children with epilepsy, we would caution against concluding from the findings of this study that epilepsy is not associated with developmental vulnerability for children.

Our findings suggest there is a need to broaden the scope of health conditions eligible for additional support at school entry. For instance, the most prevalent diagnosis was chronic otitis media; a common childhood condition which is associated with delayed language development, reading and spelling difficulties, and auditory processing deficits (Zinkus, Gottlieb, & Schapiro, 1979). Although recurrent ear infections may not be associated with significant limitations in daily activities, our study demonstrated that children with this condition are at increased risk of poor school readiness, even without having a more severe comorbid condition. We therefore echo the sentiments of others arguing for a move away from the diagnosis-based eligibility model for EI services

(Goldfeld et al., 2012; Janus & Duku, 2007; McDowell & O’Keeffe, 2012). A non-categorical view of chronic illness will inform the development of interventions applicable to children with chronic illness, broadly, which will be more relevant to a wider range of families than a disease-specific approach (Perrin et al., 1993). O’Connor and colleagues (2015) recently proposed that eligibility for EI services should be based on functioning rather than diagnosis. Our results support this approach, as they suggest that the negative association of chronic illness to school readiness is not disease-specific, and is pervasive across developmental domains. As such, multidisciplinary collaboration will be crucial in responding to the complex needs of these children.

One limitation of this study was the amount of missing parental information on sociodemographic variables. However, because missingness was included in the regression models, any bias created by missing information should be minimised. Also, it should be noted that hospital data may be subject to selection bias, since there is usually a higher rate of hospital admissions amongst disadvantaged groups, due to issues of availability and affordability of primary health care services (Bywood, Katterl, & Lunnary, 2011). There are also likely to be several un-measured sociodemographic variables influencing the association between chronic illness and school readiness, which could not be controlled for in this study. Lastly, because chronic illness was identified only from hospital datasets, it is possible that rates of chronic illness were underestimated, since in metropolitan areas, the majority of people will attend their primary care physician (and not a hospital) for management of chronic conditions (Australian Bureau of Statistics, 2011a). Emergency department data were only available for public hospitals and private hospitals under contract with the WA government; thus, this may have also resulted in under-estimation of chronic illness rates. The chronic illnesses identified in this study may therefore represent the more severe end of the spectrum. Future research should compare

rates of chronic disease recorded in hospital admissions with those recorded in general practice.

In conclusion, the findings of this study support the notion that chronic illness experienced in early childhood can influence the development of competencies which are critical to academic success. Although the increase in risk was generally small, the fact that these results are being seen at school entry, are pervasive across domains, and are likely to be additive over the child's trajectory, suggests that early intervention is required to ensure that these children do not fall behind their peers as they progress through school.

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Preface

Just as chronic illness in early childhood may limit a child physically, socially, emotionally, or cognitively, illness experienced at any time during the life-course may result in similar outcomes. As such, children may also be vulnerable to the impacts of serious and persistent illness experienced by their parents, as a consequence of limitations to the resources parents have available to support their children's development. The next two empirical studies examine additional features of the early childhood period that may predict developmental vulnerabilities at school entry: parental physical (Chapter 5) and psychiatric (Chapter 6) illness.

Chapter 5 - Developmental Vulnerabilities in Children of Chronically Ill Parents

Abstract

This study examined the association between parental chronic illness and the developmental outcomes of their young children, using linked administrative data. The study population included children born in Western Australia during 2003-2004 ($N = 19,071$; mean age 5.5 years). Child records were linked to parental health records. The outcome measure was a score in the bottom 25% on any of the five developmental domains of the Australian Early Development Census (2009 collection). Parental chronic illness information was taken from hospital records during the period from 1 year prior to the child's birth and until the end of 2009. Maternal chronic illness was associated with an increased risk of daughters experiencing developmental vulnerabilities in physical, social, emotional, and communication domains. Sons of chronically ill mothers were at increased risk of language and cognitive difficulties. Results of supplementary analyses were compatible with an increased risk of developmental vulnerabilities for children if their mother experienced multiple chronic conditions, compared to children whose mothers had a single chronic illness; however, results were not statistically significant (all $ps > .05$). This study did not find an association between fathers' chronic illness and children's developmental outcomes. The results show that maternal chronic illness is associated with an increased risk of negative developmental outcomes for children, particularly daughters. Further research is needed to determine the outcomes for children of mothers experiencing multi-morbidity. Healthcare services have an important role to play in linking families into appropriate family-centred services to best support their needs when the mother is chronically ill.

Introduction

Due to a combination of medical advances and an increasing incidence of lifestyle risk factors, rates of chronic illness are increasing (The Australian Institute of Health and Welfare, 2014). Chronic illnesses are physical conditions that are complex, prolonged, and difficult to treat (The Australian Institute of Health and Welfare, 2014). In general, individuals with chronic illnesses experience impaired physical, social, and role functioning, and reduced wellbeing, compared to healthy counterparts (Stewart et al., 1989). Awareness is also increasing that the impact of chronic illness extends beyond the patient to his/her immediate family (Anderson, Huth, Garcia, & Swezey, 2014; Armistead, Klein, & Forehand, 1995), especially to children. However, gaps remain in our knowledge in regards to the impact of parental chronic illness on children's outcomes.

Parental chronic illness has been associated with an increased risk of poor social and behavioural functioning (Bogosian, Moss-Morris, & Hadwin, 2010; Calvo et al., 2015; Chen, 2014; Kaasbøll, Lydersen, & Indredavik, 2012), academic underachievement (Chen & Fish, 2012, 2013; Sieh, Visser-Meily, & Meijer, 2013), and higher rates of internalising and externalising problems (Barkmann, Romer, Watson, & Schulte-Markwort, 2007; Diareme et al., 2006; Huizinga et al., 2011; Razaz et al., 2016; Sieh et al., 2013) in children. Qualitative research has also suggested an increased incidence of cognitive and physical difficulties in children of chronically ill parents (Visser, Huizinga, Van Der Graaf, Hoekstra, & Hoekstra-Weebers, 2004). The impact of parental chronic illness therefore appears to be wide ranging. Studies often find gender differences in children's outcomes, with much of the research finding that daughters are at greater risk of negative outcomes than sons (Huizinga et al., 2011; Kaasbøll et al., 2012), although there is some evidence for the opposite (Steck, Amsler, Kappos, & Bürgin, 2001). There is also some indication that children of ill mothers are at greater risk than children of ill fathers (Osborn, 2007; Pederson & Revenson, 2005). However, a lack of data on chronically ill

fathers precludes suppositions about the gendered effects of parental chronic illness (Barkmann et al., 2007; Visser et al., 2004).

There is also limited research on the association between parental chronic illness and outcomes for children younger than school-age (Barkmann et al., 2007; Romer, Barkmann, Schulte-Markwort, Thomalla, & Riedesser, 2002; Visser et al., 2004), with most research focusing on adolescents (Bogosian, Hadwin, Hankins, & Moss-Morris, 2016; Chen, 2014; Huizinga et al., 2011; Jantzer et al., 2013) or samples with a broad age range (Chen & Fish, 2012; Diareme et al., 2006; Watson et al., 2006). However, young children who are faced with parental chronic illness contend with a number of different factors relative to older children. Young children are rapidly developing a range of skills and abilities that set the foundation for later life achievement (Bracey, 2003; Forget-Dubois et al., 2009; Garon, Bryson, & Smith, 2008). Disruptions to this development due to stressful experiences, such as parental chronic illness, can have long-lasting negative consequences for children's lifetime health and wellbeing (Boivin & Hertzman, 2012; Shonkoff, 2003). Furthermore, chronically ill parents of young children must contend with the combined demands of child-rearing as well as coping with their illness and, as such, their physical, financial and emotional resources may be inadequate to meet the child's developmental needs (Rolland, 1999), contributing to the child's lower skill development. Similarly, young children perceive and cope with stress differently to older children (Skinner & Zimmer-Gembeck, 2007; Thastum, Johansen, Gubba, Olesen, & Romer, 2008), and tend to rely on their parents for co-regulation of their emotions (Johnston et al., 1992). Parents who are chronically unwell may be experiencing emotional distress in response to their illness (Razaz et al., 2016; Sidell, 1997; Steck et al., 2007), and may be less available to support the emotional development of their young children. Lastly, attachments with primary caregivers are formed during early childhood (Ainsworth, 1979). Parents' physical or emotional unavailability due to illness may adversely affect

attachment patterns (Armsden & Lewis, 1993), increasing the risk for the development of cognitive, social, emotional, and behavioural difficulties (Fraley, Roisman, & Haltigan, 2013; Sroufe, 2005). It is therefore necessary to examine the outcomes of young children separately from older age groups, to develop a greater understanding of the impact of parental chronic illness during the early childhood period.

There is currently no consensus in the literature as to the outcomes for young children of parents with chronic illness, with the available literature being limited and inconsistent. Some studies found an increased risk of developmental difficulties in children with chronically ill parents (Janus & Duku, 2007; Visser et al., 2004), others found no increase in risk (Razaz, Tremlett, et al., 2015; Visser et al., 2004), and at least one study found that children of chronically ill parents are *less* likely to be developmentally vulnerable than their peers with healthy parents (Razaz, Joseph, et al., 2015). It is therefore apparent that additional research is required in order to understand the outcomes of young children of parents with chronic illnesses. Such knowledge would help inform models of care to best support the family system of adults experiencing chronic illness.

Using linked population-level administrative data, this study examines the association between chronic illness in parents and the physical, social, emotional, communicative, and cognitive development of their young children. We examine the association between child development and maternal and paternal illness, for boys and girls separately, and hypothesise that young children of parents with chronic illness will be at risk of vulnerability on multiple developmental domains. As individuals who have multiple chronic conditions experience greater decreases in functioning and wellbeing than those who have a single chronic illness (Stewart et al., 1989), we also examine whether there is a greater risk to children if their parent has multiple chronic illness diagnoses, compared to a single diagnosis. Because health and developmental outcomes

are strongly linked to socioeconomic status (Siddiqi, Kawachi, Berkman, Hertzman, & Subramanian, 2012), the analyses take into account sociodemographic characteristics of the child, their family, and their community.

Methods

Ethics Approval

Ethics approval for this study was granted by the Western Australian (WA) Department of Health Human Research Ethics Committee, the University of Western Australia Human Research Ethics Committee, and the WA Aboriginal Health Ethics Committee.

Data Sources

This study used anonymised administrative data merged across the WA Department of Health and the Commonwealth Department of Education. Datasets were linked by the WA Data Linkage Branch by matching identifiers (e.g., name, address etc.) common to the sets of records (Holman et al., 2008). Details of databases used are outlined below.

Study Population

The sample included children born in WA during 2003-2004 who had a 2009 Australian Early Development Census (AEDC) record ($N = 20,653$), which was the developmental outcome measure used for this study. Children meeting the following criteria were excluded from the study: 1) missing AEDC domain scores ($n = 382$); 2) twins or triplets, in which case one child from each multiple birth was randomly selected (excluded $n = 274$); 3) identified by the teacher as 'special needs' in the AEDC dataset ($n = 753$); or 4) diagnosed with a developmental disorder (e.g., autism) or cerebral palsy ($n = 41$) in the Department of Health data collections (including hospital records and the WA Register of Developmental Anomalies). AEDC domain scores are not calculated for children identified as 'special needs', as these children have a diagnosed disability

(physical, intellectual) and already receive special assistance in school. Children with a developmental disorder or cerebral palsy were likewise excluded to limit the potential for confounding developmental outcomes with pre-existing conditions. An additional 132 children were excluded because their parent had died during the study period, which would likely have confounded the association between parental chronic illness and children's developmental outcomes. The final sample consisted of 19,071 children (mean age 5.5 years, $SD = 0.29$). Health and demographic information was also available for all mothers and 18,876 fathers (99%) of cohort children.

Outcome Measure

Developmental outcomes were assessed using the AEDC, which is based on the Canadian Early Development Instrument (Janus, Brinkman, & Duku, 2007). The AEDC is a population-based school readiness measure collected nationally every 3 years across Australia for children in their first year of formal schooling (in WA, the year prior to grade 1). Teachers complete 104 checklist items for each child in their class from which a score (from 0 to 10) is calculated for each of five developmental domains: physical, social, emotional, communication, and cognition (see Table 5-1). The method of calculating domain scores is the intellectual property of McMaster University in Canada. In accordance with these scoring methods, domain scores are analysed at the national level and classified into percentiles, with cut-offs based on the data collected in 2009. Children who score in the bottom 10% on a domain are considered 'developmentally vulnerable' on that domain; those in the bottom 11-25% as 'at risk'; and those in the top 75% as 'on track'. For this study, these three categories were collapsed into two ('vulnerable/at risk' and 'on track') to capture established and emerging developmental vulnerability.

Table 5-1

Description of Domains Assessed on the Australian Early Development Census

Domain	Areas Assessed
Physical Health & Wellbeing	Physical readiness for school day (e.g., dressed appropriately, fed) Physical independence Gross and fine motor skills
Social Competence	Overall social competence Responsibility and respect Approaches to learning (e.g., completion of work, following instructions, adaptability) Readiness to explore new things
Emotional Maturity	Pro-social and helping behaviour Anxious and fearful behaviour Aggressive behaviour Hyperactivity and inattention
Language & Cognitive Skills	Interest in literacy/numeracy and memory Basic literacy and advanced literacy Basic numeracy
Communication Skills & General Knowledge	Communication skills and general knowledge (e.g., story-telling, imaginative play, articulation, understanding of others)

Chronic Illness Measure

The list of chronic illnesses included in this study was developed from the 10 chronic physical conditions listed by the US Department of Health and Human Services (Goodman, Posner, Huang, Parekh, & Koh, 2013) and the list of conditions contributing to 80% of the disease burden in Australia (The Australian Institute of Health and Welfare, 2008). Diagnoses of chronic illness were identified from the Emergency Department data collection, which contains information on presentations to public hospitals in WA; and the Hospital Morbidity data collection, which includes information on episodes of care for public and private hospital separations in WA. Diagnoses in these datasets are recorded according to the International Classification of Diseases 10-Australian Modification (ICD-10-AM; National Centre for Classification in Health, 2004) coding (see Appendix IV for

the list of ICD-10-AM codes used in this study). Cancer diagnoses were obtained from the WA Cancer Registry. Parents were identified as having a chronic illness if they had at least one diagnosis of one of the selected chronic conditions recorded in any of the three datasets. Parents were categorised as ‘any diagnosis’ or ‘no diagnosis’. For supplementary analyses, parents in the ‘any diagnosis’ group were further categorised into ‘single diagnosis’ and ‘multiple diagnoses’, determined by summing all different major chronic illness diagnoses recorded in the datasets. The study period started 12 months prior to the child’s birth and continued to the end of 2009, to capture the impact of chronic illness on parenting, which includes the prenatal period.

Previous research has shown that children who experience chronic illness are at risk of developmental vulnerability (Bell, Bayliss, Glauert, Harrison, & Ohan, 2016; Goldfeld, O’Connor, Quach, Tarasuik, & Kvalsvig, 2015). Child chronic illness diagnoses were therefore also identified to account for inter-generational health disadvantage. Child diagnoses were determined from the same datasets as parent diagnoses, and the study period was from birth until the end of 2009. Child chronic illness diagnoses were identified based on the list used by Bell and colleagues (2016).

Covariates

Child, parent, and community sociodemographic characteristics were included as covariates (Table 5-2). Covariates were selected based on the findings of previous studies documenting an association with developmental outcomes of children (Boyle, Georgiades, Racine, & Mustard, 2007; Chen et al., 2007; Coley, Leventhal, Lynch, & Kull, 2013; Cooksey, 1997), and are detailed below.

Child characteristics.

Child gender and Aboriginality were determined from the Midwives Notification System, provided by the WA Health Department and Birth Registrations, provided by the Department of the Attorney General. These datasets contain information on birth and

pregnancy details for all births in WA, as well as demographic information on the child, mother, and father (if reported by the mother). From the AEDC dataset we identified children who spoke English as a second language, which was based on information from the enrolment record. Any missing data for Aboriginality not included in the Health datasets was also imputed from the AEDC dataset, which is also drawn from the child's enrolment record.

Aboriginality was included as a covariate as a proxy variable for a range of factors that Aboriginal children and their families may experience, and which may impact on developmental and health outcomes (De Bortoli & Thomson, 2010), such as institutional and interpersonal racial discrimination, reduced access to resources and opportunities, racial disparities in socioeconomic status, an increased incidence of psychosocial stressors, and intergenerational impacts of trauma (De Maio et al., 2005; Priest, Baxter, & Hayes, 2012; Priest, Perry, Ferdinand, Paradies, & Kelaher, 2014; Williams, Priest, & Anderson, 2016). As such, this variable is intended to account for social determinants of health and developmental outcomes of Aboriginal children and parents, rather than racial determinants.

Parent characteristics.

Maternal and paternal age and mother's marital status (at the time of the cohort member's birth) were obtained from the Midwives Notification System and Birth Registrations.

Community characteristics.

Community-level covariates were obtained from the AEDC dataset, which includes an identifier for the local community the child was living in at the time of AEDC completion. Local community remoteness and socioeconomic indices were determined by the Australian Standard Geographical Classification (ASGC; Australian Bureau of Statistics, 2011a) and Index of Relative Socioeconomic Disadvantage (IRSD; Australian

Bureau of Statistics, 2011b), respectively. The ASGC classifies a geographical area as metropolitan, inner/outer regional, or remote/very remote, based on the access to goods, services, and opportunities for social interaction in that area. Due to smaller cohort numbers outside the metropolitan areas, these five categories were collapsed into three (metropolitan, regional, remote). The IRSD is derived from census information that reflects area-level disadvantage such as low income, low educational attainment, high unemployment, and jobs in relatively unskilled occupations. Local communities were given a score ranging from 1 (most disadvantaged) to 5 (least disadvantaged).

Table 5-2
Sociodemographic Characteristics of the Study Cohort

Characteristic	Whole cohort, N (%)	Maternal chronic illness, n (%)	Paternal chronic illness, n (%)
Child's gender			
Female	9,404 (49.31)	810 (50.66)	681 (49.21)
Male	9,667 (50.69)	789 (49.34)	703 (50.79)
Ethnicity			
Aboriginal/Torres Strait Islander	1,304 (6.84)	179 (11.19)	95 (6.86)
Other*	17,767 (93.16)	1,420 (88.81)	1,289 (93.14)
Child speaks English as a second language			
No*	17,846 (93.58)	1,509 (94.37)	1,319 (95.30)
Yes	1,225 (6.42)	90 (5.63)	65 (4.70)
Child has a chronic illness			
No*	16,462 (86.32)	1,341 (83.86)	1,182 (85.40)
Yes	2,609 (13.68)	258 (16.14)	202 (14.60)
Mother's marital status at child's birth			
Single/never married	1,409 (7.39)	148 (9.26)	76 (5.49)
Divorced/widowed	223 (1.17)	38 (2.38)	21 (1.52)
Married*	17,358 (91.02)	1,401 (87.62)	1,281 (92.56)
<i>Missing</i>	<i>81 (0.42)</i>	<i>12 (0.75)</i>	<i>6 (0.43)</i>
Mother's age at child's birth			
< 20 years	1,011 (5.30)	94 (5.88)	51 (3.68)
20-29 years	8,264 (43.33)	677 (42.34)	489 (35.33)
30-39 years*	9,233 (48.41)	764 (47.78)	772 (55.78)
40 years+	563 (2.95)	64 (4.00)	72 (5.20)
Father's age at child's birth			
< 20 years	358 (1.88)	40 (2.50)	14 (1.01)
20-29 years	5,741 (30.10)	461 (28.83)	311 (22.47)
30-39 years*	10,108 (53.00)	804 (50.28)	765 (55.27)
40 years+	2,116 (11.10)	197 (12.32)	294 (21.24)
<i>Missing</i>	<i>748 (3.92)</i>	<i>97 (6.07)</i>	-

(continued)

Characteristic	Whole cohort, N (%)	Maternal chronic illness, n (%)	Paternal chronic illness, n (%)
Local community remoteness index			
Metropolitan*	12,317 (64.58)	972 (60.79)	872 (63.01)
Regional	4,812 (25.23)	445 (27.83)	371 (26.81)
Remote	1,942 (10.18)	182 (11.38)	141 (10.19)
Local community index for socioeconomic disadvantage			
1 (Most disadvantaged)	2,351 (12.33)	237 (14.82)	154 (11.13)
2	3,918 (20.54)	364 (22.76)	273 (19.73)
3	3,737 (19.60)	293 (18.32)	265 (19.15)
4	3,189 (16.72)	263 (16.45)	224 (16.18)
5 (Least disadvantaged)*	5,874 (30.80)	441 (27.58)	468 (33.82)

*Reference group for logistic regressions.

Statistical Analysis

Logistic regression models were fitted with maximum likelihood estimation using SAS version 9.3 for Windows (SAS Institute Inc, 2010). Analyses estimated the odds of children being classified as vulnerable/at-risk on each of the five AEDC domains as an outcome of parent chronic illness. Covariates were transformed into binary or continuous categorical variables with the category representing lower risk coded as the reference group (Table 5-2). Unadjusted and adjusted odds ratios (*OR*) and 95% confidence intervals (*CI*) were estimated for each AEDC domain. Adjusted models controlled for the covariates listed in Table 5-2, and parental chronic illness information was entered simultaneously. Analyses were run separately by child gender. Holm's *p*-value correction was applied to account for multiple hypothesis testing (Gaetano, 2013; Holm, 1979).

Missing Data

Missing data were identified on parental demographic variables for a total of 810 children. There were 62 (0.30%) children missing maternal marital status, 729 (3.80%) children missing paternal age, and 19 (< 0.001%) children missing data on both of these variables. Relative to children with complete parental demographic information, children

missing parental data were more likely to be Aboriginal (41.10%), ESL (16.70%), born to teenage mothers (23.50%), and living in remote locations (26.70%) and more disadvantaged communities (37.00%). Data were therefore not missing at random.

The missing indicator method was used to account for any potential bias that missing data may be introducing to the regression models, whereby missingness was included as an extra category in regression models. We also ran adjusted models including only cases with complete information ($N = 18,261$). The *ORs* from the complete-case analysis were at most 0.05 points larger than the *ORs* from the missing-indicator analysis. However, *CI*s were slightly wider. Therefore, for completeness of the sample and robustness of estimates, the results presented in this paper are from analyses using the missing indicator method.

Results

Prevalence

Frequencies of the different chronic illness diagnoses recorded for parents are shown in Table 5-3. During the study period, 1,599 mothers (8.38% of the total cohort) were diagnosed with a chronic illness, of which 99 mothers (6.19%, 0.52% of the total cohort) had more than one diagnosis recorded in the datasets (range 1-4 diagnoses). Cancer was the most common diagnosis (53.66%), followed by respiratory disease (16.07%) and cardiovascular disease (10.69%). There were 1,384 fathers (7.26% of the total cohort) with a chronic illness diagnosis during the study period, of whom 129 (9.32%, 0.68% of the total cohort) had multiple diagnoses (range 1-4 diagnoses). For fathers, musculoskeletal disorders were the most common (36.13%), followed by cancer (30.78%) and cardiovascular disease (20.09%).

Table 5-3
Prevalence of Different Chronic Illness Diagnoses

Diagnosis	Mothers	Fathers
	<i>n</i> (%)	<i>n</i> (%)
Cancer	858 (4.50)	426 (2.23)
Cardiovascular Disease	171 (< 1)	278 (1.46)
Chronic Liver Disease	4 (< 1)	10 (< 1)
Chronic Renal Disease	11 (< 1)	29 (< 1)
Diabetes	128 (< 1)	148 (< 1)
Neurological Conditions	109 (< 1)	55 (< 1)
Musculoskeletal Disorders	162 (< 1)	500 (2.62)
Respiratory Disease	257 (1.35)	92 (< 1)

Regression Analyses

Table 5-4 shows the unadjusted and adjusted *ORs* for children with a mother or father with chronic illness, compared to children whose parents did not have a chronic illness diagnosis (see Appendix V for the complete table of results). In the unadjusted models, maternal chronic illness was associated with an increased risk of daughters being classified as vulnerable/at-risk on all AEDC domains. Sons of chronically ill mothers also had an increased risk of being classified as vulnerable/at-risk on physical and cognitive domains. After adjusting for sociodemographic factors (Table 5-4), daughters of mothers with a chronic illness remained at increased risk of developmental vulnerability on the physical (32% increase), social (42% increase), emotional (25% increase) and communication (48% increase) domains. The *OR* for girls' vulnerability on the language and cognitive domain became non-significant. In the fully-adjusted models, results for sons of mothers with chronic illness were attenuated, with a significantly increased risk (32%) of developmental vulnerability for cognitive skills only. Paternal chronic illness was not associated with a significantly increased risk of developmental vulnerability for sons or daughters on any AEDC domain in either the unadjusted or fully-adjusted models (Table 5-4).

Table 5-4

Unadjusted and Fully-adjusted^a Odds of Children Being Classified as Developmentally Vulnerable/At-risk on the Australian Early Development Census as an Outcome of Parental Chronic Illness Diagnosis

AEDC Domain	Maternal Chronic Illness						Paternal Chronic Illness					
	Unadjusted			Fully-adjusted ^a			Unadjusted			Fully-adjusted ^a		
	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b
Physical Health & Wellbeing												
Girls	1.45	[1.22, 1.72]	.001	1.32	[1.11, 1.58]	.005	1.05	[0.86, 1.28]	.99	1.14	[0.93, 1.40]	.99
Boys	1.24	[1.06, 1.45]	.036	1.15	[0.98, 1.35]	.38	1.01	[0.85, 1.21]	.99	1.07	[0.89, 1.27]	.99
Social Competence												
Girls	1.58	[1.33, 1.89]	.001	1.42	[1.18, 1.71]	.001	0.98	[0.79, 1.21]	.99	1.10	[0.88, 1.38]	.99
Boys	1.16	[0.99, 1.35]	.13	1.08	[0.92, 1.27]	.89	0.96	[0.81, 1.13]	.99	1.02	[0.86, 1.21]	.99
Emotional Maturity												
Girls	1.36	[1.14, 1.63]	.001	1.25	[1.03, 1.50]	.042	0.91	[0.73, 1.13]	.99	0.97	[0.78, 1.22]	.99
Boys	1.17	[1.00, 1.36]	.13	1.09	[0.93, 1.27]	.89	0.90	[0.76, 1.06]	.99	0.94	[0.79, 1.11]	.99
Communication Skills & General Knowledge												
Girls	1.62	[1.36, 1.92]	.001	1.48	[1.24, 1.78]	.001	0.98	[0.80, 1.21]	.99	1.08	[0.87, 1.34]	.99
Boys	1.15	[0.98, 1.34]	.13	1.08	[0.91, 1.27]	.89	0.96	[0.81, 1.14]	.99	1.02	[0.85, 1.22]	.99
Language & Cognitive Skills												
Girls	1.30	[1.11, 1.52]	.001	1.18	[1.00, 1.39]	.05	0.96	[0.81, 1.15]	.99	1.04	[0.86, 1.25]	.99
Boys	1.42	[1.22, 1.64]	.001	1.32	[1.13, 1.53]	.002	0.95	[0.81, 1.12]	.99	1.01	[0.86, 1.19]	.99

Note. Significant results at $p < .05$ indicated in bold. AEDC=Australian Early Development Census, *OR*=Odds ratio, *CI*=Confidence Interval.

^a Adjusted for chronic illness in the other parent; child chronic illness; child Aboriginality; parent age; mother's marital status; child's ESL status; and local community socioeconomic disadvantage and remoteness indices. ^b adjusted p -values after Holm's correction applied.

Supplementary analyses.

Additional analyses were conducted to examine whether there was an increase in risk for children who had mothers with multiple chronic illnesses compared to children who had mothers with a single diagnosis. These models were not run for paternal chronic illness, as results in the previous models were non-significant. Table 5-5 shows the fully-adjusted models estimating the *ORs* for children of mothers with a single or multiple chronic illness diagnosis. Girls who had a mother with a single chronic illness diagnosis were more likely to be classified as vulnerable/at-risk on emotional (37% increase) and communication domains (45% increase), compared to daughters of mothers with no recorded diagnoses. When girls had a mother with multiple chronic illnesses, they were at significantly increased risk of vulnerability on the physical (168% increase) and social domains (123% increase). The *ORs* for all other domains were elevated but did not reach statistical significance, likely due to the small number of mothers with multiple diagnoses ($n = 99$). The *ORs* for the comparison of multiple to single maternal diagnoses also did not reach statistical significance, but all were compatible with an increased risk of developmental vulnerability on all AEDC domains for daughters of mothers with multiple chronic illnesses, compared to daughters of mothers with a single diagnosis, with a 39-115% increase in risk. Results for sons of mothers who had a single chronic illness diagnosis showed an increased risk of vulnerability on the language and cognitive skills domain (32% increased risk), but the *ORs* for all other AEDC domains were non-significant (Table 5-5). The *ORs* for sons of mothers with multiple chronic illness diagnoses also did not reach statistical significance, but were compatible with an increased risk of vulnerability on all developmental domains. Again, the *ORs* for the comparison analyses were not statistically significant, but suggested an increase in risk for physical, social, emotional and communication difficulties for sons of mothers with multiple chronic illnesses compared to sons of mothers with a single diagnosis.

Table 5-5

Fully-adjusted^a Odds of Children Being Classified as Developmentally Vulnerable/At-risk on the Australian Early Development Census as an Outcome of Mother's Single or Multiple Chronic Illness Diagnosis

AEDC Domain	Single vs no diagnosis			Multiple vs no diagnosis			Multiple vs single diagnoses		
	OR	95% CI	<i>p</i> ^b	OR	95% CI	<i>p</i> ^b	OR	95% CI	<i>p</i> ^b
Physical Health & Wellbeing									
Girls	1.24	[1.03, 1.49]	.06	2.68	[1.51, 4.74]	.004	2.15	[1.19, 3.90]	.06
Boys	1.12	[0.95, 1.33]	.76	1.67	[0.91, 3.06]	.38	1.49	[0.80, 2.79]	.75
Social Competence									
Girls	1.37	[1.13, 1.66]	.006	2.23	[1.22, 4.06]	.036	1.63	[0.87, 3.04]	.51
Boys	1.06	[0.90, 1.24]	.99	1.60	[0.88, 2.93]	.38	1.52	[0.82, 2.82]	.75
Emotional Maturity									
Girls	1.20	[0.99, 1.46]	.13	1.92	[1.05, 3.52]	.07	1.60	[0.85, 3.01]	.51
Boys	1.05	[0.89-1.23]	.99	1.90	[1.03, 3.51]	.20	1.82	[0.97, 3.41]	.32
Communication Skills & General Knowledge									
Girls	1.45	[1.20, 1.74]	.001	2.01	[1.10, 3.68]	.07	1.39	[0.74, 2.60]	.51
Boys	1.05	[0.88, 1.25]	.99	1.58	[0.85, 2.92]	.38	1.51	[0.80, 2.84]	.75
Language & Cognitive Skills									
Girls	1.15	[0.97, 1.36]	.13	1.65	[0.93, 2.95]	.09	1.44	[0.79, 2.62]	.51
Boys	1.32	[1.13, 1.55]	.002	1.16	[0.63, 2.15]	.64	0.88	[0.47, 1.65]	.75

Note. Significant results at $p < .05$ indicated in bold. AEDC=Australian Early Development Census, OR=Odds ratio, CI=Confidence Interval.

^a Adjusted for child chronic illness; child Aboriginality; parent age; mother's marital status; child's ESL status; and local community socioeconomic disadvantage and remoteness indices. ^b adjusted p -values after Holm's correction applied.

Discussion

This study examined the association between parental chronic illness and the developmental outcomes of their children. We focused on a sample of young children, as there is limited research on the outcomes of this age group separate to outcomes for older children. Based on literature documenting a range of important factors in the early childhood period that may increase the chances that young children will experience adverse outcomes when their parents are chronically ill (Armsden & Lewis, 1993; Boivin & Hertzman, 2012; Fraley et al., 2013; Johnston et al., 1992; Razaz et al., 2016; Rolland, 1999; Shonkoff, 2003; Sidell, 1997; Skinner & Zimmer-Gembeck, 2007; Sroufe, 2005; Steck et al., 2007; Thastum et al., 2008), we expected that our sample of children aged 5-6 years would be at risk of vulnerability on multiple developmental domains. In accordance with our expectations, we found that girls whose mothers had a chronic illness were at risk of physical, social, emotional, and communication difficulties and boys were at increased risk of cognitive difficulties. However, we did not find an association between paternal chronic illness and poor developmental outcomes in children. Our findings in relation to maternal chronic illness add to the existing literature by demonstrating a risk for early childhood development across a number of core competencies. This is consistent with a previous study which found children of mothers with poor self-rated health were at risk of lower development on a broad range of abilities (Janus & Duku, 2007), and expands on these findings by using a sample of mothers with diagnosed chronic illness. Our findings also concur with another study which found that physical illness in mothers, but not fathers, was associated with greater emotional and behavioural problems in children (Diareme et al., 2006). However, at least one study has found an association between paternal ill health and children's maladjustment (Romer et al., 2002), suggesting more research is needed to reach a consensus on the impact of paternal chronic illness on children.

The reason why paternal chronic illness was not a risk factor for the developmental abilities studied for our sample cannot be determined from the available information, but the available literature may offer some explanations. For instance, one study found that healthy mothers cope better with illness demands when the father is ill, compared to healthy fathers and ill mothers (Steck et al., 2001). Parental coping with their spouse's illness has been found to be related to how well children cope (Ehrensperger et al., 2008). Perhaps, therefore, children whose fathers are chronically unwell are protected from adverse effects by having a mother who compensates for the reduced resources the father has available for their children. Alternatively, children with chronically ill mothers may experience maladjustment due to the added burden maternal chronic illness may place on the family. This is supported by one study that found that maternal chronic illness impacts negatively on both the child and the spouse, with illness demands leading to feelings of depression and marital and parenting difficulties in the father (Lewis, Woods, Hough, & Bensley, 1989). Children with a chronically ill mother may therefore experience adverse outcomes because both their mother and father are lacking resources to provide the optimum environment for their development. However, without similar research on ill fathers and effects on mothers, it is difficult to draw such conclusions. Finally, fathers may be less involved in caregiving, particularly when ill, so children may have less exposure to their father's illness, and therefore there may be less impact on their development (Diareme et al., 2006). Investigation of features of the family context that may mediate the relationship between parental chronic illness and children's outcomes will be an important consideration for future research.

We also found gender differences in the association between children's outcomes and maternal chronic illness. Daughters appeared to be most at risk, particularly on physical, social, emotional, and communication domains. Our findings are consistent with studies on older children, which have found a greater incidence of social, emotional,

physical, and cognitive difficulties in adolescent girls, compared to daughters of healthy parents (Barkmann et al., 2007; Bogosian et al., 2010; Calvo et al., 2015; Chen, 2014; Compas, Worsham, Ey, & Howell, 1996; Diareme et al., 2006; Huizinga et al., 2011; Kaasbøll et al., 2012; Sieh et al., 2013; Visser et al., 2004). Hypotheses as to why girls may be more affected by maternal chronic illness than boys have been offered by other researchers, such as an expectation that girls should take on additional family responsibilities, or that girls are more emotionally involved in their families (Compas et al., 1994; Grant & Compas, 1995). However, this research has not been conducted with younger children, and as such, it is difficult to draw conclusions as to the mechanisms of risk transmission in our sample. We also found that boys of mothers with chronic illnesses were at risk of developmental vulnerability, but only for cognitive abilities. When we compared children of mothers with multiple and single chronic illnesses, results suggested that both girls and boys whose mothers had multiple chronic illnesses were at increased risk compared to those with a single diagnosis. However, due to the limited number of mothers in our sample we identified as experiencing more than one chronic illness during the study period, these results were not statistically significant. We therefore caution against drawing conclusions based on these analyses, and strongly recommend that further research is done with larger samples to more robustly assess the outcomes of children of mothers with multiple chronic conditions. Recently, attention has been drawn to the increased health-care costs and decreased quality of life for individuals suffering multiple chronic conditions (Parekh, Goodman, Gordon, & Koh, 2011). Although comorbidity of chronic illnesses is more common in the elderly, there is a substantial minority of adults of child-rearing age who have multiple chronic conditions (Hoffman, Rice, & Sung, 1996; Ward & Schiller, 2013). Currently, there is a lack of research on the impact of the increased illness demands for parents with multiple chronic conditions on their children. Our results suggest that this is an important area of future research.

Understanding how maternal chronic illness can impact on children's early development is important for developing interventions to minimise negative effects, and invites speculation based on previous findings. For example, if experienced during the prenatal period, poor maternal health may lead to preterm delivery or intrauterine growth retardation (Rogers & Velten, 2011), both of which have been associated with poorer developmental outcomes (Anderson & Doyle, 2003). Post-birth, chronic illness may limit a parent physically, financially, emotionally, or cognitively, meaning that they have fewer resources and are less available to care for their child (Romer et al., 2002). Parents who can provide stimulating and varied learning environments assist in the positive development of children's cognitive, social, emotional, and behavioural development (McWayne, Hampton, Fantuzzo, Cohen, & Sekino, 2004; Potter, Mashburn, & Grissmer, 2013; Sénéchal & Lefevre, 2002), demonstrating the critical importance of parental resources for children's early development. In addition, parents' emotional responses to their illness have also been suggested to predict children's outcomes more strongly than the severity or duration of the illness (Bogosian et al., 2016), indicating the importance of appropriate family support services when a parent is chronically unwell.

It has long been recommended that care for chronic illness takes a family-centred approach (Bamm & Rosenbaum, 2008), which involves addressing the needs of all family members (Gorter, Visser-Meily, & Ketelaar, 2010). However, this approach is not routinely implemented (Gorter et al., 2010; Umberger, Risko, & Covington, 2015), as there remain many barriers to implementing family-centred care (Bamm & Rosenbaum, 2008; Gorter et al., 2010), such as timing of referral, mode of referral, pre-existing family problems, a lack of education among professionals, and a lack of standardised guidelines for when intervention should be provided (Romer et al., 2007). Yet, there is promising evidence for the effectiveness of such interventions in improving children's coping skills and decreasing family emotional distress (Horner, 2013; Rosenbaum, King, Law, King, &

Evans, 1998; Thastum, Munch-Hansen, Wiell, & Romer, 2006). Healthcare professionals are in a unique position to link families into appropriate services: in the early years, young children generally have more exposure to healthcare services than to education services, and healthcare services can readily identify chronically ill patients who are also parents. An increased recognition of the importance of family-centred interventions for chronically ill parents, as well as efforts to address the barriers to implementing them, are both essential if we are to better support at-risk families.

The strengths of our study include the use of a population-based sample, use of diagnostic health information instead of self-report measures, and use of a standardised population measure of child development. One limitation of this study was the missing information on parental demographic variables. However, because missingness was included in the regression models, any effect of bias created by missing information should be minimised. There are also likely to be several un-measured sociodemographic variables influencing the association between parental chronic illness and children's school readiness, which could not be controlled for in this study. Also, it should be noted that hospital data may be subject to selection bias, since there is usually a higher rate of hospital admissions amongst disadvantaged groups, due to issues of availability and affordability of primary health care services (Bywood, Katterl, & Lunnary, 2011). In addition, chronic conditions requiring hospitalisation are likely to be more severe and/or poorly managed than chronic conditions treated wholly in primary care. Lastly, because chronic illness was identified only from hospital datasets, it is possible that rates of chronic illness were underestimated, since in metropolitan areas, the majority of people will attend their primary care physician for management of chronic conditions, rather than attend a hospital (Australian Bureau of Statistics, 2011). For instance, prevalence estimates indicate that cardiovascular and endocrine/metabolic diseases and musculoskeletal disorders are the most common chronic illnesses seen in primary care (Harrison, Britt,

Miller, & Henderson, 2013), whereas the most common chronic illnesses in our sample were cancer, respiratory, and cardiovascular diseases, and musculoskeletal disorders. Parental cancer was identified in our study from the Cancer Registry, which includes information on all cancer diagnoses in WA. It is therefore likely that we have accurately identified cancer prevalence in our sample, but under-identified other chronic illness diagnoses. Emergency department data were only available for public hospitals and private hospitals under contract with the WA government; thus, this may have also resulted in under-estimation of chronic illness rates. Due to unavailability of linked primary care data in WA it is possible that children in our comparison group have parents with a chronic illness, which we could not identify through the available datasets. If this is the case, we expect that we have underestimated the association between parental chronic illness and children's developmental outcomes, relative to comparisons of exclusive samples of children with and without chronically ill parents. As such, our estimates would be more conservative.

In conclusion, the findings of this study provide further evidence that maternal chronic illness is associated with an increased risk of adverse outcomes for children. Specifically, we added to the limited literature base examining outcomes in young children, and demonstrated that girls exposed to maternal chronic illness in the early childhood period are at risk of poor development on social, emotional, physical, and communication domains and boys are at risk of cognitive difficulties. We did not find any evidence of an increased risk for children of chronically ill fathers. Therefore, it is essential that maternal health status is considered when supporting children's early development, and that treatment of chronic illness considers the broader impacts on the patient's family. Early intervention is especially important, as the impact of this family-level adversity may compound negative effects on children's development as they progress through school. Future research into potential mediating and moderating factors

at the child, family and system level will provide important information for development of services to support families at risk of negative outcomes.

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Chapter 6 - Parental Psychiatric Hospitalisation is Associated with a Risk for Children's School Readiness

Abstract

Children of parents who have been hospitalised for mental illness are at increased risk of psychopathology and emotional and behavioural difficulties. However, less is known about the impact on children's school readiness, which is linked to later academic achievement. This study assessed whether parental psychiatric hospitalisation is associated with lower school readiness in children. Readiness in multiple developmental domains (physical, social, emotional, communication and cognitive) for 19,071 Western Australian children (mean age 5.5 years) was measured by the Australian Early Development Census (AEDC), conducted by teachers in the first year of formal schooling. AEDC scores were linked to parental psychiatric hospitalisation records, which included information on diagnosis and hospital admission type (frequency and duration of admissions). Adjusted logistic regression models estimated the odds of children of parents with psychiatric hospitalisations being developmentally vulnerable. Parental psychiatric hospitalisation in the early childhood period was associated with increased risk of children being classified as vulnerable/at-risk for school readiness, over and above sociodemographic factors. This increase in risk was evident regardless of the gender of the parent, and the duration of the parent's hospitalisation. The results demonstrate that children of parents who have had a psychiatric hospitalisation are at risk for lower school readiness. This finding adds weight to the argument that care for adult psychiatric inpatients needs to be coordinated and integrated to meet the needs of the family, rather than only taking an individualised approach.

Introduction

The cognitive, emotional, social, and behavioural capacities that underlie academic competence rapidly develop during early childhood (Forget-Dubois et al., 2007; Garon, Bryson, & Smith, 2008; Lloyd & Hertzman, 2009). Parental mental illness can impact on this early development, so that offspring may not optimally develop the skills and abilities they require for school success (Baker & Iruka, 2013). In particular, hospitalisation of a parent due to mental illness can cause extreme stress for offspring (Fudge & Mason, 2004; Handley, Farrell, Josephs, Hanke, & Hazelton, 2001; Maybery, Ling, Szakacs, & Reupert, 2005). Parental psychiatric hospitalisation brings a number of added stressors for the child, including family disruption, changes to living arrangements, and uncertainty relating to the parent's prognosis, duration of absence, and discharge plans (Fudge & Mason, 2004; Maybery et al., 2005; Shachnow, 1987; Somers, 2007). Although this event may be stressful for the child, it is also an opportune time for identification of at-risk children and implementation of appropriate interventions (Shachnow, 1987). Whilst there are recommendations to incorporate evaluations of child wellbeing into psychiatric assessment for patients who are parents (Nicholson, Geller, Fisher, & Dion, 1993; Reupert & Maybery, 2007), questions remain regarding the impact of parental psychiatric hospitalisation on the development of children's abilities that are critical for school success. This information is particularly needed for fathers, as the majority of research to date has been conducted with mothers.

Parental mental illness in the early years can have a profound influence on a child's academic trajectory. For example, recent evidence shows that children exposed to parental depression in the early childhood period finish secondary school with lower academic abilities than their peers (Shen et al., 2016). It is less clear, however, whether this impact is evident at the start of school. This can be examined by investigating the relationship between parental psychiatric hospitalisations and children's school readiness.

Measures of school readiness provide a profile of a child's cognitive, intellectual, psychosocial, emotional, physical, and communicative abilities at the point that they enter school (Guhn, Gadermann, & Zumbo, 2007; Janus & Duku, 2007). There is substantial evidence that these skills predict children's later school achievement (Bracey, 2003; Duncan et al., 2007; Forget-Dubois et al., 2007), and can shape life trajectories in health and wellbeing (Keating & Hertzman, 1999). Of the few studies that have examined the link between parental mental illness and school readiness in offspring, all have found evidence for poorer outcomes (Baker & Iruka, 2013; Kersten-Alvarez et al., 2012; Sinclair & Murray, 1998). However, these studies limited their conceptualisation of school readiness to academic achievement or adjustment to the school experience. The current study will build on previous research by examining the broad range of skills children need to be 'ready' for school. In addition, given that severity and chronicity of mental illness are particularly important for determining child and parenting outcomes (Mowbray, Oyserman, Bybee, & Macfarlane, 2002; NICHD Early Child Care Research Network, 1999; Oyserman, Mowbray, Meares, & Firminger, 2000; Rogosch, Mowbray, & Bogat, 1992), and those receiving inpatient care are likely to have more severe and persistent mental illness (Montgomery & Kirkpatrick, 2002), we will examine whether children's school readiness is related to parental psychiatric hospitalisation.

This linked-data study uses a population-based sample, which overcomes the problems of sample bias often encountered in mental health research due to opt-in recruitment (Haapea et al., 2008; Newson, Karlsson, & Tiemeier, 2011), and enables inclusion of both mothers and fathers. Children's school readiness is assessed using a teacher-reported measure, which provides a profile of children's cognitive, psychosocial, emotional, physical, and communicative abilities at school entry (Guhn, Janus, & Hertzman, 2007; Janus & Duku, 2007). We hypothesise that children whose parents were hospitalised for mental illness during the early childhood period will be at increased risk

of lower school readiness, compared to children of parents who were not. Furthermore, we expect that children of parents with more frequent and longer duration hospitalisations will be at highest risk of poor school readiness.

Method

Ethics Approval

Ethics approval for this study was granted by the Western Australian (WA) Department of Health Human Research Ethics Committee, the University of Western Australia Human Research Ethics Committee, and the WA Aboriginal Health Ethics Committee.

Data Sources

This linked-data study used anonymised administrative data merged across the WA Department of Health and the Commonwealth Department of Education. Datasets were linked by the WA Data Linkage Branch by matching identifiers common to the sets of records (e.g., name, address etc.), using a probabilistic matching approach and clerical review (Holman et al., 2008).

Study Population

The study included children born in WA during 2003-2004 with a 2009 Australian Early Development Census (AEDC) record ($N = 20,653$). Children were excluded from analyses if they: 1) had missing AEDC scores ($n = 382$); 2) were from a multiple birth, in which case one child from each twin or triplet set was randomly selected (excluded $n = 274$); 3) had a parent who had died during the study period ($n = 132$); 4) were identified by the teacher as 'special needs' in the AEDC dataset ($n = 753$); or 5) had a diagnosis of developmental disorder (e.g., autism) or cerebral palsy in the Health Department datasets ($n = 41$). Children considered as 'special needs' are those with a diagnosed disability (physical, intellectual), as identified on the child's school record. AEDC domain scores are not calculated for these children, since they have already been identified as having

substantial developmental needs, and are receiving in-school assistance. Children with a developmental disorder or cerebral palsy were likewise excluded to limit the potential for confounding school readiness outcomes with pre-existing developmental conditions. The final study sample consisted of 19,071 children (mean age 5.5 years, $SD = 0.29$). Maternal health and demographic information was also available for all children and paternal health and demographic information for 18,876 children (99%).

Outcome Measure

Children's school readiness was assessed using the AEDC, which is based on the Canadian Early Development Instrument (EDI; Janus, Brinkman, & Duku, 2007) and is completed nationally every 3 years on children in their first year of formal schooling (in WA, the year prior to grade 1). The EDI is a reliable and valid measure (Brinkman et al., 2007; Forget-Dubois et al., 2007; Janus, Brinkman, & Duku, 2011; Janus & Duku, 2007), which has been shown to predict children's academic achievement and socio-emotional development throughout elementary school (Brinkman et al., 2013; Davies, Janus, Duku, & Gaskin, 2016; Forget-Dubois et al., 2007; Guhn, Gadermann, Almas, Schonert-Reichl, & Hertzman, 2016). In the first half of the academic year, teachers complete 104 checklist items for each child in their class, from which a score (from 0 to 10) is calculated for each of five developmental domains (Table 6-1). The method of calculating domain scores is the intellectual property of McMaster University. In accordance with these scoring methods, AEDC domain scores are analysed at the national level and classified into percentiles, with cut-offs based on the data collected in 2009. Children who score in the bottom 10% of a domain are considered 'developmentally vulnerable', on that domain; those in the bottom 11-25% as 'at risk'; and those in the top 75% as 'on track'. For this study, these three categories were collapsed into two ('vulnerable/at risk' and 'on track') to capture established and emerging developmental vulnerability.

Table 6-1

Description of Domains Assessed for the Australian Early Development Census

Domain	Areas Assessed
Physical Health & Wellbeing	Physical readiness for school day (e.g., dressed appropriately, fed) Physical independence Gross and fine motor skills
Social Competence	Overall social competence Responsibility and respect Approaches to learning (e.g., completion of work, following instructions, adaptability) Readiness to explore new things
Emotional Maturity	Pro-social and helping behaviour Anxious and fearful behaviour Aggressive behaviour Hyperactivity and inattention
Language & Cognitive Skills	Interest in literacy/numeracy and memory Basic literacy and advanced literacy Basic numeracy
Communication Skills & General Knowledge	Communication skills and general knowledge (e.g., storytelling, imaginative play, articulation, understanding of others)

Parental Psychiatric Hospitalisations

Parental psychiatric hospitalisations were identified from the Hospital Morbidity data collection provided by the WA Health Department. This database contains information on episodes of care for all public and private hospital separations. Diagnostic information was recorded using the International Classification of Diseases, Tenth Revision, Australian Modification (ICD-10-AM; National Centre for Classification in Health, 2004) and these codes were used to identify parental diagnoses of mental illness. A list of ICD-10-AM codes used in this study is included in Appendix VI. Parents were recorded as having a psychiatric hospitalisation if they had a hospital admission during the study period with a primary diagnosis of mental illness, or if they were admitted for a self-inflicted injury or poisoning, and received psychiatric care during their hospital stay. The

study period started 12 months prior to the cohort member's birth and up to the end of 2009. This period was chosen to capture psychiatric hospitalisations during the period of parenting, which includes the prenatal period.

Details of parental psychiatric hospitalisations were also identified. All parental records meeting the above criteria were summed to determine the total number of psychiatric hospitalisations a parent had during the study period. Length of stay information was also recorded for all admissions. Parents were grouped into one of three categories according to their total psychiatric hospitalisations, and length of hospital stay: '1 admission, 1 day', '1 admission, 2 or more days', or 'multiple admissions'.

Covariates

Child, parent, and community sociodemographic characteristics were included as covariates in the regression models, transformed into binary or continuous categorical variables with the category representing lower risk coded as the reference group (Table 6-2). Variables were selected based on findings of previous studies documenting an association with developmental outcomes of children (Boyle, Georgiades, Racine, & Mustard, 2007; Chen et al., 2007; Cooksey, 1997)

Child characteristics.

Child gender, year of birth, and Aboriginality were obtained from the Midwives Notification System, provided by the WA Health Department, and Birth Registrations, from the Registry of Births, Deaths and Marriages. These datasets contain pregnancy and birth information for all births in Western Australia. In the AEDC dataset, teacher-reported information identified children who spoke English as a second language (ESL). If there were any values for Aboriginality missing from birth information, this was imputed from the AEDC dataset, which takes this information from the child's school enrolment record. Aboriginality was included as a proxy variable for a range of contextual factors that Aboriginal children and their families may experience which may impact on health

and developmental outcomes (De Bortoli & Thomson, 2010), such as institutional and interpersonal racial discrimination, reduced access to resources and opportunities, racial disparities in socioeconomic status, an increased incidence of psychosocial stressors, and intergenerational impacts of trauma (De Maio et al., 2005; Priest, Baxter, & Hayes, 2012; Priest, Perry, Ferdinand, Paradies, & Kelaher, 2014; Williams, Priest, & Anderson, 2016). As such, any associations between Aboriginality and developmental outcomes in this study should be viewed as social rather than racial determinants.

Parent characteristics.

Parental age and mother's marital status were also obtained from the Midwives Notification System and Birth Registrations, and were recorded at the time of the child's birth.

Community characteristics.

In the AEDC dataset, each child is assigned a code for the local community in which they were residing at the time of AEDC completion. Each local community ID has corresponding values for the Australian Standard Geographical Classification (ASGC; Australian Bureau of Statistics, 2011a) and Index of Relative Socioeconomic Disadvantage (IRSD; Australian Bureau of Statistics, 2011b), which are determined by the Australian Bureau of Statistics. The ASGC classifies a geographical area as metropolitan, inner/outer regional, or remote/very remote, based on the access to goods, services, and opportunities for social interaction in that area. Due to smaller cohort numbers outside the metropolitan areas, these five categories were collapsed into three (metropolitan, regional, remote). The IRSD is derived from census information that reflects area-level disadvantage such as low income, low educational attainment, high unemployment, and jobs in relatively unskilled occupations. Local communities were given a score ranging from 1 (most disadvantaged) to 5 (least disadvantaged).

Table 6-2
Demographic Characteristics of the Sample

Characteristic	Whole cohort, N (%)	Maternal inpatient, n (%)	Paternal inpatient, n (%)
Child's gender			
Female	9,404 (49.31)	358 (49.79)	206 (49.40)
Male	9,667 (50.69)	361 (50.21)	211 (50.60)
Ethnicity			
Aboriginal/Torres Strait Islander	1,304 (6.84)	157 (21.84)	89 (21.34)
Other*	17,767 (93.16)	562 (78.16)	328 (78.66)
Child speaks English as a second language			
No*	17,846 (93.58)	671 (93.32)	379 (90.89)
Yes	1,225 (6.42)	48 (6.68)	38 (9.11)
Mother's marital status at child's birth			
Single/never married	1,409 (7.39)	146 (20.31)	70 (16.79)
Divorced/widowed	223 (1.17)	28 (3.89)	12 (2.88)
Married*	17,358 (91.02)	532 (73.99)	332 (79.62)
<i>Missing</i>	<i>81 (0.42)</i>	<i>13 (1.81)</i>	<i>3 (0.72)</i>
Mother's age at child's birth			
<20 years	1,011 (5.30)	98 (13.63)	56 (13.43)
20-29 years	8,264 (43.33)	388 (53.96)	203 (48.68)
30-39 years*	9,233 (48.41)	220 (30.60)	148 (35.49)
40 years+	563 (2.95)	13 (1.81)	10 (2.40)
Father's age at child's birth			
<20 years	358 (1.88)	22 (3.06)	24 (5.76)
20-29 years	5,741 (30.10)	276 (38.39)	184 (44.12)
30-39 years*	10,108 (53.00)	241 (33.52)	173 (41.49)
40 years+	2,116 (11.10)	61 (8.48)	36 (8.63)
<i>Missing</i>	<i>748 (3.92)</i>	<i>119 (16.55)</i>	-
Local community remoteness index			
Metropolitan*	12,317 (64.58)	389 (54.10)	223 (53.48)
Regional	4,812 (25.23)	214 (29.76)	126 (30.22)
Remote	1,942 (10.18)	116 (16.13)	68 (16.31)

(continued)

Characteristic	Whole cohort, <i>N</i> (%)	Maternal inpatient, <i>n</i> (%)	Paternal inpatient, <i>n</i> (%)
Local community index for socioeconomic disadvantage			
1 (Most disadvantaged)	2,351 (12.33)	184 (25.59)	93 (22.30)
2	3,918 (20.54)	179 (24.90)	120 (28.78)
3	3,737 (19.60)	134 (18.64)	83 (19.90)
4	3,189 (16.72)	90 (12.52)	44 (10.55)
5 (Least disadvantaged)*	5,874 (30.80)	131 (18.22)	77 (18.47)

*Reference group for logistic regressions.

Statistical Analysis

Logistic regression models were fitted with maximum likelihood estimation using SAS version 9.3 for Windows (SAS Institute Inc, 2010). This method modelled the odds of children of parents with a history of psychiatric hospitalisation being classified as vulnerable/at-risk on each of the five AEDC domains, compared to children whose parents did not have a record of a psychiatric hospitalisation during the study period. Unadjusted and adjusted odds ratios (*OR*) and 95% confidence intervals (*CI*) were estimated for each AEDC domain. Adjusted models controlled for the sociodemographic variables listed in Table 6-2. Mothers' and fathers' hospitalisation information were entered into the models simultaneously to take into account the hospitalisation of the other parent. Holm's *p*-value correction was applied to account for multiple hypothesis testing (Gaetano, 2013; Holm, 1979).

Results

Descriptive Statistics

Demographics.

Compared to children whose parents had no psychiatric hospitalisations, the sample of children whose parents had been hospitalised for mental illness included a

higher proportion of children who were Aboriginal, born to young or unmarried parents, and living in disadvantaged areas (Table 6-2).

Prevalence of parental psychiatric hospitalisations.

Table 6-3 displays the frequencies of different parental psychiatric diagnoses. There were 719 (3.77% of the total cohort) children with a mother who had a psychiatric hospitalisation during the study period. Of these mothers, 283 (39.36%; 1.48% of total cohort) had multiple hospitalisations (range 1-51 hospitalisations), and the average length of stay was 17 days ($SD = 38$ days). Maternal diagnoses were most frequently mood disorders (46.18%), followed by anxiety (40.75%) and substance abuse (27.82%) disorders.

A total of 417 (2.19% of the total cohort) children had a father who had a psychiatric hospitalisation during the study period. There were 182 fathers who had been hospitalised more than once (43.65%; 0.95% of total cohort; range 1-43 hospitalisations). The average length of stay in hospital for fathers was 19 days ($SD = 52$ days). The most common paternal diagnoses were substance abuse disorders (43.89%), followed by anxiety (36.45%), and mood (34.05%) disorders.

Table 6-3
Prevalence of Different Psychiatric Diagnoses.

Diagnostic group	Mothers, <i>n</i> (%)	Fathers, <i>n</i> (%)
Mood disorder	332 (1.74)	142 (< 1)
Anxiety disorder	293 (1.53)	152 (< 1)
Substance abuse disorder	200 (1.05)	183 (< 1)
Psychotic disorder	64 (< 1)	52 (< 1)
Personality disorder	40 (< 1)	22 (< 1)
Eating disorder	5 (< 1)	-
Organic disorder	2 (< 1)	6 (< 1)
Disorder of childhood	1 (< 1)	1 (< 1)
Developmental disorder	1 (< 1)	-
Other psychiatric diagnosis	1 (< 1)	1 (< 1)

Regression Analyses

Table 6-4 displays the unadjusted and fully-adjusted *ORs* for children of parents who had been hospitalised for psychiatric illness being classified as vulnerable/at-risk on the AEDC domains, compared to children whose parents had no psychiatric hospitalisations (see Appendix VII for the complete table of results). In the unadjusted models, children whose mother or father had been hospitalised for psychiatric care were at increased risk of developmental vulnerability on all developmental domains. Adjusting for demographic characteristics attenuated the results (Table 6-4). In the adjusted models, maternal psychiatric hospitalisation was associated with a 33-46% increase in risk of developmental vulnerability in children, across all measured domains. Similarly, paternal psychiatric hospitalisation was associated with a 31-40% increase in the odds of their children being developmentally vulnerable. Overlapping CIs indicated that the association between parental psychiatric hospitalisation and developmental vulnerability was similar for all AEDC domains.

Table 6-4

Unadjusted and Fully-adjusted^a Odds of Being Classified as Developmentally Vulnerable/At-risk on the Australian Early Development Census as an Outcome of Maternal or Paternal Psychiatric Hospitalisation

AEDC Domain	Unadjusted			Fully-adjusted ^a		
	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b
Physical Health & Wellbeing						
Maternal hospitalisation	1.98	[1.69, 2.32]	.001	1.46	[1.24, 1.72]	.001
Paternal hospitalisation	1.81	[1.48, 2.23]	.001	1.38	[1.11, 1.71]	.014
Social Competence						
Maternal hospitalisation	1.88	[1.61, 2.20]	.001	1.37	[1.16, 1.61]	.001
Paternal hospitalisation	1.81	[1.47, 2.22]	.001	1.37	[1.10, 1.69]	.014
Emotional Maturity						
Maternal hospitalisation	1.97	[1.69, 2.29]	.001	1.45	[1.24, 1.71]	.001
Paternal hospitalisation	1.77	[1.45, 2.17]	.001	1.40	[1.14, 1.73]	.008
Communication Skills & General Knowledge						
Maternal hospitalisation	1.74	[1.48, 2.04]	.001	1.33	[1.12, 1.58]	.001
Paternal hospitalisation	1.76	[1.43, 2.16]	.001	1.31	[1.05, 1.63]	.018
Language & Cognitive Skills						
Maternal hospitalisation	2.06	[1.77, 2.39]	.001	1.45	[1.24, 1.70]	.001
Paternal hospitalisation	1.72	[1.42, 2.10]	.001	1.31	[1.07, 1.61]	.018

Note. Significant results at $p < .05$ indicated in bold. AEDC=Australian Early Development Census, *OR*=Odds ratio, *CI*=Confidence Interval.

^a Adjusted for psychiatric hospitalisation of the other parent; child Aboriginality; parent age; mother's marital status; child's ESL status; and local community socioeconomic disadvantage and remoteness indices. ^b Adjusted p -values after Holm's correction applied.

We then examined the outcomes of children according to the characteristics of their parents' psychiatric hospitalisation. As the *ORs* for maternal and paternal psychiatric hospitalisations in the previous models were largely equivalent, results for mothers and fathers were combined for these analyses. This required removal of data for 54 children who had both a mother and a father with a history of psychiatric hospitalisations, as it could not be determined which group these children should be assigned to due to differences in their parent's hospital stay characteristics.

Table 6-5 shows the results of the fully-adjusted logistic regression models predicting AEDC vulnerability as an outcome of parental hospitalisation type. Children whose parent had only one psychiatric admission which lasted 1 day were at increased risk of being vulnerable/at-risk on all AEDC domains (33-64% increase) compared to peers whose parents did not have a history of psychiatric hospitalisations. Children whose parent had only one psychiatric admission which lasted multiple days also had increased odds of being classified as vulnerable/at-risk on the physical (50% increase), emotional (40% increase) and language and cognitive skills (45% increase) domains. Results for the social and communication domains were also consistent with an increased risk of developmental vulnerability for these children, but were not statistically significant. Lastly, children whose parents had a history of two or more psychiatric hospitalisations were more likely than children whose parents had no psychiatric hospitalisations to be vulnerable/at-risk on all AEDC domains (36-60% increase in risk). Overlapping CIs for all *ORs* indicate a similarity of effect on school readiness regardless of hospitalisation type.

Table 6-5

Fully-adjusted^a Odds of Being Classified as Developmentally Vulnerable/At-risk on the Australian Early Development Census as an Outcome of Parental Psychiatric Hospitalisation Type

AEDC Domain	Single admission, 1 day (<i>n</i> = 226)			Single admission, 2+ days (<i>n</i> = 387)			Multiple admissions (<i>n</i> = 415)		
	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b
Physical Health & Wellbeing	1.56	[1.18, 2.06]	.006	1.50	[1.20, 1.86]	.002	1.44	[1.16, 1.78]	.002
Social Competence	1.60	[1.21, 2.12]	.004	1.27	[1.02, 1.59]	.05	1.52	[1.23, 1.87]	.001
Emotional Maturity	1.54	[1.16, 2.02]	.006	1.40	[1.13, 1.73]	.008	1.60	[1.30, 1.97]	.001
Communication Skills & General Knowledge	1.33	[1.00, 1.78]	.05	1.30	[1.03, 1.63]	.05	1.47	[1.19, 1.83]	.002
Language & Cognitive Skills	1.64	[1.24, 2.16]	.002	1.45	[1.18, 1.79]	.002	1.36	[1.11, 1.67]	.003

Note. Significant results at $p < .05$ indicated in bold. OR= Odds ratio, CI= Confidence Interval, AEDC = Australian Early Development Census.

^a Adjusted for child Aboriginality; parent age; mother's marital status; child's ESL status; and local community socioeconomic disadvantage and remoteness indices. ^b Adjusted p -values after Holm's correction applied.

Discussion

This study aimed to examine the school readiness of children whose parents had been hospitalised for mental illness. In accordance with our expectations, children whose mother or father had a history of psychiatric hospitalisations were at greater risk of developmental vulnerability in physical, social, emotional, communication, and cognitive domains, compared to children whose parents had not been hospitalised for psychiatric care. Our study builds on previous findings showing a negative effect of parental mental illness on specific child outcomes (Larsson, Knutsson-Medin, Sundelin, & Von Werder, 2000; Lee & Gotlib, 1989) by demonstrating that parental psychiatric hospitalisation creates a risk for children's development across a range of abilities that underlie academic success. These vulnerabilities have the potential to lead to lower academic ability in later childhood (Duncan et al., 2007), which would compound the impact of parental mental illness on offspring throughout the life course. We also add to the limited research examining mental illness in both parents, as we found that both maternal and paternal psychiatric hospitalisation was associated with increased risk of developmental vulnerability for their offspring, even after accounting for the psychiatric hospitalisation of the other parent. Our study therefore supports suggestions in previous research that paternal mental health is equally important for children's outcomes as maternal mental health (Ramchandani & Psychogiou, 2009).

We also expected that children whose parents were hospitalised for psychiatric care for frequently or for longer durations would experience greater difficulties in developmental domains compared to children whose parents were hospitalised only briefly, or not at all. Results did not support this expectation, with the increased risk of developmental vulnerability for children seen regardless of the frequency or length of time parents had been hospitalised. Our results indicate that if a parent's psychiatric illness is severe enough to require hospitalisation, even if only for a single day, there is an increased

risk of adverse outcomes for the child. It is possible that this outcome reflects the disruption to the child's life as a consequence of the acute episode of their parents' illness preceding the hospitalisation (Blanch, Nicholson, & Purcell, 1994; Fudge & Mason, 2004; Maybery et al., 2005; Mordoch & Hall, 2008), more so than the event of separation from the parent. Furthermore, the parents' psychiatric hospitalisation may simply be a marker of long-term underlying issues that the parent is experiencing, and which may impact on his/her capacity to support the child's development.

Our findings support previous recommendations (Cook & Steigman, 2000; Maybery & Reupert, 2009; Reupert & Maybery, 2007) that mental health professionals consider the impact of the adult patient's psychiatric illness on the developing child, in both treatment and discharge planning. Prevention and early intervention are both critical in ensuring vulnerable children have the greatest chance of being developmentally 'ready' when they start school. Identifying which psychiatric patients are also parents is a critical step, as this information is not always collected in mental health clinics (Blanch et al., 1994; Gatsou, 2016; Nicholson et al., 1993). When psychiatric patients are parents of young children, it may be necessary to shift focus away from the traditional individualised treatment, and towards a family-based model of care that incorporates collaborative relationships with the multiple services (e.g., medical, mental health, education, and early childhood) with which the family has contact (Blanch et al., 1994; Rishel, 2012). This can be difficult in an often-fragmented mental health system, where the separation of child and adult services can impede the ability to provide holistic services to address mental illness in the family context (Gatsou, 2016; National Mental Health Commission, 2014). However, our results suggest that steps must be taken to address these systemic barriers. Currently, children of parents with mental illness may only be identified as requiring support once they themselves present with an established emotional, behavioural, or academic difficulty, or if they are under the protection of the child welfare system (Nicholson,

Biebel, Hinden, Henry, & Stier, 2001). A preventative approach would involve implementing strategies prior to the establishment of difficulties in the child, commencing when the parent presents for inpatient treatment. Fudge and Mason (2004) suggested that such strategies may include: access to 'family friendly' facilities and support groups; identification of parent-patient at the initial contact; provision of mental health education to children and caregivers; and development of individual crisis plans to improve safety and care arrangements for children when their parent requires hospitalisation. Adult psychiatric interventions that consider the family context have been shown to reduce the burden of parental mental illness on children and young people (Falloon, 2003), demonstrating the importance of holistic interventions to meet the needs of the family.

Strengths of this study include use of an observer-rated measure of child school readiness, rather than relying on parent-report which, in psychiatric populations, can be influenced by the parent's mental state (Larsson et al., 2000; Luoma, Koivisto, & Tamminen, 2004). In addition, we used clinical diagnosis to identify parental mental illness, instead of self-reported measures of psychological distress, which can be also be affected by bias (Newson et al., 2011). However, a limitation of this study is that we used a dichotomous indicator for parental psychiatric disorder, which does not take into account the heterogeneous nature of psychiatric illness, which may be better viewed within a continuum (Newson et al., 2011). We also did not account for timing of exposure, which may alter the association between parental psychiatric hospitalisations and child development (Downey & Coyne, 1990; Hammen & Brennan, 2003). In addition, our results showed that children whose parents had been hospitalised for mental illness were more likely than their peers to experience other sociodemographic risk factors (e.g., low socioeconomic status, single parent families). Although these variables were covaried in the regression models, future research should specifically examine how these factors might mediate the association between children's school readiness outcomes and parental

psychiatric hospitalisation. There are also likely to be several un-measured sociodemographic variables influencing the association between parental psychiatric illness and school readiness, which could not be controlled for in this study

In conclusion, these findings lend support to the recommendation that children whose parents are hospitalised for mental illness need to be considered in the treatment and discharge planning for the adult. These children are at risk of developmental vulnerability on a range of competencies critical for academic success, which will likely compound over the child's academic trajectory if intervention does not take place. This association was found irrespective of the gender of the parent, and the length of time they were hospitalised. Intervention for families should ideally begin early to minimise the impact on a child's developmental capacities.

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Preface

Topics that are seen as the domain of the family are particularly difficult to research, due to the unwillingness of some individuals to divulge sensitive information that they perceive could be used to judge, sanction, or humiliate. The ways in which chronic physical illness and psychiatric hospitalisation may impact on children's early development are two such sensitive topics; however, there are other topics that can be even more difficult to investigate, due to factors such as stigma and issues of confidentiality. The final two empirical chapters of this thesis present investigations into the developmental vulnerabilities experienced by maltreated children (Chapter 7), and children whose parents have been involved with the criminal justice system (Chapter 8). Representative samples of these groups have been historically difficult to include in research, due to the highly sensitive nature of the information required to investigate how these factors impact on children's early development. Linkage of administrative data provides a unique opportunity to conduct these investigations, as it allows identification of individuals from high-risk groups, whilst protecting their anonymity.

Chapter 7 - School Readiness of Maltreated Children: The Impact of Timing, Type, and Chronicity of Maltreatment

Abstract

Children who have been maltreated during early childhood may experience a difficult transition into fulltime schooling, due to maladaptive development of the skills and abilities that are important for positive school adaptation. An understanding of how different dimensions of maltreatment relate to children's school readiness is important for informing appropriate supports for maltreated children. In this study, the Australian Early Development Census scores of 19,203 children were linked to information on child maltreatment allegations, including whether the allegation was substantiated or unsubstantiated, the type of alleged maltreatment, the timing of the allegation (infancy-toddlerhood or preschool), and the total number of allegations (chronicity). Children with substantiated or unsubstantiated maltreatment allegations were at risk of poor school readiness in cognitive and non-cognitive domains. Substantiated maltreatment was associated with poor social and emotional development in children, regardless of maltreatment type, timing, or chronicity. For children with unsubstantiated maltreatment allegations, developmental outcomes according to the type of alleged maltreatment were more heterogeneous; however, these children were also at risk of poor school readiness irrespective of the timing and/or chronicity of the alleged maltreatment. The findings suggest that all children with allegations of maltreatment are at risk for poor school readiness; hence, these children may need additional support to increase the chance of a successful school transition. Interventions should commence prior to the start of school to mitigate early developmental difficulties that children with a history of maltreatment allegations may be experiencing, with the aim of reducing the incidence of continuing difficulties in the first year of school and beyond.

Introduction

School can provide a stabilising environment and opportunities for building self-esteem and resilience for children experiencing adversity in their home lives (Gilligan, 2000; Veltman & Browne, 2001), but this requires that children have a level of physical, emotional, social, and cognitive competence that enables them to meet the demands of school. Ideally, children start school with a solid foundation of skills and abilities that enable them to respond to these demands (Duncan et al., 2007; Entwisle & Alexander, 1993; Forget-Dubois et al., 2009), increasing the probability of future school success (Bracey, 2003). It is now widely acknowledged that the transition from home to school marks an important role change for the child; and the success or otherwise of this event can influence a child's educational trajectory. For children who have experienced significant adversity in the early childhood period, the transition to school may be particularly difficult. One group of children who arguably experience the greatest adversity are those who have been maltreated. The effects of trauma may mean that these children are ill-equipped to handle the transition to school, heightening the difficulty of adapting to this new developmental challenge (Veltman & Browne, 2001).

School readiness is a multi-dimensional construct that incorporates the physical, social, emotional, communicative, and cognitive abilities that are important for positive adaptation to formal schooling (Diamond, 2010; Doherty, 1997; Guhn, Gadermann, & Zumbo, 2007). Maltreatment in the early childhood period has the potential to interrupt the development of these abilities, therefore impinging on children's readiness for school (Hildyard & Wolfe, 2002; Keiley, Howe, Dodge, Bates, & Petti, 2001). Indeed, there is substantial evidence that children who have been subject to maltreatment are at increased risk of social, emotional, behavioural and cognitive difficulties, which may place them at risk of starting school not ready to learn (e.g., Kovan, Mishra, Susman-Stillman, Piescher, & LaLiberte, 2014; Trickett & McBride-Chang, 1995; Trocmé & Counce, 1995; Veltman

& Browne, 2001; Wulczyn, Smithgall, & Chen, 2009). These difficulties may be a consequence of the trauma, the sociodemographic risks in the home, or a combination of both (Belsky, 1993; Brooks-Gunn & Furstenberg, 1986; Leiter & Johnsen, 1994). If early difficulties are not addressed, the ongoing challenges of the school environment can exacerbate problems. Evidence shows that maltreated children are more likely to be rejected by peers (Dodge, Pettit, & Bates, 2008; Rogosch, Cicchetti, & Aber, 1995; Salzinger, Feldman, & Hammer, 1993), have lower academic achievement (Barnett, Vondra, & Shonk, 1996; Eckenrode, Laird, & Doris, 1993; Wodarski, Kurtz, Gaudin, & Howing, 1990), be suspended from school (Fantuzzo, Perlman, & Dobbins, 2011; Kendall-Tackett & Eckenrode, 1996), and be held back a grade (Eckenrode et al., 1993). Children's school readiness has been shown to predict later academic achievement (Davies, Janus, Duku, & Gaskin, 2016; Downer & Pianta, 2006; Duncan et al., 2007; Oberle, Schonert-Reichl, Hertzman, & Zumbo, 2014), school attendance rates (Bell, Bayliss, Glauert, & Ohan, this thesis.), socio-emotional abilities (Guhn, Gadermann, Almas, Schonert-Reichl, & Hertzman, 2016), and behavioural outcomes such as suspension from school (Bell et al., this thesis.). It is therefore crucial to develop a comprehensive understanding of the ways in which maltreatment in the early childhood period may influence children's school readiness.

A number of researchers have argued for the importance of 'unpacking' maltreatment to better understand how different dimensions of maltreatment may influence child outcomes (e.g., English, Upadhyaya, et al., 2005; Manly, Cicchetti, & Barnett, 1994). In other words, a dichotomous investigation of 'maltreatment versus no maltreatment' is considered insufficient. Dimensions of maltreatment include the type of maltreatment, the developmental timing of the first maltreatment event, and the chronicity of maltreatment. As yet, there has not been a comprehensive investigation of the association between different dimensions of maltreatment and school readiness. Studies

generally examine only one or two outcome/s (e.g., socio-emotional abilities, pre-academic skills), and/or investigate the dimensions of maltreatment in isolation. The various dimensions of maltreatment are significantly associated with academic achievement in later schooling (Romano, Babchishin, Marquis, & Frechette, 2015), so it is possible that these factors are also important for determining how ready a child is to start school. The following section provides a review of the existing evidence on the association between different dimensions of maltreatment and children's developmental and educational outcomes.

Type, Timing, and Chronicity of Maltreatment

Maltreatment is classified as physical, emotional, psychological, or sexual abuse, or neglect. All types of maltreatment are associated with maladjustment for children and adolescents; however, there is some evidence that different types of maltreatment predict different outcomes. Neglect is one of the most researched types of maltreatment, and has been associated with poor academic outcomes (Eckenrode et al., 1993; Fantuzzo et al., 2011; Kendall-Tackett & Eckenrode, 1996; Kurtz, Gaudin, Howing, & Wodarski, 1993), cognitive and language deficits (Allen & Oliver, 1982; Hoffman-Plotkin & Twentyman, 1984), poor social skills (Fantuzzo et al., 2011; Hoffman-Plotkin & Twentyman, 1984), lower school attendance rates (Fantuzzo et al., 2011), and out-of-school suspensions (Fantuzzo et al., 2011; Kendall-Tackett & Eckenrode, 1996). Physical abuse, on the other hand, is most commonly associated with behavioural problems (Eckenrode et al., 1993; Hoffman-Plotkin & Twentyman, 1984; Manly et al., 1994; Manly, Kim, Rogosch, & Cicchetti, 2001), and poor social skills (Dodge et al., 2008; Hoffman-Plotkin & Twentyman, 1984). Research findings on outcomes for children who have been sexually abused have been more variable: some studies find that sexual abuse is not significantly associated with academic and behavioural outcomes (Eckenrode et al., 1993; Manly et al., 1994), whereas other research documents an increased risk of behavioural problems, lower

cognitive ability, emotional difficulties, and lower academic achievement for sexually abused children (Einbender et al., 1989; Maclean, Taylor, & O'Donnell, 2016; Mian, 1996). Emotional abuse and psychological abuse have received less attention in the literature, and frequent co-occurrence with other types of maltreatment (Claussen & Crittenden, 1991; Crittenden, Claussen, & Sugarman, 1994) makes parsing out the effects of emotional and psychological abuse on outcomes difficult. However, the available evidence suggests that this form of maltreatment is associated with behavioural, social, and emotional difficulties in children (Bolger & Patterson, 2001; Crittenden et al., 1994; Gagné, Drapeau, Melançon, Saint-Jacques, & Lépine, 2007; Manly et al., 2001; Shaffer, Yates, & Egeland, 2009) and low self-esteem in adulthood (Mullen, Martin, Anderson, Romans, & Herbison, 1996). In sum, it appears that neglect and sexual abuse may be related to lower academic outcomes, and physical, emotional, and psychological abuse are associated with behavioural outcomes, but all types of maltreatment are significantly related to social and emotional difficulties in children.

The developmental period in which children first experience maltreatment may also have a bearing on the developmental difficulties they experience. The association between the timing of maltreatment and children's developmental outcomes is unclear from the available evidence. Given the importance of the first few years of life for physical and neurobiological development (Shonkoff, 2003), formation of attachment relationships (Ainsworth, 1979), and the development of an autonomous self (Cicchetti, 2016), it is reasonable to assume that maltreatment that begins early in a child's life would be associated with more deleterious outcomes than maltreatment that first occurs later in childhood. Within an organisational perspective of development, mastery of primary skills prepares children for mastery of subsequent, more complex skills (Cicchetti, 1993; Sroufe & Rutter, 1984). Thus, the effects of maltreatment on early development may mean that the child's ability to respond to subsequent developmental challenges is seriously

impaired. Children who have been able to successfully navigate early developmental tasks, on the other hand, may have more resources for being able to cope with the trauma of maltreatment when it occurs in later childhood (Manly et al., 2001). Consistent with these hypotheses, a number of studies have found evidence that maltreatment occurring during the first years of life is associated with more deleterious outcomes than maltreatment occurring at later ages (Bolger, Patterson, & Kupersmidt, 1998; Dunn, McLaughlin, Slopen, Rosand, & Smoller, 2013; English, Graham, Litrownik, Everson, & Bangdiwala, 2005; Fantuzzo et al., 2011; Kaplow & Widom, 2007; Keiley et al., 2001). However, one study found no effect of early maltreatment on social and cognitive outcomes (Ayoub et al., 2006), and another found an equal effect on children's emotional and behavioural outcomes, regardless of the timing of maltreatment (Manly et al., 2001). Of note, the authors of this latter study found that maltreatment that begins during the preschool period and persists through subsequent developmental stages is associated with significant maladjustment (Manly et al., 2001). Therefore, the chronicity of maltreatment is also posited to predict the level of maladjustment maltreated children may experience.

Another way in which child maltreatment may have a negative impact on child development is through the chronicity of the maltreatment. Chronicity has been variably defined in the literature, with some researchers classifying chronic maltreatment according to the total duration of maltreatment (e.g., length of time between first and last maltreatment event), and others using frequency of maltreatment events (English, Graham, et al., 2005). However chronicity is defined, research shows that children who have been subjected to repeated or persistent maltreatment exhibit more emotional, behavioural, and social problems (Bolger et al., 1998; Éthier, Lemelin, & Lacharité, 2004; Graham et al., 2010; Jaffee & Maikovich-Fong, 2011; Manly et al., 1994, 2001) and lower cognitive ability (Cowell, Cicchetti, Rogosch, & Toth, 2015; Jaffee & Maikovich-Fong, 2011) than children who have been maltreated at one time point only. How chronicity of maltreatment

relates to school readiness is unclear, although based on the available evidence, it is possible that children who have had limited exposure to maltreatment are more likely to be ready for school than children who have experienced repeated episodes of maltreatment.

Substantiated and Unsubstantiated Maltreatment Allegations

Whether or not a maltreatment allegation is substantiated has also been considered as a possible factor influencing children's developmental outcomes; thus, the school readiness of children with substantiated and unsubstantiated maltreatment allegations requires further investigation. A substantiation of maltreatment requires sufficient evidence to conclusively determine that real harm has occurred, or that there is a significant risk of harm to the child (Steering Committee for the Review of Government Service Provision, 2016). If there is insufficient evidence of harm, maltreatment is defined as unsubstantiated. Children with unsubstantiated allegations may have been exposed to harm, but due to insufficient evidence (such as lack of witnesses, inability/unwillingness of the child to provide evidence), it may not be possible to substantiate the current allegation of maltreatment (Drake, 1996). As such, a determination of 'unsubstantiated' may not be an accurate indicator of whether or not maltreatment actually occurred, especially for young children, who may not be able to provide the required evidence for substantiation (Drake, 1996; Hussey et al., 2005). There is growing evidence that children with unsubstantiated maltreatment allegations have outcomes that are more similar to children with substantiated maltreatment allegations than they are to children with no maltreatment allegations (Barth et al., 2008; Fantuzzo et al., 2011; Hussey et al., 2005; Leiter, Myers, & Zingraff, 1994; Maclean et al., 2016). This suggests that, although children with substantiated and unsubstantiated allegations are quite different in legal terms, their developmental outcomes are similar. Due to the determination of the allegation as being unsubstantiated, however, these children may be less likely than children with substantiated maltreatment to receive critical intervention services to support

their development (Hussey et al., 2005; Rosenberg & Smith, 2008). Few studies have examined the outcomes of children with substantiated maltreatment separately to those with unsubstantiated maltreatment – most combine the two groups (e.g., Jaffee & Maikovich-Fong, 2011; Thompson & Tabone, 2010), or limit samples to children with substantiated maltreatment only (e.g., Bolger et al., 1998; Cowell et al., 2015). As such, an investigation of the school readiness of children with unsubstantiated maltreatment is required to identify whether these children are also in need of support services at the transition to formal schooling.

Current Study

This study aims to examine the association between different dimensions of child maltreatment (i.e., type, timing, chronicity) and children's school readiness, using a population sample of children in their first year of formal school. These associations will be examined for children with both substantiated and unsubstantiated allegations of maltreatment. School readiness scores are linked to administrative records of child maltreatment notifications (from birth until school entry), as well as to child, parent, and community demographic information. This study design has the advantage of being able to compare children with unsubstantiated and substantiated allegations to a non-maltreated comparison group on the same standardised measure of school readiness. This measure of school readiness is completed by teachers, which limits the reporting bias that can be problematic in studies using parent-reported measures of children's developmental outcomes, particularly when the parent is the perpetrator of the maltreatment (Kinard, 2002; Shaffer et al., 2009). We are also able to examine maltreated children's outcomes depending on maltreatment type, timing of maltreatment, and chronicity of maltreatment. As such, this study constitutes a significant contribution to the literature by presenting a comprehensive analysis of the associations of various maltreatment dimensions to school readiness for a large group of children.

We expect that children with a history of substantiated maltreatment will have lower school readiness than non-maltreated children, and that children with unsubstantiated maltreatment notifications will have a similar level of school readiness to children with substantiated maltreatment. In addition, we expect that children who have had multiple maltreatment allegations, starting earlier in life, will have the poorest school readiness outcomes, compared to children who have had one maltreatment allegation, and/or a more recent allegation of maltreatment. Finally, we expect to find differences in the nature of school readiness difficulties for children who have been subjected to different types of maltreatment.

Method

Ethics Approval

Ethics approval for this study was granted by the Western Australian (WA) Department of Health Human Research Ethics Committee, the University of Western Australia Human Research Ethics Committee, and the WA Aboriginal Health Ethics Committee.

Data Sources

This study used anonymised administrative data merged across the Department for Child Protection and Family Support, the WA Department of Health, and the Commonwealth Department of Education. Datasets were linked by the WA Data Linkage Branch by matching identifiers (e.g., name, address etc.) common to the sets of records (Holman et al., 2008). Only de-identified information was provided to researchers. Details of the datasets used are included below.

Study Population

The sample included children born in WA during 2003-2004 who had a 2009 Australian Early Development Census (AEDC) record ($N = 20,653$) which was the school readiness measure used for this study. Children meeting the following criteria were

excluded from analyses: 1) missing AEDC domain scores ($n = 382$); 2) twins or triplets, in which case one child from each multiple birth was randomly selected (excluded $n = 274$); 3) identified by the teacher as ‘special needs’ in the AEDC dataset ($n = 753$); or 4) diagnosed with a developmental disorder (e.g., autism) or cerebral palsy ($n = 41$) in the Department of Health datasets (hospital records; WA Register of Developmental Anomalies). AEDC domain scores are not calculated for children identified as ‘special needs,’ as these children have a diagnosed disability (physical, intellectual) and already receive special assistance in school. Children with a developmental disorder or cerebral palsy were likewise excluded to limit the potential for confounding developmental outcomes with pre-existing conditions. The final sample consisted of 19,203 children (mean age 5.5 years, $SD = 0.29$). Demographic information was also available for all mothers and 18,448 fathers (96%) of cohort children.

School Readiness

AEDC data were used to assess children’s school readiness. The AEDC is a population-level measure, which is based on the Canadian Early Development Instrument (Janus et al., 2007), and is collected nationally every 3 years across Australia for children in their first year of formal schooling (in WA, this is the year prior to grade 1). The AEDC is completed by teachers, who are asked to rate each child in their classroom on 104 checklist items during the first half of the academic year (May-July). From these items, a score (from 0 to 10) is calculated for each of five developmental domains: physical wellbeing, social competence, emotional maturity, communication and general knowledge, and language and cognitive skills (see Table 7-1 for examples of skills measured for each domain). The method of calculating domain scores is the intellectual property of McMaster University in Canada. Children’s domain scores are classified into percentiles, with cut-offs based on national data. Children who score in the bottom 10% on a domain are considered ‘developmentally vulnerable’ on that domain; those in the bottom

11-25% as ‘at risk’; and those in the top 75% as ‘on track’. For this study, these three categories were collapsed into two (‘vulnerable/at risk’ and ‘on track’) to capture established and emerging developmental vulnerability.

Table 7-1

Description of Domains Assessed for the Australian Early Development Census

Domain	Areas Assessed
Physical Health & Wellbeing	Physical readiness for school day (e.g., dressed appropriately, fed) Physical independence Gross and fine motor skills
Social Competence	Overall social competence Responsibility and respect Approaches to learning (e.g., completion of work, following instructions, adaptability) Readiness to explore new things
Emotional Maturity	Pro-social and helping behaviour Anxious and fearful behaviour Aggressive behaviour Hyperactivity and inattention
Language & Cognitive Skills	Interest in literacy/numeracy and memory Basic literacy and advanced literacy Basic numeracy
Communication Skills & General Knowledge	Communication skills and general knowledge (e.g., storytelling, imaginative play, articulation, understanding of others)

Child Maltreatment

Data on allegations of suspected child maltreatment were provided by the Department for Child Protection and Family Support (CPFS). In this dataset, information is recorded on the start date of the investigation into the allegation, the outcome of the investigation (substantiated or unsubstantiated), the primary nature of concern (physical, sexual, emotional, or psychological abuse, or neglect), the age of the child at the time of the allegation, and demographic information on the child (date of birth, gender, postcode of home residence). Allegations of child maltreatment were identified from the child’s

birth up until the end of 2009 (the year the AEDC was collected). Initially, children were grouped according to their maltreatment history. These groups included children with at least one record of a substantiated maltreatment event ('substantiated maltreatment'), those with at least one record of an unsubstantiated allegation and no substantiated maltreatment during the study period ('unsubstantiated maltreatment'), and those who had no records of maltreatment ('no allegations'). For all children with a maltreatment record (substantiated or unsubstantiated), we further determined the primary type of maltreatment, the timing of the first allegation of maltreatment, and the number of maltreatment allegations.

Types of maltreatment included physical abuse, neglect, emotional abuse, psychological abuse, and sexual abuse. Only the primary type of maltreatment is provided per notification in the dataset; however, it is possible for children with multiple maltreatment records to have multiple maltreatment types recorded during the study period. As such, children who had been subject to multiple forms of maltreatment were included in each relevant category. Children for whom only one type of maltreatment was recorded were included in that group. If children in the 'substantiated maltreatment' group also had one or more unsubstantiated allegations, they were grouped only according to the type of substantiated maltreatment, and not according to the unsubstantiated allegation.

Timing of maltreatment was determined by identifying the age of the child (in months) at the start date of the investigation into the first maltreatment allegation. These first maltreatment allegations were then defined as occurring in infancy-toddlerhood (0-3 years) or preschool (3-6 years). Children whose age fell within either of these age ranges at the start of investigation of the first allegation were categorised into the corresponding group (separately for the 'unsubstantiated maltreatment' and 'substantiated maltreatment' groups). If children had both a substantiated and an unsubstantiated maltreatment allegation, the age of the child at the date of the first substantiated allegation was

determined as the earliest record, regardless of whether an unsubstantiated allegation had been made earlier.

Chronicity of maltreatment was determined by summing the total number of allegations recorded for a child during the study period (i.e., frequency of maltreatment events). Children who had one allegation (substantiated or unsubstantiated) were categorised as ‘single allegation;’ those who had two or more allegations during the study period were categorised as ‘multiple allegations’. For the ‘substantiated maltreatment’ group, this included the total of both substantiated and unsubstantiated allegations. A notification to child welfare services suggests there is concern for the child’s wellbeing, even if that concern is not substantiated; therefore, inclusion of the unsubstantiated allegations in calculation of chronicity for the ‘substantiated maltreatment’ group was done to approximate total duration of maltreatment.

Covariates

It is widely acknowledged that factors from multiple levels of influence contribute to children’s development and educational adjustment (Bronfenbrenner, 1986). Certain demographic characteristics are also associated with a higher incidence of child maltreatment. As such, we included child, parent and community sociodemographic characteristics as covariates in our analyses (see Table 7-2). Variables were selected based on findings of previous studies documenting an association with either increased incidence of child maltreatment, or developmental outcomes of children. Details are provided below.

Child characteristics.

Gender, ethnicity, and minority language status have all been found to influence developmental and educational outcomes (De Bortoli & Thomson, 2009; Downer & Pianta, 2006; Hair, Halle, Terry-Humen, Lavelle, & Calkins, 2006; Kurdek & Sinclair, 2001). There is also some evidence that children from ethnic minorities are more frequently affected by child maltreatment, or at least are more frequently the subject of

notifications to child welfare services (Brown, Cohen, Johnson, Salzinger, & Abuse, 1998; Hussey, Chang, & Kotch, 2006; O'Donnell et al., 2010), and that girls and boys are differentially at risk for certain types of maltreatment (Edwards, Holden, Felitti, & Anda, 2003; Silverman, Reinherz, & Giaconia, 1996). We therefore included gender, Aboriginality, and English language status as covariates in our analyses. Child gender and Aboriginality were determined from the Midwives Notification System and Birth Registrations datasets, provided by the WA Health Department and the Registry of Births, Deaths and Marriages, respectively. These datasets contain information on birth and pregnancy details for all births in WA, as well as demographic information on the child, mother, and father (if reported by the mother). Any missing information from the Midwives Notification System was imputed from the Birth Registrations dataset. Any additional missing data for Aboriginality not included in the Health datasets was imputed from the AEDC dataset, which draws this information from the child's enrolment record. From the AEDC dataset we identified children who spoke English as a second language, which was based on information reported by teachers.

Aboriginality is included as a covariate in our analyses as a proxy variable for a range of factors that Aboriginal children and their families may experience, and which may impact on developmental and educational outcomes (De Bortoli & Thomson, 2010). These factors include institutional and interpersonal racial discrimination, reduced access to resources and opportunities, racial disparities in socioeconomic status, an increased incidence of psychosocial stressors, and intergenerational impacts of trauma (De Maio et al., 2005; Priest, Baxter, & Hayes, 2012; Priest, Perry, Ferdinand, Paradies, & Kelaher, 2014; Williams, Priest, & Anderson, 2016). Many of these factors also influence the likelihood of Aboriginal families having contact with child welfare services (Cunneen & Libesman, 2000). As such, this variable is intended to represent social, rather than racial, determinants of children's outcomes.

Parent characteristics.

Children born to young, single mothers have been found to be at increased risk of both child maltreatment (Bolton et al., 1980; Budd, Heilman, & Kane, 2000; O'Donnell et al., 2010), and lower developmental outcomes (Brooks-Gunn & Furstenberg, 1986; Chen et al., 2007; Cooksey, 1997). Variables for parental age and mother's marital status (at the time of the cohort member's birth) were therefore included as covariates, and were obtained from the Midwives Notification System and Birth Registrations.

Community characteristics.

Neighbourhood poverty has been associated with an increased incidence of child maltreatment (Drake & Pandey, 1996), as well as lower developmental and educational outcomes for children (Boyle, Georgiades, Racine, & Mustard, 2007; Leventhal & Brooks-Gunn, 2000). As such, a measure of community-level socioeconomic status was included as a covariate. This was obtained from the AEDC dataset, which includes a dummy-coded identifier for the local community the child was living in at the time the AEDC was completed. In this dataset, each local community is assigned a value for the Index of Relative Socioeconomic Disadvantage (IRSD; Australian Bureau of Statistics, 2011b), which is derived from census information that reflects area-level disadvantage such as low income, low educational attainment, high unemployment, and jobs in relatively unskilled occupations. Values of the IRSD range from 1 (most disadvantaged) to 5 (least disadvantaged).

Each local community is also assigned a value for the Australian Standard Geographical Classification (ASGC; Australian Bureau of Statistics, 2011a). Geographic isolation from formal and informal support services and relative lack of access to child- and family-oriented resources has been shown to influence both child development (Avan & Kirkwood, 2010; Vernon-Feagans et al., 2012) and child maltreatment rates (Belsky, 1980; Garbarino, 1977). We therefore included the geographical location of the home

community for children as a covariate. The ASGC classifies a geographical area as metropolitan, inner/outer regional, or remote/very remote, based on the access to goods, services, and opportunities for social interaction in that area. Due to smaller cohort numbers outside the metropolitan areas, these five categories were collapsed into three (metropolitan, regional, remote).

Table 7-2

Sociodemographic Characteristics of the Study Cohort.

Characteristic	Whole cohort, <i>N</i> (%)	No allegations, <i>n</i> (%)	Substantiated maltreatment, <i>n</i> (%)	Unsubstantiated maltreatment, <i>n</i> (%)
Child's gender				
Female	9,467 (49.30)	9,084 (49.07)	193 (54.99)	190 (55.88)
Male	9,736 (50.70)	9,428 (50.93)	158 (45.01)	150 (44.12)
Ethnicity				
Aboriginal/Torres Strait Islander	1,328 (6.92)	1,076 (5.81)	148 (42.17)	104 (30.59)
Other*	17,875 (93.08)	17,436 (94.19)	203 (57.83)	236 (69.41)
Child speaks English as a second language				
No*	17,966 (93.56)	17,347 (93.71)	307 (87.46)	312 (91.76)
Yes	1,237 (6.44)	1,165 (6.29)	44 (12.54)	28 (8.24)
Mother's marital status at child's birth				
Single/never married	1,421 (7.40)	1,232 (6.66)	103 (29.34)	86 (25.29)
Divorced/widowed	224 (1.17)	192 (1.04)	18 (5.13)	14 (4.12)
Married*	17,476 (91.01)	17,018 (91.93)	220 (62.68)	238 (70.00)
<i>Missing</i>	82 (0.43)	70 (0.38)	10 (2.85)	2 (0.59)
Mother's age at child's birth				
< 20 years	1 023 (5.33)	887 (4.79)	75 (21.37)	61 (17.94)
20-29 years	8,317 (43.31)	7,940 (42.89)	187 (53.28)	190 (55.88)
30-39 years*	9,294 (48.40)	9,129 (49.31)	84 (23.93)	81 (23.82)
40 years+	569 (2.96)	556 (3.00)	5 (1.42)	8 (2.35)

(continued)

Characteristic	Whole cohort, <i>N</i> (%)	No allegations, <i>n</i> (%)	Substantiated maltreatment, <i>n</i> (%)	Unsubstantiated maltreatment, <i>n</i> (%)
Father's age at child's birth				
< 20 years	361 (1.88)	324 (1.75)	21 (5.98)	16 (4.71)
20-29 years	5,794 (30.17)	5,518 (29.81)	138 (39.32)	138 (40.59)
30-39 years*	10,156 (52.89)	9,992 (53.98)	67 (19.09)	97 (28.53)
40 years+	2,137 (11.13)	2,095 (11.32)	20 (5.70)	22 (6.47)
<i>Missing</i>	755 (3.93)	583 (3.15)	105 (29.91)	67 (19.71)
Local community remoteness index				
Metropolitan*	12,385 (64.50)	12,049 (65.09)	173 (49.29)	163 (47.94)
Regional	4,856 (25.29)	4,636 (25.04)	97 (27.64)	123 (36.18)
Remote	1,962 (10.22)	1,827 (9.87)	81 (23.08)	54 (15.88)
Local community index for socioeconomic disadvantage				
1 (Most disadvantaged)	2,381 (12.40)	2,163 (11.68)	111 (31.62)	107 (31.47)
2	3,952 (20.58)	3,765 (20.34)	95 (27.07)	92 (27.06)
3	3,762 (19.59)	311 (19.51)	73 (20.80)	78 (22.94)
4	3,209 (16.71)	3,140 (16.96)	34 (9.69)	35 (10.29)
5 (Least disadvantaged)*	5,897 (30.71)	5,831 (31.50)	38 (10.83)	28 (8.24)

*Reference group for logistic regressions

Data Analysis

Univariate and multivariate logistic regression models estimated the odds of children being classified as vulnerable/at-risk on any of the AEDC domains, as an outcome of child maltreatment. Models were run separately for substantiated and unsubstantiated allegations (compared to no allegations). Models were also run to examine the effect on school readiness of type of maltreatment, timing of maltreatment, and chronicity of maltreatment. Multivariate models were adjusted for child, parent, and community sociodemographic factors, transformed into binary or continuous categorical variables with the category representing lower risk coded as the reference group (see Table 7-2). Analyses were conducted using SAS Version 9.3 for Windows (SAS Institute Inc, 2010). Results are presented as odds ratios (*ORs*) with 95% confidence intervals (*CI*s). Holm's *p*-value correction was applied to account for multiple hypothesis testing (Gaetano, 2013; Holm, 1979).

Missing Data

Missing data were identified for parental demographic variables for a total of 817 children. There was a larger proportion of missing paternal age data for maltreated children, which is likely a reflection of the higher proportion of maltreated children born to single mothers, and paternal age information not being recorded on the birth registration (see Table 7-2). Compared to children with complete parental demographic information, children missing parental data were more frequently Aboriginal (5.38% with complete parental information compared to 41.49% with missing parental information), born to single mothers (5.72% with complete parental information compared to 50.34% with missing parental information), and/or spoke ESL (5.98% with complete parental information compared to 16.77% with missing parental information). As such, data were not missing at random.

To address the problem of missing data, analyses were run with complete cases

(i.e., children with data on all variables) and those with missing data. For analyses including cases with missing data, missingness was included as an extra category in the multivariate models to account for any potential bias missing data may be introducing into the results. In the complete case analysis, *ORs* were in the same direction as *ORs* from the missing indicator method analyses, but were inflated by up to 0.35 points, and confidence intervals were wider. Therefore, *ORs* from the missing indicator method are more conservative. For completeness of the sample and robustness of estimates, results presented in this paper are from analyses using the missing indicator method.

Results

Descriptive Statistics

In total, there were 351 children (1.83% of the total cohort) with at least one substantiated maltreatment allegation, and 340 children (1.77% of the total cohort) with at least one unsubstantiated maltreatment allegation (and no substantiated maltreatment) during the study period. Of the children with substantiated maltreatment, 101 (28.77%) also had at least one unsubstantiated maltreatment allegation. The majority of children had only one allegation during the study period: in the ‘unsubstantiated maltreatment’ group there were 287 children (84.41%) with one allegation and 53 children (15.59%) with multiple allegations; in the ‘substantiated maltreatment’ group there were 199 children (56.70%) with a single allegation and 152 children (43.30%) with two or more allegations (substantiated or unsubstantiated).

Table 7-2 displays the sociodemographic characteristics of the cohort, with frequencies presented separately for maltreated and non-maltreated children. Descriptive statistics show that maltreated children experienced a high prevalence of individual, parental, and community risk factors. Compared to children with no maltreatment allegations, children with either a substantiated or unsubstantiated allegation were more frequently Aboriginal, born to young and/or single mothers, and lived in remote areas and

in the most disadvantaged communities.

Table 7-3 displays the frequencies of different maltreatment types. For the ‘unsubstantiated maltreatment’ group, physical abuse, neglect, and sexual abuse made up around a third each of all notifications. Only one type of maltreatment had been alleged for most of these children ($n = 307$, 90.29%); 33 children (9.71%) had more than one type of alleged maltreatment. More than half of all substantiated maltreatment allegations were cases of neglect. In Table 7-3, frequencies of type of maltreatment are shown for the ‘substantiated maltreatment’ group separately for unsubstantiated and substantiated allegations. Physical abuse made up almost a quarter of all substantiated maltreatment allegations, with the other types of maltreatment less common. Most children ($n = 315$, 89.74%) had records of one type of maltreatment, with multiple maltreatment types recorded for 36 children (10.26%).

Table 7-3
Frequencies of Maltreatment Types

Maltreatment type	Unsubstantiated maltreatment, n (%)	Substantiated maltreatment, n (%)	
		Substantiated allegations	Unsubstantiated allegations
Physical abuse	104 (30.59)	75 (21.37)	39 (11.11)
Neglect	106 (31.18)	206 (58.69)	42 (11.97)
Psychological abuse	6 (1.76)	3 (< 1)	3 (< 1)
Emotional abuse	49 (14.41)	60 (17.09)	16 (4.56)
Sexual abuse	109 (32.06)	43 (12.25)	21 (5.98)

The first allegation for children in the ‘unsubstantiated maltreatment’ group most frequently occurred during the preschool years ($n = 212$, 62.35%), with fewer children having records of the first allegation of maltreatment in the infancy-toddlerhood period ($n = 128$, 37.65%). Conversely, children in the ‘substantiated maltreatment’ group most frequently experienced their first substantiated maltreatment event during the infancy-toddlerhood period ($n = 218$, 62.11%). There were 133 children (37.89%) who were aged between 3-6 years when the first substantiated maltreatment event occurred.

Regression Analyses

Substantiated and unsubstantiated maltreatment.

Unadjusted and fully-adjusted logistic regression models estimated the odds of children with substantiated or unsubstantiated maltreatment allegations being classified as vulnerable/at-risk on the AEDC, compared to non-maltreated children (Table 7-4). In the unadjusted models, children with either an unsubstantiated or a substantiated maltreatment allegation were at increased risk of developmental vulnerability on all school readiness domains. The *ORs* were large and significant, with the odds of children with unsubstantiated maltreatment having lower school readiness scores more than 2-times greater than for non-maltreated children. This risk was higher for children with substantiated maltreatment, who had 2- 3-times greater odds of being vulnerable/at-risk on all AEDC domains than children with no maltreatment records.

Adjusting for sociodemographic factors attenuated results (Table 7-4). Children with unsubstantiated maltreatment allegations were between 36-81% more likely to have lower school readiness on any of the AEDC domains than non-maltreated children, with the highest *ORs* seen for physical and communicative abilities. Children with substantiated maltreatment allegations were also more likely to be vulnerable/at-risk on four of the AEDC domains, compared to children with no maltreatment reports, at between 55% (physical wellbeing) to 123% (social competence) increased risk (see Appendix VIII for the complete table of results).

Table 7-4

Unadjusted and Fully-adjusted^a Odds of Children Being Classified as Developmentally Vulnerable/At-risk on the Australian Early Development Census as an Outcome of Child Maltreatment

AEDC Domain	Unsubstantiated maltreatment					
	Unadjusted			Fully-adjusted ^a		
	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b
Physical Health & Wellbeing	2.71	[2.18, 3.37]	.001	1.81	[1.44, 2.27]	.001
Social Competence	2.05	[1.64, 2.56]	.001	1.36	[1.08, 1.72]	.009
Emotional Maturity	2.20	[1.77, 2.74]	.001	1.47	[1.17, 1.84]	.002
Communication Skills & General Knowledge	2.49	[2.00, 3.10]	.001	1.70	[1.35, 2.15]	.001
Language & Cognitive Skills	2.69	[2.16, 3.33]	.001	1.63	[1.30, 2.05]	.001
AEDC Domain	Substantiated maltreatment					
	Unadjusted			Fully adjusted ^a		
	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b
Physical Health & Wellbeing	2.53	[2.04, 3.14]	.001	1.55	[1.23, 1.94]	.001
Social Competence	3.59	[2.91, 4.44]	.001	2.23	[1.78, 2.79]	.001
Emotional Maturity	3.21	[2.60, 3.97]	.001	1.98	[1.58, 2.47]	.001
Communication Skills & General Knowledge	2.12	[1.70, 2.64]	.001	1.26	[0.99, 1.59]	.06
Language & Cognitive Skills	2.84	[2.30, 3.52]	.001	1.47	[1.17, 1.85]	.002

Note. Significant results at $p < .05$ indicated in bold. AEDC=Australian Early Development Census, *OR*=Odds ratio, *CI*=Confidence Interval.

^a Adjusted for child Aboriginality; parent age; mother's marital status; child's ESL status; and local community socioeconomic disadvantage and remoteness indices.

^b Adjusted p values after Holm's correction applied.

We also evaluated the odds of being vulnerable/at-risk on the AEDC for the substantiated maltreatment group compared to the unsubstantiated maltreatment group. Children with substantiated allegations had significantly higher odds of social vulnerability compared to children with unsubstantiated allegations (adjusted $OR = 1.64$, 95% $CI = 1.20, 2.24$). Results were also consistent with greater odds of emotional vulnerability for children with substantiated maltreatment compared to children with unsubstantiated allegations, but this OR was not statistically significant (adjusted $OR = 1.35$, $CI = 0.99, 1.84$). The comparisons for the other three AEDC domains did not indicate any differences between the two groups, and the ORs were non-significant (all $ps > .05$).

Dimensions of maltreatment.

Analyses for the different dimensions of maltreatment were run separately for the ‘unsubstantiated allegations’ and the ‘substantiated allegations’ groups. Each model compared children with maltreatment records to children with no records of maltreatment. For brevity, only the results of the fully-adjusted models are presented here.

Type of maltreatment.

Due to the small numbers of children with allegations of psychological abuse (see Table 7-3), these children were combined with the emotional abuse group. Separate analyses were run to examine the association between each type of maltreatment (physical, sexual, or emotional abuse, neglect) and the five school readiness outcomes. As stated before, in the CPFS dataset only the primary type maltreatment is available for each allegation; however, evidence suggests that there is a frequent co-occurrence of different types of maltreatment (Herrenkohl & Herrenkohl, 2009; Manly et al., 2001). As such, it is highly likely that children, for whom we have only one type of maltreatment recorded, had also experienced at least one other type of maltreatment. Therefore, rather than compare groups of maltreated children to each other, creating potentially false discrete groups, we

contrasted maltreated children with different types of abuse or neglect to non-maltreated children, and not to each other. The fully-adjusted models are shown in Table 7-5.

The top half of Table 7-5 displays the results for children with different types of unsubstantiated maltreatment. Compared to non-maltreated children, children who had unsubstantiated allegations of physical abuse were at significantly increased risk of physical (149% increase), communication (127% increase), and cognitive (79% increase) difficulties. Children who had an unsubstantiated allegation of neglect were at significantly increased risk of developmental vulnerability on all school readiness domains, with communication (107% increase) and cognitive (119% increase) skills most affected. Unsubstantiated allegations of emotional/psychological abuse were not associated with a significantly increased risk for children's school readiness. The *ORs* for unsubstantiated sexual abuse were also not statistically significant, but results for the physical, communication, and cognitive domains were consistent with these children being at increased risk of developmental vulnerability.

Results for children with different substantiated maltreatment types are shown in the bottom half of Table 7-5. Compared to non-maltreated children, children who had been physically abused had around 2-times greater odds of being socially and emotionally vulnerable. Results also suggested that these children were more likely to experience language and cognitive difficulties, but this *OR* was not statistically significant after *p*-value adjustment. Children who had been neglected during early childhood were at significantly increased risk of lower school readiness in the domains of physical (51% increase), social (123% increase), and emotional (65% increase) development. Results were also compatible with an increased risk of poor communication and cognitive skills for children who had been neglected, but these *ORs* were not statistically significant. Children who had been subjected to emotional/psychological abuse were at increased risk of social and emotional development, with odds around 2-times greater than for non-

maltreated children. Results also indicated that these children were at increased risk of physical and cognitive vulnerability, but the *ORs* were not statistically significant. In addition, children who had been sexually abused had 2- to 3-times greater odds compared to non-maltreated children of experiencing poorer physical, social, and emotional development.

Table 7-5

Fully-adjusted^a Odds of Children Being Classified as Developmentally Vulnerable/At-risk on the Australian Early Development Census as an Outcome of Alleged Maltreatment Type

AEDC Domain	Unsubstantiated maltreatment											
	Physical abuse (n = 104)			Neglect (n = 106)			Emotional abuse (n = 54)			Sexual abuse (n = 109)		
	OR	95% CI	p ^b	OR	95% CI	p ^b	OR	95% CI	p ^b	OR	95% CI	p ^b
Physical Health & Wellbeing	2.49	[1.67, 3.71]	.001	1.81	[1.21, 2.69]	.011	1.21	[0.68, 2.16]	.99	1.36	[0.91, 2.04]	.50
Social Competence	1.45	[0.96, 2.18]	.07	1.67	[1.12, 2.49]	.020	1.22	[0.68, 2.16]	.99	1.06	[0.70, 1.61]	.89
Emotional Maturity	1.61	[1.08, 2.41]	.039	1.69	[1.13, 2.52]	.010	1.05	[0.59, 1.87]	.99	1.17	[0.78, 1.75]	.89
Comm. Skills & Gen. Knowledge	2.27	[1.51, 3.41]	.001	2.07	[1.39, 3.10]	.002	0.79	[0.42, 1.48]	.99	1.52	[1.01, 2.28]	.27
Language & Cognitive Skills	1.79	[1.19, 2.70]	.005	2.19	[1.43, 3.37]	.002	1.27	[0.73, 2.24]	.99	1.36	[0.92, 2.01]	.50
AEDC Domain	Substantiated maltreatment											
	Physical abuse (n = 75)			Neglect (n = 206)			Emotional abuse (n = 63)			Sexual abuse (n = 43)		
	OR	95% CI	p ^b	OR	95% CI	p ^b	OR	95% CI	p ^b	OR	95% CI	p ^b
Physical Health & Wellbeing	1.24	[0.76, 2.00]	.77	1.51	[1.13, 2.03]	.018	1.35	[0.79, 2.28]	.54	2.12	[1.14, 3.93]	.049
Social Competence	1.97	[1.23, 3.15]	.018	2.23	[1.67, 2.98]	.001	2.11	[1.27, 3.50]	.021	2.58	[1.40, 4.78]	.010
Emotional Maturity	2.48	[1.54, 3.99]	.001	1.65	[1.23, 2.21]	.003	2.09	[1.26, 3.46]	.021	3.36	[1.79, 6.28]	.001
Comm. Skills & Gen. Knowledge	0.90	[0.54, 1.51]	.77	1.26	[0.92, 1.71]	.15	1.06	[0.61, 1.83]	.85	1.41	[0.73, 2.73]	.60
Language & Cognitive Skills	1.63	[1.00, 2.67]	.15	1.37	[1.02, 1.85]	.08	1.74	[1.03, 2.94]	.11	1.10	[0.58, 2.06]	.78

Note. Significant results at $p < .05$ indicated in bold. AEDC=Australian Early Development Census, OR=Odds ratio, CI=Confidence Interval.

^a Adjusted for child Aboriginality; parent age; mother's marital status; child's ESL status; and local community socioeconomic disadvantage and remoteness indices. ^b Adjusted p values after Holm's correction applied.

Timing of maltreatment.

The analyses in Table 7-6 were run to examine whether the timing of the first maltreatment event was associated with increased odds of lower school readiness. Models estimated the odds of maltreated children being classified as vulnerable/at-risk on the AEDC, relative to non-maltreated children, according to the timing of the first maltreatment allegation.

Fully-adjusted *ORs* for unsubstantiated maltreatment are shown in the top half of Table 7-6. Compared to children with no maltreatment allegations, children with unsubstantiated maltreatment who had a first allegation during the first 3 years of life were at significantly increased risk of developmental vulnerability on all school readiness domains, at 63-103% increased risk. Communication and cognitive skills were most affected. If the first unsubstantiated maltreatment allegation occurred between the ages of 3-6 years, children were at significantly increased risk of vulnerability on physical (71% increase), communicative (48% increase), and cognitive (43% increase) domains. The *ORs* for the social and emotional domains were not statistically significant, but nevertheless consistent with an increased risk of vulnerability in these areas if children experienced their first unsubstantiated maltreatment allegation in the preschool period. Comparison of *ORs* for the infancy-toddlerhood period to *ORs* for the preschool period indicated that the risk associated with the timing of maltreatment did not significantly differ according to whether the child had their first unsubstantiated allegation early or later in the first 6 years of life.

Results for substantiated maltreatment are shown in the bottom half of Table 7-6. Children who had their first substantiated maltreatment allegation during infancy-toddlerhood were at increased risk of lower school readiness across three out of five AEDC domains, with the largest *ORs* seen for social competence (122% increase) and emotional maturity (93% increase). The *ORs* for the other domains were elevated, but not

statistically significant. If the first substantiated maltreatment event occurred when the child was aged 3-6 years, there was evidence of an increased risk of developmental vulnerability on all domains. Children who had a substantiated maltreatment event in the preschool period were found to be at significant risk of physical (67% increased risk), social (125% increased risk), emotional (110% increased risk), and cognitive (73% increased risk) difficulties at school entry. Results for the communication and general knowledge domain were not statistically significant, but were compatible with an increased risk of vulnerability in this area for children who had experienced their first substantiated maltreatment event during this period. Again, comparison of *ORs* for the two developmental periods indicated a similarity of effect on school readiness, regardless of the timing of the first substantiated maltreatment event.

Table 7-6

Fully-adjusted^a Odds of Children Being Classified as Developmentally Vulnerable/At-risk on the Australian Early Development Census as an Outcome of Timing of First Maltreatment Allegation

AEDC Domain	Unsubstantiated maltreatment								
	Infancy-toddlerhood			Preschool			Preschool vs Infancy-toddlerhood		
	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b
Physical Health & Wellbeing	1.89	[1.31, 2.72]	.002	1.71	[1.28, 2.27]	.001	0.91	[0.57, 1.43]	.77
Social Competence	1.67	[1.16, 2.41]	.011	1.15	[0.86, 1.55]	.35	0.69	[0.43, 1.10]	.58
Emotional Maturity	1.63	[1.13, 2.34]	.011	1.33	[1.00, 1.77]	.11	0.82	[0.52, 1.29]	.77
Communication Skills & General Knowledge	2.03	[1.41, 2.94]	.001	1.48	[1.10, 1.99]	.036	0.73	[0.46, 1.16]	.69
Language & Cognitive Skills	1.98	[1.36, 2.90]	.002	1.43	[1.08, 1.91]	.040	0.72	[0.45, 1.15]	.69
AEDC Domain	Substantiated maltreatment								
	Infancy-toddlerhood			Preschool			Preschool vs Infancy-toddlerhood		
	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b
Physical Health & Wellbeing	1.43	[1.07, 1.91]	.043	1.67	[1.16, 2.39]	.011	1.16	[0.74, 1.83]	.99
Social Competence	2.22	[1.68, 2.94]	.001	2.25	[1.58, 3.21]	.001	1.01	[0.65, 1.58]	.99
Emotional Maturity	1.93	[1.45, 2.55]	.001	2.10	[1.47, 2.99]	.001	1.09	[0.70, 1.70]	.99
Communication Skills & General Knowledge	1.17	[0.87, 1.58]	.31	1.37	[0.94, 1.98]	.10	1.17	[0.73, 1.87]	.99
Language & Cognitive Skills	1.33	[1.00, 1.78]	.10	1.73	[1.20, 2.49]	.009	1.30	[0.82, 2.05]	.99

Note. Significant results at $p < .05$ indicated in bold. Infancy-toddlerhood defined as age 0-3 years; Preschool defined as age 3-6 years. AEDC=Australian Early Development Census, *OR*=Odds ratio, *CI*=Confidence Interval.

^a Adjusted for child Aboriginality; parent age; mother's marital status; child's ESL status; and local community socioeconomic disadvantage and remoteness indices.

^b adjusted p -values after Holm's correction applied.

Chronicity of maltreatment.

The chronicity analyses examined the school readiness of children who had experienced one maltreatment allegation separate to those who had multiple allegations during the study period. Because we had counted all allegations (substantiated and unsubstantiated) for children in the substantiated maltreatment group, we ran additional models to examine whether this would influence the results. First, we ran the analyses for the substantiated maltreatment group and included those children who had one substantiated allegation and one or more unsubstantiated allegations in the ‘multiple allegations’ category. Then we ran the model again, limiting the multiple allegations group to only those children with multiple substantiated allegations. The *ORs* were generally similar for these analyses (at most, 0.30 points larger in the initial analyses), and did not affect interpretation of the results. As such, for completeness of the sample, we have included the initial analyses in this study. Results of the fully-adjusted models are presented in Table 7-7.

For children with a single unsubstantiated allegation, there was a significantly increased risk of developmental vulnerability on all school readiness domains (top half of Table 7-7). Children with multiple unsubstantiated allegations were also at increased risk of lower school readiness in all domains, however after *p*-value adjustment only the *OR* for the communication domain was statistically significant, with a 187% increase in risk of developmental vulnerability. There was no evidence of an increased risk associated with having multiple unsubstantiated allegations compared to a single allegation.

Children with a single substantiated allegation had increased odds of developmental vulnerability on all domains, with the *ORs* for physical (44% increase), social (115% increase), and emotional (92% increase) domains reaching statistical significance. Similarly, children who had multiple allegations were at significantly increased risk of vulnerability on the physical, social, emotional, and language and

cognitive skills domains. For children in the substantiated maltreatment group, social and emotional abilities were the most affected, with more than 2-times greater odds of developmental vulnerability compared to non-maltreated children, regardless of the number of allegations. Furthermore, comparison of *ORs* for the two groups indicated that the association with school readiness was similar, irrespective of whether the child had one or multiple allegations (bottom half of Table 7-7).

Table 7-7

Fully-adjusted^a Odds of Children Being Classified as Developmentally Vulnerable/At-risk on the Australian Early Development Census as an Outcome of Maltreatment Chronicity

AEDC Domain	Unsubstantiated maltreatment								
	Single allegation			Multiple allegations			Multiple vs Single allegation/s		
	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b
Physical Health & Wellbeing	1.76	[1.38, 2.25]	.001	1.85	[1.06, 3.22]	.09	1.05	[0.57, 1.91]	.99
Social Competence	1.29	[1.00, 1.67]	.047	1.57	[0.90, 2.74]	.23	1.21	[0.66, 2.23]	.99
Emotional Maturity	1.43	[1.12, 1.83]	.009	1.46	[0.84, 2.55]	.23	1.02	[0.56, 1.87]	.99
Communication Skills & General Knowledge	1.51	[1.17, 1.94]	.005	2.87	[1.63, 5.04]	.001	1.91	[1.03, 3.52]	.20
Language & Cognitive Skills	1.54	[1.20, 1.97]	.002	2.11	[1.17, 3.81]	.05	1.37	[0.73, 2.59]	.99
AEDC Domain	Substantiated maltreatment								
	Single allegation			Multiple allegations ^c			Multiple vs Single allegation/s		
	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b
Physical Health & Wellbeing	1.44	[1.07, 1.95]	.049	1.62	[1.16, 2.27]	.010	1.12	[0.72, 1.74]	.99
Social Competence	2.15	[1.60, 2.88]	.001	2.35	[1.69, 3.29]	.001	1.10	[0.71, 1.69]	.99
Emotional Maturity	1.92	[1.43, 2.57]	.001	2.09	[1.50, 2.92]	.001	1.09	[0.71, 1.68]	.99
Communication Skills & General Knowledge	1.30	[0.96, 1.77]	.19	1.16	[0.82, 1.66]	.40	0.90	[0.57, 1.42]	.99
Language & Cognitive Skills	1.26	[0.94, 1.70]	.19	1.81	[1.28, 2.57]	.002	1.43	[0.91, 2.25]	.58

Note. Significant results at $p < .05$ indicated in bold. AEDC=Australian Early Development Census, *OR*=Odds ratio, *CI*=Confidence Interval.

^a Adjusted for child Aboriginality; parent age; mother's marital status; child's ESL status; and local community socioeconomic disadvantage and remoteness indices. ^b Adjusted p values after Holm's correction applied. ^c Includes children who have had either multiple substantiated allegations, or one substantiated allegation plus one or more unsubstantiated allegations.

Discussion

This study examined the school readiness of children with a history of maltreatment allegations. We made a significant contribution to the literature by examining the association between a broad range of developmental abilities, and different dimensions of maltreatment: substantiated or unsubstantiated allegations; type of alleged maltreatment; timing of the first maltreatment allegation; and chronicity of maltreatment. In line with our expectations, we found that all children with maltreatment allegations were at risk for lower school readiness, regardless of whether the maltreatment was substantiated or not. The effect of maltreatment was over and above that observed for sociodemographic risk factors commonly associated with both poor readiness for school and child maltreatment. Children with either substantiated or unsubstantiated maltreatment allegations were at risk of poorer physical, social, emotional, communicative, and cognitive development at school entry, which concurs with the large body of evidence demonstrating poor outcomes for maltreated children across a broad range of skills and abilities (Kovan et al., 2014; Piescher, Colburn, LaLiberte, & Hong, 2014; Trickett & McBride-Chang, 1995). This finding adds to the evidence base suggesting that children with unsubstantiated allegations are at similar overall risk of maladjustment as children whose maltreatment has been substantiated (Barth et al., 2008; Fantuzzo et al., 2011; Hussey et al., 2005), and supports earlier assertions that substantiation is often more a reflection of child welfare practices than the actual severity of the maltreatment (Leiter, 2007).

Although outcomes for children with substantiated and unsubstantiated maltreatment were similar overall, we did find that children with substantiated maltreatment were at significantly increased risk of social vulnerability compared to children with unsubstantiated maltreatment. Results also indicated an increased risk of emotional vulnerability for children with substantiated maltreatment compared to children

with unsubstantiated maltreatment, but this did not reach statistical significance. Moreover, a significant negative association between substantiated maltreatment and children's social and emotional abilities was a common finding across all the analyses, regardless of type, timing, or chronicity. Such an effect was not seen for unsubstantiated maltreatment. The social competence and emotional maturity domains of the AEDC are highly correlated (Forget-Dubois et al., 2007), and both measure characteristics that can impact on the development of peer relationships, such as social competence, pro-social behaviour, and aggressive behaviour. These results therefore suggest that children with substantiated maltreatment are particularly at risk of having social and emotional difficulties at school entry, which may make establishment of positive relationships with peers and adults difficult. Many other studies have found that social difficulties are prominent in children with a history of maltreatment, with maltreated children often being less popular with their peers and more likely to be socially rejected than non-maltreated children (Dodge et al., 2008; Rogosch et al., 1995; Salzinger et al., 1993). These social and emotional difficulties may stem from disrupted attachment relationships with the primary caregiver (Aber & Allen, 1987; Bolger et al., 1998; Schwartz & Davis, 2006), or from an absence of an effective model from which children can learn appropriate social skills, due to their parent's own lack of social competence (Crittenden, 1985). Strategies to promote social skill development and emotion regulation prior to the commencement of formal schooling may be especially important for supporting maltreated children in this important life transition.

A novel finding of this study was that there appeared to be differences in outcomes for children with unsubstantiated and substantiated maltreatment, depending on the type of alleged maltreatment. For instance, we did not find evidence of an increased risk of lower school readiness for children who had unsubstantiated allegations of emotional/psychological abuse. However, for children with substantiated allegations of

this type of abuse, there was a significant increase in the risk of lower social and emotional readiness for school. Emotional or psychological maltreatment is difficult to recognise, define, and substantiate (Glaser, 2002), which may mean that in our sample, the unsubstantiated allegations of emotional maltreatment were true instances where there was no risk of harm to the child. However, if there was sufficient evidence to substantiate emotional or psychological maltreatment, the maltreatment was severe enough to be associated with significant maladjustment in the child. An alternative hypothesis is that the effects seen for substantiated emotional/psychological abuse were associated with another form of maltreatment the child had experienced, as emotional maltreatment commonly co-occurs with other types of maltreatment (e.g., Claussen & Crittenden, 1991). In one study, Manly et al. (2001) found no differences between emotionally maltreated children and non-maltreated children on emotional and behavioural assessments; however, when emotional maltreatment co-occurred with another type of maltreatment, children experienced significant emotional and behavioural difficulties. However, because only the primary type of maltreatment for each allegation was available in the CPFS dataset, we cannot assess whether this is the case, and further research is needed.

We also found a non-significant increase in risk of physical, communicative, and cognitive vulnerability for children with unsubstantiated sexual abuse, which contrasted with the large and significant effect on physical, social, and emotional abilities of substantiated sexual abuse (112-236% increased risk). The extant literature on the outcomes of children who have been sexually abused suggests that these children are more likely to experience emotional, behavioural, and cognitive difficulties (Einbender et al., 1989; Mian, 1996). Although we did not find evidence of a significantly increased risk of cognitive difficulties associated with substantiated sexual abuse, our finding of increased social and emotional difficulties is consistent with other studies. An increased risk of physical vulnerability for sexually abused children is a novel finding, and one that

indicates that these children may face difficulties in mastering basic motor skills and lack independence when attempting physically challenging tasks in the school environment. A high dependence on adults and an unwillingness to explore the environment has previously been demonstrated for maltreated children (Aber & Allen, 1987), which may go some way to explaining our results. The reason why we did not find a significantly increased risk of vulnerability associated with unsubstantiated maltreatment is unclear, but unlikely to be due to a lack of power ($n = 109$, compared to $n = 43$ for substantiated maltreatment). It may be that there is a high rate of variability in outcomes for children who have unsubstantiated allegations of sexual abuse, and that the elevated *ORs* reflect the significant maladjustment in those children who have experienced sexual abuse, which could not be substantiated.

Both unsubstantiated and substantiated allegations of physical abuse were associated with an increased risk of poorer physical, social, emotional, and cognitive development at school entry. Our findings for substantiated physical abuse concur with the existing literature, which has demonstrated increased behavioural problems and poor social skills for children who have been physically abused (Dodge et al., 2008; Eckenrode et al., 1993; Hoffman-Plotkin & Twentyman, 1984; Manly et al., 1994, 2001). However, only unsubstantiated abuse was associated with a significantly increased risk of communication skills deficits. This could be a reflection of the reasons why the allegation could not be substantiated (e.g., children with poor communicative abilities may not be able to assist in providing evidence for their maltreatment), but without further details on the allegation this is impossible to determine. Neglect was also associated with an increased risk of poor school readiness on all domains, for both unsubstantiated and substantiated allegations (although some results for the ‘substantiated maltreatment’ group were not statistically significant). These findings are consistent with previous research, which has demonstrated that children who have been neglected are more likely to exhibit

cognitive and language deficits (Allen & Oliver, 1982; Hoffman-Plotkin & Twentyman, 1984) and poor social skills (Fantuzzo et al., 2011; Hoffman-Plotkin & Twentyman, 1984). Furthermore, neglect is associated with a persistent failure to meet the child's basic needs, such as adequate clothing, feeding, and stimulation (Hildyard & Wolfe, 2002; O'Hara et al., 2015; Romano et al., 2015). This makes our finding that children who had allegations of neglect were at increased risk of vulnerability on the physical wellbeing domain unsurprising, given that this domain captures aspects such as whether children are appropriately dressed and fed at the start of the school day, as well as children's competence in fine and gross motor skills. In sum, our findings demonstrate that social and emotional difficulties characterise the experience of children with all types of substantiated maltreatment, but that the outcomes for children with unsubstantiated allegations of maltreatment are more variable.

Based on previous findings (Bolger et al., 1998; Dunn et al., 2013; English, Graham, et al., 2005; Kaplow & Widom, 2007), maltreatment with onset during the infancy-toddlerhood period (i.e., between the ages of 0-3 years) was expected to be associated with poorer school readiness than maltreatment with onset in the preschool period. Contrary to our expectations, we found that the association between timing of the first maltreatment event and school readiness was similar, regardless of the age period in which the first recorded maltreatment allegation occurred. We also expected that children who had multiple allegations of maltreatment would have significantly poorer school readiness than children who had a single maltreatment allegation. This expectation was not supported, with results showing that the school readiness of both groups of children was similar, regardless of the number of allegations recorded. This finding differs from other studies that have found that chronically maltreated children have worse outcomes than those whose maltreatment was situational (Bolger et al., 1998; Éthier et al., 2004; Jaffee & Maikovich-Fong, 2011; Manly et al., 1994, 2001). What our results do show is that a

single allegation of maltreatment – even if that allegation is not substantiated – is a marker for physical, emotional, social, communicative, and cognitive difficulties at the start of school. Chronicity of maltreatment should therefore not be a condition of eligibility for support services; rather, assessment of the need for intervention should be arranged upon first contact with child welfare.

It is possible that our categorisation of chronicity as one versus two or more allegations was too simplistic to identify variability in outcomes. Other studies have operationalised chronicity as, for example, length of time between first and last maltreatment allegation (Bolger et al., 1998), or length of time a child's case file was open (Éthier et al., 2004; Manly et al., 1994), and found poorer outcomes for children with chronic maltreatment compared to situational maltreatment. However, there are also issues with these definitions of chronicity: length of time between the first and last maltreatment allegation does not take into account the frequency of maltreatment between these two events, and case files may remain open for a number of reasons, such as provision of interventions to the family, instead of being due to ongoing abuse (English, et al., 2005). There is therefore no agreed upon method of operationalising chronicity of maltreatment. Furthermore, it is possible that frequency and duration of maltreatment have differential impacts on outcomes depending on the type of maltreatment. For instance, for acute events such as physical and sexual abuse, frequency of maltreatment may be more informative than duration, whereas for neglect and emotional abuse, duration may be more informative than frequency (Jackson, Gabrielli, Fleming, Tunno, & Makanui, 2014). The information available to us from the child welfare dataset did not permit calculation of duration of maltreatment, and so only frequency could be used to define chronicity. Where possible, future research should examine how both duration and frequency of maltreatment is related to school readiness.

Although our results do not allow us to conclude that maltreatment *caused* lower

school readiness, there is substantial literature available on the hypothesised mechanisms linking maltreatment to maladjustment. Maltreatment is thought to influence developmental outcomes through both biological and psychosocial processes. For example, it is possible that maltreatment interrupts neural development, leading to maladaptive thinking, learning, and communication processes (Cicchetti, Rogosch, Gunnar, & Toth, 2010; De Bellis, 2001; Eisen, Goodman, Qin, Davis, & Crayton, 2007). There is also support for the idea that development is negatively affected by a lack of appropriate physical, emotional, and cognitive stimulation in the child's environment, resulting in under-developed skills (Romano et al., 2015). Children who have not had their basic needs met within the home environment may not develop mastery of early developmental abilities, such as those required for school success (Fantuzzo et al., 2011; Veltman & Browne, 2001). Moreover, constant chaos in the home may impact on children's ability to self-regulate attention and emotion (Haight, Kayama, Kincaid, Evans, & Kim, 2013), leading to ongoing school difficulties.

The high rates of co-occurring sociodemographic risk factors maltreated children often experience is also likely to have some bearing on poor developmental outcomes (Zielinski & Bradshaw, 2006), however, child maltreatment has repeatedly been shown to make an independent contribution to the likelihood of children experiencing negative developmental outcomes over and above the effects of socioeconomic disadvantage (e.g., Aber & Allen, 1987; Hoffman-Plotkin & Twentyman, 1984; Trickett, Aber, Carlson, & Cicchetti, 1991). Our results add to this evidence base, as even after controlling for sociodemographic factors, there was evidence of a predictive effect of child maltreatment on children's school readiness. However, it should also be acknowledged that child and family characteristics, such as socioeconomic status and ethnicity, can also influence teacher ratings of children's abilities (Rimm-Kaufman, Pianta, & Cox, 2000). Thus, the increased risk of developmental vulnerability observed for maltreated children in this

sample may also be influenced by the expectations and judgements of teachers based on these children's demographic characteristics.

Consideration of the socio-ecological context in which maltreatment occurs is still important for informing interventions. On average, the sociodemographic characteristics of the maltreated children and their parents in our sample were very different to those for non-maltreated children. Maltreated children were more frequently than non-maltreated children born to young, unmarried mothers, were of Aboriginal or Torres Strait Islander descent, and lived in communities that were geographically isolated and characterised by high levels of socioeconomic disadvantage. Other research on the sociodemographic risk factors associated with child maltreatment has similarly found parental age and marital status, and family and community socioeconomic status are important predictors of the incidence of child abuse and neglect (Bolton et al., 1980; Budd et al., 2000; Drake & Pandey, 1996; O'Donnell et al., 2010), as is geographical isolation from informal and formal support services (Belsky, 1980; Garbarino, 1977). Children from ethnic minorities are also often found to experience higher rates of child maltreatment (Brown et al., 1998; Hussey et al., 2006; O'Donnell et al., 2010). Socioeconomic adversity can contribute to a stressful developmental context, which can both increase the incidence of child maltreatment, and exacerbate the consequences of maltreatment (Kotch et al., 1995; Zielinski & Bradshaw, 2006). Intervention and prevention strategies therefore need to include an emphasis on the functioning and wellbeing of the family and the community context the maltreated child is exposed to, as maltreatment is likely to be only one of many stressors in the child's life (MacKenzie, Kotch, Lee, Augsberger, & Hutto, 2011).

The disproportionate representation of Aboriginal children in our sample of maltreated children is of great concern: more than 40% of all children with substantiated maltreatment and 30% of children with unsubstantiated maltreatment were Aboriginal, despite Aboriginal children making up only 6% of the total cohort. This disparity is not

unique to our sample; during 2014-2015 the rate of maltreatment substantiations for Aboriginal children aged 0-17 years in Australia was almost 7-times that for non-Aboriginal children (Steering Committee for the Review of Government Service Provision, 2016). It is possible that this is due to biases in reporting, whereby children from ethnic minorities are disproportionately referred to child welfare services (Ards, Myers, Malkis Erin, & Zhou, 2003). However, it is also possible that Aboriginal children are particularly vulnerable to maltreatment, due to situational, historical, family, community, and societal factors (Memmott, Stacy, Chambers, & Keys, 2001; Stanley, Tomison, & Pocock, 2003). Communities and neighbourhoods that are troubled by high crime rates, poverty, unemployment, poor housing, and inadequate infrastructure have been connected with an increased risk of child maltreatment, particularly neglect (Drake & Pandey, 1996; Garbarino & Sherman, 1980). In Australia, Aboriginal people are more likely to live in such communities, and to experience disadvantage across multiple socioeconomic measures (Memmott et al., 2001; Stanley et al., 2003). This socioeconomic adversity, coupled with historical factors such as forced separation, is linked to violence, behavioural problems, and mental illness, all of which can impact on parenting ability (Cunneen & Libesman, 2000), and therefore increase the likelihood of child maltreatment. Any strategies aimed at improving early developmental outcomes of maltreated Aboriginal children need to be culturally appropriate, and sensitive to the intergenerational impacts of trauma and social inequality. Exactly what these interventions should be, and how they should be delivered is unclear, but certainly, relationships between government services and Aboriginal communities are vitally important, as is respect for community knowledge on how best to support Aboriginal children (Tilbury et al., 2014).

The results of this study show that any allegation of maltreatment, regardless of the timing, frequency, or type, and regardless of whether the allegation is ultimately substantiated or not, is a risk factor for lower school readiness across multiple

developmental domains. Intervention therefore needs to commence prior to the start of school, so that children with a history of child welfare contact can be adequately supported in the transition to school and thus maximise their likelihood of future school success. The first year of formal schooling is particularly important for setting the foundation for future school experiences (Rimm-Kaufman & Pianta, 2000). Research on older children with a history of maltreatment has demonstrated that these children are more likely than non-maltreated children to become disengaged from school (Fantuzzo et al., 2011), have lower academic achievement (Barbosa Pacheco, Irigaray, Werland, Tiellet Nunes, & Lima Argimon, 2014; Barnett et al., 1996; Chapple & Vaske, 2010; Crozier & Barth, 2005; Eckenrode et al., 1993; Wodarski et al., 1990), higher rates of grade retention (Eckenrode et al., 1993), and drop out of school early (Wulczyn et al., 2009). In fact, it has been suggested that school problems are “by far the most prominent characteristic of maltreated children” (Trocmé & Caunce, 1995, p. 127). Our results, and others (Allen & Oliver, 1982; Veltman & Browne, 2001), suggest that this may be due to significant impairments in functioning these children may be experiencing early on in schooling. Addressing academic, social, behavioural, communicative, or physical difficulties early is therefore imperative for promoting children’s competence and adaptation in preparation for starting school (Trocmé & Caunce, 1995). However, teachers may not be privy to information regarding a student’s involvement with child welfare, and so identification of children requiring this support is problematic. If schools are to play a supportive role in the child’s recovery, they must be made aware of maltreatment notifications, within reasonable limits of confidentiality (Leiter, 2007). As such, collaboration between child welfare and education services is key to preventing poor school outcomes for maltreated children (Crozier & Barth, 2005).

Intervention to mitigate the effects of child maltreatment on school readiness requires a comprehensive approach with strategies at the individual, family, and school

levels. For example, interventions focusing on improving parenting behaviours have been found to increase secure attachment in maltreated children, which is important for positive emotional and social development (Cicchetti, Rogosch, & Toth, 2006). There have also been some promising findings for improved emotional and behavioural outcomes following child and parent cognitive behavioural therapy (Cohen & Mannarino, 1998). Early childcare education programs are also likely to provide essential support for children and parents for scaffolding early cognitive and social development (Waldfogel, 2009), particularly if these programs are of high quality (Dinehart, Manfra, Katz, & Hartman, 2012). Currently, services such as these are more likely to be delivered to children in out-of-home care than to children who remain at home (Forsman & Vinnerljung, 2012; Ringeisen, Casanueva, Cross, & Urato, 2009; Snow, 2009). However, evidence suggests that maltreated children who remain at home are equally in need of services to support their development and schooling (Crozier & Barth, 2005; Font & Maguire-Jack, 2013). Furthermore, our results show that children with unsubstantiated maltreatment allegations are at increased risk of poor school readiness. Children with unsubstantiated allegations are generally not eligible for the protective or ameliorative interventions provided to children with substantiated allegations. Our results (and others) demonstrate that despite the child's circumstances not meeting the legal definition of substantiated maltreatment, these children may experience significant adverse effects. There is currently a considerable gap between the need for services and service use, as well as service provision (Ringeisen et al., 2009) that needs to be urgently addressed.

There are some limitations of this study that must be noted. In our sample, only a small proportion of maltreated children had multiple types of maltreatment recorded. This likely to be because only the primary type of maltreatment for each allegation was provided in the CPFS dataset. However, other studies have found that maltreated individuals frequently experience more than one type of maltreatment (e.g., Dong et al.,

2004), so it is likely that we have underestimated the frequency of different maltreatment types in our sample. Furthermore, as administrative data only capture individuals who have had contact with a service, it is possible that there were children in our comparison group who have been maltreated, but the maltreatment has not been reported; reported maltreatment makes up only a fraction of the actual maltreatment that occurs. The overall incidence of child maltreatment in our sample may therefore be underestimated. However, by also examining the outcomes of children with unsubstantiated allegations, we are likely to more closely approximate the true prevalence of child maltreatment in our sample. The differences in demographic characteristics between the sample of children with allegations compared to children without allegations is also a limitation, as sociodemographic disadvantage is associated with increased rates of maltreatment, as well as lower teacher ratings of abilities. These differences may have therefore inflated associations between maltreatment allegations and school readiness. However, as we included all covariates in the adjusted models, the impact of this bias is presumed to be minimal. There are also likely to be several un-measured sociodemographic variables influencing the association between child maltreatment and school readiness, which could not be controlled for in this study.

In conclusion, our study found an increased risk of lower school readiness for children with a history of maltreatment allegations, regardless of whether an investigation found evidence of substantiated maltreatment or not. The increased risk of developmental vulnerability did not substantially differ depending on the type, timing, or chronicity of maltreatment. This demonstrates that all children notified to child welfare services are at risk of poor developmental outcomes, and that intervention to improve their chances of success at school needs to start from the first contact. Interventions should target all developmental abilities, and not just focus on more “obvious” difficulties, as a broad range of abilities are required for success at school. Collaboration between child welfare services

and educators, as well as input from other involved allied health personnel, will be critical for providing optimal support for these children in the transition to school.

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Chapter 8 – Using Linked Data to Investigate the Developmental Outcomes of Children of Criminally Convicted Parents

Abstract

There is evidence that children of incarcerated parents are at risk of poor developmental and educational outcomes. However, much of this evidence is limited by biased samples, as studies must rely on opt-in recruitment. Administrative data present an opportunity to overcome this challenge, as they capture information on all individuals in contact with the criminal justice system. This study used administrative data on justice contacts of the parents of 19,071 children aged 5-6 years in Western Australia. Parental justice records (starting from 1 year prior to the child's birth) were linked to children's scores on the Australian Early Development Census, which is a teacher-reported measure of children's physical, social, emotional, communicative, and cognitive development. Logistic regression models estimated the odds of children of parents with criminal justice involvement being developmentally vulnerable. Models were adjusted for child, parent, and neighbourhood sociodemographic factors. Compared to children with non-convicted parents, children whose mother or father had either served a community order or been incarcerated were at risk of poor development across all developmental domains, even after adjusting for sociodemographic risk. Comparisons of children of incarcerated parents to children of convicted but non-incarcerated parents did not reveal any significant differences in risk of developmental vulnerability. The results suggest that, although children of convicted parents experience a higher incidence of sociodemographic risk, their parents' criminal activity constitutes an independent risk factor for their development. Intervention to support the early development of children of convicted parents is therefore essential, and should consider the family context.

Introduction

It is well accepted that a child's family context influences his/her developmental outcomes (Bronfenbrenner, 1986). In light of this understanding, there has been much attention paid to the wellbeing of children impacted by family separation, due to factors such as death, illness, divorce, or occupational demands (Amato & Anthony, 2014; Amato & Keith, 1991; W. G. Black, 1993; Cluver et al., 2013; Marcussen, Thuen, Bruun, & Hounsgaard, 2015). Notably, however, one marked family event that has received relatively little attention has been parental incarceration. Some experts have suggested that children with an incarcerated parent form a somewhat 'invisible' group, who, for the most part, are not adequately identified, assessed, or supported by either adult- or child-oriented services (Nesmith & Ruhland, 2008; Reed & Reed, 1997; Trotter, Flynn, & Baidawi, 2016). The relative dearth of information on the outcomes of these children has been suggested to reflect a lack of academic and public interest in the issues facing children of incarcerated parents (Murray & Farrington, 2008b). However, in many countries the highest imprisonment rate is for individuals of child-rearing age (Australian Bureau of Statistics, 2015; Bureau of Justice Statistics, 2016; Canadian Centre for Justice Statistics, 2016; Statistics New Zealand, 2016), so it is imperative we develop a better understanding of the outcomes of children affected by parental incarceration.

There are many reasons for the hypothesis that parental incarceration is a unique risk factor for children's development. Incarceration of a parent may be associated with a number of stressors for the child, such as disruptions to care, living, and schooling arrangements; stigma; financial hardship; and psychological distress (Arditti, 2012; Saunders & Barry, 2013). For some children, incarceration of a parent may bring relief (D. Black, 1992), but for others, difficulties maintaining contact with their incarcerated parent may bring additional stress, associated with fear of the prison environment (Nesmith & Ruhland, 2008), reliance on other adults to facilitate contact (D. Black, 1992; Saunders &

Barry, 2013; Shlafer & Poehlmann, 2010), long distances between home and prison facilities (D. Black, 1992), and financial barriers to maintaining regular visitation (Nesmith & Ruhland, 2008). Some children are not told about the reason for their parent's absence, which may bring about feelings of confusion and abandonment (Saunders & Barry, 2013); others who are aware of their parent's imprisonment may feel ashamed, and consequently keep this information secret from peers and adults outside of the family (Arditti, 2005; Saunders & Barry, 2013). Children who do disclose to others that their parent is in prison risk bullying and exclusion by both peers and adults (Saunders & Barry, 2013). The wide range of stressors that children of incarcerated parents may potentially experience makes it plausible that parental incarceration constitutes a unique risk for children's development.

The available literature supports the hypothesis that children of incarcerated parents are at risk of poor outcomes, with evidence that these children experience greater difficulties in a range of areas, relative to their peers with parents who have not been incarcerated. Children with incarcerated parents have been found to be at increased risk of emotional and behavioural problems, social difficulties, school problems, delinquent behaviour, and mental health and substance abuse difficulties (Craigie, 2011; Fritsch & Burkhead, 1981; Hagan & Foster, 2012; Haskins, 2015; Hissel, Bijleveld, & Kruttschnitt, 2011; Kjellstrand & Eddy, 2011; Midgley & Lo, 2013). However, there remain many gaps in the literature, as well as methodological challenges to research with this population, which mean that we are far from reaching a consensus on just how children are affected by parental incarceration.

One of the main gaps is in our understanding of how young children are affected when their parent is incarcerated. Most of the research has been conducted with adolescents, who are likely to face different challenges to young children, due to their developmental stage (Murray & Farrington, 2008b). For example, young children who are

not yet in full-time school have a higher probability of exposure to their parent's criminal activity and arrest (Johnston, 1995), which is associated with increased emotional and cognitive difficulties for children (Dallaire & Wilson, 2010). Young children are also more likely than are adolescents to be taken into out-of-home care when their parent goes to prison, and to experience multiple placements (Trotter et al., 2016), which may create additional disruption for the child. Moreover, young children are still heavily reliant on parents to co-regulate emotions and assist in coping with stressful situations (Johnston, 1995; Vondra, Shaw, Swearingen, Cohen, & Owens, 2001), and so it is possible that separation from a parent due to incarceration creates a significant risk for children's emotional development. Separation from a parent during the early developmental period can also result in disrupted attachment relationships (Poehlmann, 2005), which can lead to emotional and behavioural difficulties at home and school (Schwartz & Davis, 2006). As such, examining the outcomes of young children is important for understanding age-relevant challenges these children may face. Despite the many reasons why young children may be especially vulnerable to the impact of a parent's incarceration, only a handful of studies are available that test these possible relationships. These studies have presented evidence of increased emotional and behavioural problems and poorer cognitive development in children of incarcerated parents, compared to children of non-incarcerated parents (Craigie, 2011; Haskins, 2014; Wakefield & Wildeman, 2011). However, at least one study found no effects of parental incarceration on children aged 0-6 years (Besemer, Van Der Geest, Murray, Bijleveld, & Farrington, 2011). We therefore need to develop a better understanding of the early developmental outcomes of children exposed to parental incarceration.

The literature also remains unclear on whether the poor outcomes seen for children of incarcerated parents are a consequence of the incarceration itself, or of the sociodemographic background of the family. Children who grow up in families where

members engage in criminal activity have a high probability of being exposed to several sociodemographic risk factors that may adversely affect their development. For instance, individuals who have a history of criminal offending are more likely to come from lower socioeconomic backgrounds, be unemployed, have lower levels of education, have higher rates of mental illness and substance abuse, and be unmarried or in unstable relationships (Australian Institute of Health and Welfare, 2013; Geller, Cooper, Garfinkel, Schwartz-Soicher, & Mincy, 2012; Reed & Reed, 1997; Wildeman, 2009; Woodward, 2003). As such, it is possible that the sociodemographic risks that characterise the child's developmental context are the primary cause of poor outcomes, rather than the impact of the incarceration specifically. This is supported by several studies that have found that differences in outcomes between children of incarcerated and non-incarcerated parents become non-significant once sociodemographic characteristics are taken into account (e.g., Kinner, Alati, Najman, & Williams, 2007; Murray, Janson, & Farrington, 2007). However, there is also evidence to the contrary, whereby the incarceration of a parent appears to exert an independent influence on children's outcomes over and above the influence of sociodemographic risk factors. For example, a number of studies have found that children of incarcerated parents exhibit poorer outcomes compared to children who are not separated from their parents, and/or children separated from their parents due to other reasons (e.g., divorce), even after controlling for demographic characteristics (Fritsch & Burkhead, 1981; Geller et al., 2012; Murray & Farrington, 2008a).

However, these studies do not take into account the possibility that exposure to parental criminal offending, and not just separation due to incarceration, may predict children's outcomes. To evaluate this possibility, some researchers have utilised comparison groups of children whose parents have been convicted of a crime, but not been incarcerated. The few studies that have employed this method have had mixed results. When compared to children of parents who have been convicted but not incarcerated, one

study found that children of incarcerated parents were more likely to engage in criminal behaviour during adolescence (Besemer et al., 2011). Conversely, another study found that paternal incarceration did not constitute a unique risk factor for children's behaviour difficulties and substance abuse problems over and above paternal offending generally (Kinner et al., 2007). Yet another study found that children of incarcerated mothers were both more likely to exhibit emotional problems, and less likely to exhibit behavioural problems, than children of mothers on probation (Hissel, 2011). Notably however, all three of these studies have issues with potential sample bias in that all used opt-in recruitment to obtain the study populations. Furthermore, the study by Besemer et al. (2011) used two samples of adolescents who were already exhibiting high levels of delinquent and anti-social behaviour, and the study by Kinner et al. (2007) relied on mothers to report the criminal history of their partners. As such, the generalisability of these findings to the population level is questionable. There is therefore currently no consensus as to whether children of incarcerated parents are at risk of maladjustment because of the event of incarceration, or because of the direct and indirect effects of parental criminal offending more generally.

There may also be differences in children's outcomes depending on the gender of the incarcerated parent. Children of incarcerated mothers may be particularly at risk, as they are more likely to be cared for outside of the family home (D. Black, 1992), as opposed to children of incarcerated fathers, who more frequently remain in the care of the mother (Clopton & East, 2008; Makariev & Shaver, 2010). Children are also more likely to witness maternal offending and/or arrest as opposed to paternal offending/arrest due to the nature of caregiving arrangements (Dallaire & Wilson, 2010; Phillips & Zhao, 2010). Mothers are also usually the primary attachment figure. Children who have experienced prolonged separations from their mother or unstable or unpredictable caregiving arrangements due to their mother's criminal activity may experience disruptions to the

formation of secure attachment relationships; other children who have developed secure attachments with their mother are likely to experience considerable distress when separated from their mother upon incarceration (Poehlmann, 2005). In addition, there are fewer facilities for female prisoners, and mothers are consequently more likely to be held in prisons further away from their homes (Hagan & Dinovitzer, 1999), making visiting even more difficult for children.

Equally, children of incarcerated fathers may experience significant adversity, albeit for somewhat different reasons. Sentences for males are usually longer than for females, which may create more adversity for children (Murray & Farrington, 2008b). For example, families may experience financial difficulty upon the incarceration of a father. Mothers separated from their spouses due to their incarceration are not generally afforded any financial recourse from their spouse or the government, as their status as a single parent is not formally recognised (Arditti, 2005). Those who are formally separated from the child's father may receive lower or no child support payments for the duration of the fathers' imprisonment. Mothers may therefore experience financial hardship and housing instability, having significant impacts on their ability to provide for their children (D. Black, 1992; Geller & Franklin, 2014; Schwartz-Soicher, Geller, & Garfinkel, 2011). Parental resources are important for supporting child development (McWayne, Hampton, Fantuzzo, Cohen, & Sekino, 2004; Potter, Mashburn, & Grissmer, 2013), and so a lack of material, financial, emotional or physical resources on the part of the caregiver of children of incarcerated fathers may result in the child's maladjustment.

Despite the different possible mechanisms of risk transmission depending on the gender of the incarcerated parent, the relative impact of these effects on children's developmental outcomes is difficult to discern from past research. Very few studies have examined the comparative risk associated with maternal and paternal incarceration – most studies examine maternal and paternal incarceration separately, or aggregate both genders

of parent in analyses (Hissel, 2011; Murray & Farrington, 2008b; Murray, Farrington, & Sekol, 2012). In one study, which did include both mothers and fathers, differences in children's outcomes by gender of the parent were found: maternal incarceration was associated with increased depressive symptoms in children and paternal incarceration was associated with increased substance abuse issues in children (Foster & Hagan, 2013). However, another study found no difference in the impact of maternal and paternal incarceration on children's risk of offending (Besemer et al., 2011). More research is needed to determine whether the gender of the incarcerated parent is an important predictor of children's outcomes.

The available evidence on the outcomes of children of incarcerated parents is also often affected by a number of methodological limitations. Research on prison populations is notoriously difficult, particularly when it comes to obtaining information on dependent children of prisoners (Dallaire, 2007; Eddy, Powell, Szubka, McCool, & Kuntz, 2001). This is largely because opt-in recruitment is the primary means of obtaining participants, and prisoners may be unwilling to disclose that they are parents (Murray & Farrington, 2008b), often due to fears of child welfare involvement (D. Black, 1992). As such, it is very difficult to obtain estimates of just how many children are affected by parental imprisonment. This means that much of the current knowledge we have on the outcomes of children of incarcerated parents is limited in its generalisability, due to small and/or non-representative samples (Dallaire, 2007). Moreover, children's outcomes are usually assessed by parent- or caregiver-reported measures, which can be affected by issues such as biased responding (e.g., under-reporting problems), or erroneous responding due to limited contact between the incarcerated parent and their child (Hissel et al., 2011).

Recently, the benefits of using linked administrative data to overcome these methodological problems in investigating parental incarceration have been recognised (Geller, Jaeger, & Pace, 2016; Sabol, 2016), particularly when combined with direct

assessments of children's outcomes. Such data have already been used to estimate the prevalence of maternal imprisonment (Dowell, Preen, & Segal, 2016), and to examine educational outcomes of adolescents with incarcerated parents (Andersen, 2016), but to date there have been no investigations into the outcomes of young children of incarcerated parents using this methodology. Linked administrative data can help overcome many of the methodological challenges inherent in research with high-risk populations, primarily through enabling the capture of information on the whole population of prisoners, rather than relying on opt-in recruitment. This method also helps to facilitate research into comparisons of maternal and paternal incarceration. Information is collected prospectively, enabling the identification of parental criminal justice system involvement over prolonged periods, rather than relying on retrospective or cross-sectional analysis. When merged with child-level measures of developmental outcomes, it is possible to take a whole-of-population approach to evaluating the outcomes of children with incarcerated parents.

This study utilises linked administrative data to examine the developmental outcomes of a large sample of children whose parents have a history of criminal offending. Using a standardised teacher-reported measure of children's physical, social, emotional, communicative, and cognitive development at school entry, we compare the outcomes of children of incarcerated parents to those who have been convicted but not incarcerated, and to those whose parents have no records of criminal offending. We examine the outcomes associated with both maternal and paternal offending, and hypothesise that children whose parents have a history of criminal offending will have poorer developmental outcomes than children whose parents have no criminal record. Furthermore, we expect that children of incarcerated parents will have poorer outcomes compared to children whose parents have criminal involvement, but have not been incarcerated. Importantly, all analyses take into account a number of sociodemographic

risk factors that may influence both criminal offending and children's developmental outcomes.

Method

Ethics Approval

Ethics approval for this study was granted by the Western Australian (WA) Department of Health Human Research Ethics Committee, the University of Western Australia Human Research Ethics Committee, and the WA Aboriginal Health Ethics Committee.

Data Sources

Administrative data were linked by the WA Data Linkage Branch by matching identifiers (e.g., name, address etc.) common to the sets of records (Holman et al., 2008). Only de-identified records were provided to researchers, with identifying information kept separate from service information. Data from multiple government agencies were merged for analyses, including data from the Registry of Births, Deaths and Marriages; the WA Department of Health; the WA Department of Corrective Services (DCS); and the Commonwealth Department of Education. Details of data used in analyses are outlined below.

Study Population

The sample included 20,653 children who were: 1) born in WA during 2003-2004; 2) enrolled in the first year of compulsory schooling (pre-primary, the year prior to grade 1) in 2009; and 3) included in the 2009 collection of the Australian Early Development Census (AEDC) in WA. The AEDC was used as the measure of developmental outcomes in this study. Sample exclusion criteria included: 1) missing AEDC domain scores ($n = 382$); 2) twins or triplets, in which case one child from each multiple birth was randomly selected (excluded $n = 274$); 3) identified by the teacher as 'special needs' in the AEDC dataset ($n = 753$); or 4) diagnosed with a developmental disorder (e.g., autism) or cerebral

palsy ($n = 41$) in the Department of Health datasets. AEDC domain scores are not calculated for children identified as ‘special needs’, as these children have a diagnosed disability (i.e., physical, intellectual) and already receive special assistance in school. Children with a developmental disorder or cerebral palsy were likewise excluded to limit the potential for confounding developmental outcomes with pre-existing conditions. An additional 132 children were excluded because their parent had died during the study period, which may have confounded the association between parental criminal offending and child development. The final sample consisted of 19,071 children (mean age 5.5 years, $SD = 0.29$). Demographic information was also available for all mothers and 18,876 fathers (99%) of cohort children.

Developmental Outcome Measure

Children’s early development was assessed using the AEDC, the Australian adaptation of the Canadian Early Development Instrument (Janus et al., 2007), which has good validity and reliability (Brinkman et al., 2007; Janus, Brinkman, & Duku, 2011). The AEDC is a teacher-reported measure collected nation-wide in Australia every 3 years on children in their first year of compulsory schooling (pre-primary in WA). In the first half of the academic year (May-July), teachers complete 104 checklist items for each child in their class from which a score (from 0 to 10) is calculated for each of five developmental domains: physical, social, emotional, communication, and cognition (see Table 8-1). The method of calculating domain scores is the intellectual property of McMaster University, Canada. In accordance with these scoring methods, domain scores are analysed at the national level and classified into percentiles, with cut-offs based on the data collected in that year. Children who score in the bottom 10% on a domain are considered ‘developmentally vulnerable’ on that domain; those in the bottom 11-25% as ‘at risk’; and those in the top 75% as ‘on track’. For this study, these three categories were collapsed into two (‘vulnerable/at risk’ and ‘on track’) to capture established and emerging

developmental vulnerability. Data from the 2009 collection of the AEDC were used for analyses in this study.

Table 8-1
Description of Domains Assessed for the Australian Early Development Census

Domain	Areas Assessed
Physical Health & Wellbeing	Physical readiness for school day (e.g., dressed appropriately, fed) Physical independence Gross and fine motor skills
Social Competence	Overall social competence Responsibility and respect Approaches to learning (e.g., completion of work, following instructions, adaptability) Readiness to explore new things
Emotional Maturity	Pro-social and helping behaviour Anxious and fearful behaviour Aggressive behaviour Hyperactivity and inattention
Language & Cognitive Skills	Interest in literacy/numeracy and memory Basic literacy and advanced literacy Basic numeracy
Communication Skills & General Knowledge	Communication skills and general knowledge (e.g., storytelling, imaginative play, articulation, understanding of others)

Parental Offending

Records of parental criminal justice system involvement were obtained from the DCS, and included information on community orders, remand terms, and custodial sentences for the juvenile and adult justice system. Parents who had a record of any involvement with the criminal justice system during the study period were identified from these databases. The study period was from the 12 months prior to the child's birth up until the end of 2009, chosen to evaluate parental criminal activity during the period of parenting, which includes the prenatal period. Parents with criminal justice system contact were grouped according to whether they had ever been incarcerated (either on remand or

as a custodial sentence), or if they had only ever received a community-based order.

Covariates

Child, parent and community sociodemographic characteristics were included as covariates in analyses (Table 8-2). Covariates were selected based on the findings of previous studies documenting an association with developmental outcomes of children, as well as demographic characteristics associated with an increased risk of criminal behaviour (Boyle, Georgiades, Racine, & Mustard, 2007; Chen et al., 2007; Coley, Leventhal, Lynch, & Kull, 2013; Cooksey, 1997; Petrill, Pike, Price, & Plomin, 2004; Rouse & Fantuzzo, 2009). Details are provided below.

Child characteristics.

Child gender and Aboriginality were determined from the Midwives Notification System provided by the WA Health Department, and Birth Registrations, provided by the Registry of Births, Deaths, and Marriages. These datasets contain information on birth and pregnancy details for all births in WA, as well as demographic information on the child, mother, and father (if reported by the mother). If there were missing data for Aboriginal status in these datasets, Aboriginality was imputed from the AEDC dataset, which draws this information from the child's school enrolment record. From the AEDC dataset we also identified children who spoke English as a second language (ESL), which was based on information reported by teachers.

Aboriginality was included as a covariate as a proxy for a range of factors that Aboriginal children and their families may experience, and which may impact on developmental outcomes and incarceration rates (De Bortoli & Thomson, 2010), such as institutional and interpersonal racial discrimination, reduced access to resources and opportunities, racial disparities in socioeconomic status, an increased incidence of psychosocial stressors, and intergenerational impacts of trauma (De Maio et al., 2005; Priest, Baxter, & Hayes, 2012; Priest, Perry, Ferdinand, Paradies, & Kelaher, 2014;

Williams, Priest, & Anderson, 2016). As such, this variable is intended to represent a measure of the social determinants of child outcomes, rather than racial determinants.

Parent characteristics.

Maternal and paternal age and mother's marital status (both recorded at the time of the cohort member's birth) were obtained from the Midwives Notification System and Birth Registrations.

Community characteristics.

The AEDC dataset contains a dummy-coded identifier for the local community in which the child was living at the time of AEDC completion. Assigned to each local community identifier are a geographical remoteness index and a socioeconomic index, determined by the Australian Bureau of Statistics. The Australian Standard Geographical Classification (Australian Bureau of Statistics, 2011a) classifies a geographical area as metropolitan, inner/outer regional, or remote/very remote, based on the access to goods, services, and opportunities for social interaction in that area. Due to smaller cohort numbers outside the metropolitan areas, these five categories were collapsed into three (metropolitan, regional, remote). The Index of Relative Socioeconomic Disadvantage (Australian Bureau of Statistics, 2011b) is derived from census information that reflects area-level disadvantage such as low income, low educational attainment, high unemployment, and jobs in relatively unskilled occupations. Local communities were given a score ranging from 1 (most disadvantaged) to 5 (least disadvantaged).

Statistical Analysis

To estimate the odds of children being classified as vulnerable/at-risk on each of the five AEDC domains as an outcome of parental criminal justice involvement, logistic regression models were fitted with maximum likelihood estimation using SAS version 9.3 for Windows (SAS Institute Inc, 2010). All covariates were transformed into binary or continuous categorical variables with the category representing lower risk coded as the

reference group (see Table 8-2). Unadjusted and adjusted odds ratios (*OR*) and 95% confidence intervals (*CI*) were estimated for each AEDC domain. Adjusted models controlled for sociodemographic covariates, and parental criminal offending information was entered simultaneously. Holm's *p*-value correction was applied to account for multiple hypothesis testing (Gaetano, 2013; Holm, 1979).

Missing Data

Missing data were identified on parental demographic variables for a total of 810 children. There were 62 (0.30% of the total cohort) children missing maternal marital status, 729 (3.80% of the total cohort) children missing paternal age, and 19 (< 0.001% of the total cohort) children missing data on both of these variables. Relative to children with complete parental demographic information, children missing parental data were more likely to be Aboriginal (41.10%), ESL (16.70%), be born to teenage mothers (23.50%), and live in remote locations (26.70%) and in more disadvantaged communities (37.00%). Data were therefore not missing at random.

The missing indicator method was used to account for any potential bias that missing data may introduce into the regression models, whereby missingness was included as an extra category in regression models. We also ran adjusted models including only cases with complete information ($N = 18,261$). The *ORs* from the complete-case analysis were at most 0.05 points larger than the *ORs* from the missing-indicator analysis. However, *CI*s were slightly wider. Therefore, for completeness of the sample and robustness of estimates, the results presented in this paper are from analyses using the missing indicator method.

Results

Descriptive Statistics

Sociodemographic characteristics of the sample are shown in Table 8-2. Frequencies show that, of the children whose parents had criminal justice contact, there

were a disproportionate number of children who were Aboriginal, born to unmarried and teenage mothers, and lived in more remote and socioeconomically disadvantaged areas, compared to children whose parents had no criminal justice involvement. Most notably, almost 50% of children of mothers on community orders and over 60% of children of incarcerated mothers were of Aboriginal or Torres Strait Islander descent, compared to 5% of children whose mothers had no criminal justice contact. Similarly large differences in proportions of Aboriginal children were seen for the group whose fathers had criminal justice involvement. Although there were marked differences in the average sociodemographic profile of children of parents with and without criminal justice involvement, the profile was similar for children of parents who had served community orders and those whose parents had been incarcerated.

Table 8-2

Sociodemographic Characteristics of the Cohort

Characteristic	Whole cohort, N (%)	Maternal criminal history, n (%)			Paternal criminal history, n (%)		
		None	Community order	Prison	None	Community order	Prison
Child's gender							
Female	9,404 (49.31)	9,115 (49.23)	189 (50.81)	100 (54.64)	8,861 (49.28)	213 (49.08)	330 (50.38)
Male	9,667 (50.69)	9,401 (50.77)	183 (49.19)	83 (45.36)	9,121 (50.72)	221 (50.92)	325 (49.62)
Child's ethnicity							
Aboriginal/Torres Strait Islander	1,304 (6.84)	1,002 (5.41)	185 (49.73)	117 (63.93)	866 (4.82)	152 (35.02)	286 (43.66)
Other*	17,767 (93.16)	17,514 (94.59)	187 (50.27)	66 (36.07)	17,116 (95.18)	282 (64.98)	369 (56.34)
Child speaks English as a second language							
No*	17,846 (93.58)	17,357 (93.74)	323 (86.83)	166 (90.71)	16,865 (93.79)	392 (90.32)	589 (89.92)
Yes	1,225 (6.42)	1,159 (6.26)	49 (13.17)	17 (9.29)	1,117 (6.21)	42 (9.68)	66 (10.08)
Mother's marital status at child's birth							
Single/never married	1,409 (7.39)	1,218 (6.58)	119 (31.99)	72 (39.34)	1,141 (6.35)	95 (21.89)	173 (26.41)
Divorced/widowed	223 (1.17)	203 (1.10)	15 (4.03)	5 (2.73)	192 (1.07)	9 (2.07)	22 (3.36)
Married*	17,358 (91.02)	17,028 (91.96)	228 (61.29)	102 (55.74)	16,583 (92.22)	325 (74.88)	450 (68.70)
<i>Missing</i>	<i>81 (0.42)</i>	<i>67 (0.36)</i>	<i>10 (2.69)</i>	<i>4 (2.19)</i>	<i>66 (0.37)</i>	<i>5 (1.15)</i>	<i>10 (1.53)</i>
Mother's age at child's birth							
< 20 years	1,011 (5.30)	885 (4.78)	82 (22.04)	44 (24.04)	766 (4.26)	112 (25.81)	133 (20.31)
20-29 years	8,264 (43.33)	7,948 (42.93)	215 (57.80)	101 (55.19)	7,652 (42.55)	232 (53.46)	380 (58.02)

(continued)

Characteristic	Whole cohort, N (%)	Maternal criminal history, n (%)			Paternal criminal history, n (%)		
		None	Community order	Prison	None	Community order	Prison
30-39 years*	9,233 (48.42)	9,125 (49.28)	73 (19.62)	35 (19.13)	9,014 (50.13)	85 (19.59)	134 (20.46)
40 years+	563 (2.95)	558 (3.01)	2 (0.54)	3 (1.64)	550 (3.06)	5 (1.15)	8 (1.22)
Father's age at child's birth							
< 20 years	358 (1.88)	316 (1.71)	32 (8.60)	10 (5.46)	214 (1.19)	60 (13.82)	84 (12.82)
20-29 years	5,741 (30.10)	5,527 (29.85)	153 (41.13)	61 (33.33)	5,136 (28.56)	236 (54.38)	369 (56.34)
30-39 years*	10,108 (53.00)	10,006 (54.04)	72 (19.35)	30 (16.39)	9,805 (54.53)	128 (29.49)	175 (26.72)
40 years+	2,116 (11.10)	2,104 (11.36)	7 (1.88)	5 (2.73)	2,079 (11.56)	10 (2.30)	27 (4.12)
<i>Missing</i>	748 (3.92)	563 (3.04)	108 (29.03)	77 (42.08)	748 (4.16)	-	-
Local community remoteness index							
Metropolitan*	12,317 (64.59)	12,053 (65.10)	158 (42.47)	106 (57.92)	11,718 (65.17)	235 (54.15)	364 (55.57)
Regional	4,812 (25.23)	4,667 (25.21)	105 (28.23)	40 (21.86)	4,531 (25.20)	118 (27.19)	163 (24.89)
Remote	1,942 (10.18)	1,796 (9.70)	109 (29.30)	37 (20.22)	1,733 (9.64)	81 (18.66)	128 (19.54)
Local community index for socioeconomic disadvantage							
1 (Most disadvantaged)	2,351 (12.33)	2,149 (11.61)	147 (39.52)	55 (30.05)	1,996 (11.10)	137 (31.57)	218 (33.28)
2	3,918 (20.55)	3,761 (20.31)	95 (25.54)	62 (33.88)	3,611 (20.08)	130 (29.95)	177 (27.02)
3	3,737 (19.60)	3,640 (19.66)	66 (17.74)	31 (16.94)	3,511 (19.53)	92 (21.20)	134 (20.46)
4	3,189 (16.72)	3,148 (17.00)	26 (6.99)	15 (8.20)	3,099 (17.23)	34 (7.83)	56 (8.55)
5 (Least disadvantaged)*	5,874 (30.80)	5,816 (31.41)	38 (10.22)	20 (10.93)	5,763 (32.05)	41 (9.45)	70 (10.69)

*Reference group for logistic regressions

Prevalence

During the study period, the parents of 1,402 children (7.35% of total cohort) had criminal justice involvement. This included 555 mothers (2.91% of the total cohort) and 1,089 fathers (5.71% of the total cohort); 242 children (1.27% of the total cohort) had both parents who had experienced criminal justice involvement. Of the children who had both parents with a history of criminal justice involvement, 70 (0.37%) had experienced the incarceration of both parents at some point during the study period. The majority of mothers ($n = 372$, 67.03%) were sentenced to community orders, with fewer mothers being incarcerated ($n = 183$, 32.97%). Most incarcerated mothers had received a custodial sentence ($n = 116$, 63.39%), with the remainder in prison on remand. Almost all incarcerated mothers ($n = 160$, 87.43%) had also been sentenced to a community order at some point during the study period. Conversely, most fathers with a criminal history had been incarcerated ($n = 655$, 60.15%), and fewer fathers ($n = 434$, 39.85%) had received a community order only. Similarly to incarcerated mothers, the majority of incarcerated fathers had received a custodial sentence ($n = 494$, 75.42%), and/or had also been sentenced to a community order during the study period ($n = 540$, 82.44%).

Regression Analyses

Results of the unadjusted models estimating the odds of children being vulnerable/at-risk on the AEDC domains as an outcome of parental criminal offending are presented in Table 8-3. Compared to children with non-convicted parents, both children whose parents had served a community order and children whose parents had been incarcerated had increased odds of developmental vulnerability on all AEDC domains. Comparisons of children of incarcerated parents to children whose parents had served community orders revealed a significantly increased risk associated with paternal incarceration for children's vulnerability in physical and communicative development (Table 8-3).

Table 8-3

Unadjusted Odds of Children Being Classified as Developmentally Vulnerable/At-risk on the Australian Early Development Census as an Outcome of Highest Level of Parental Justice Contact

AEDC Domain	Community order			Prison			Prison vs community order		
	<i>OR</i>	95% CI	<i>p</i> ^a	<i>OR</i>	95% CI	<i>p</i> ^a	<i>OR</i>	95% CI	<i>p</i> ^a
Physical Health & Wellbeing									
Maternal offending	2.68	[2.18, 3.30]	.001	3.45	[2.58, 4.62]	.001	1.29	[0.90, 1.84]	.49
Paternal offending	1.68	[1.37, 2.06]	.001	2.61	[2.22, 3.06]	.001	1.55	[1.20, 2.00]	.004
Social Competence									
Maternal offending	2.45	[1.99, 3.02]	.001	3.52	[2.63, 4.71]	.001	1.44	[1.01, 2.05]	.19
Paternal offending	1.98	[1.62, 2.42]	.001	2.44	[2.08, 2.86]	.001	1.23	[0.96, 1.58]	.12
Emotional Maturity									
Maternal offending	2.30	[1.87, 2.83]	.001	2.61	[1.95, 3.50]	.001	1.14	[0.80, 1.62]	.66
Paternal offending	1.99	[1.64, 2.42]	.001	2.52	[2.15, 2.95]	.001	1.27	[0.99, 1.62]	.12
Communication Skills & General Knowledge									
Maternal offending	2.36	[1.91, 2.92]	.001	3.62	[2.70, 4.84]	.001	1.53	[1.07, 2.19]	.10
Paternal offending	2.12	[1.73, 2.58]	.001	2.97	[2.53, 3.48]	.001	1.40	[1.09, 1.80]	.032
Language & Cognitive Skills									
Maternal offending	3.45	[2.79, 4.26]	.001	4.14	[3.05, 5.63]	.001	1.20	[0.83, 1.74]	.66
Paternal offending	2.55	[2.12, 3.09]	.001	3.32	[2.83, 3.89]	.001	1.30	[1.02, 1.66]	.11

Note. AEDC=Australian Early Development Census, *OR*=Odds ratio, *CI*=Confidence Interval.

^a Adjusted *p* values after Holm's correction applied.

The fully-adjusted models are shown in Table 8-4 (see Appendix IX for the complete table of results). Once sociodemographic factors were taken into account, the *ORs* estimating children's developmental vulnerability as an outcome of parental criminal offending were largely attenuated, but still indicated a significantly increased risk of developmental vulnerability on a number of AEDC domains, for both maternal and paternal criminal offending. Children whose fathers had served a community order had increased odds of being scored as vulnerable/at-risk on the social (29% increased risk), emotional (29% increased risk), communication (43% increased risk) and cognitive (51% increased risk) domains. Children of mothers who had served community orders had significantly higher odds of vulnerability on the physical (52% increased risk), social (38% increased risk), and cognitive (59% increased risk) domains compared to children whose mothers had no criminal justice record.

Similarly, parental incarceration remained a significant predictor of children's developmental vulnerability on the majority of AEDC domains after adjusting for sociodemographic factors (Table 8-4). Compared to children with non-convicted parents, children with an incarcerated mother had an increased risk of developmental vulnerability on the physical (91% increase), social (100% increase), communication (84% increase), and cognitive (78% increase) domains. Children with an incarcerated father also had higher odds of developmental vulnerability on all AEDC domains compared to children with non-convicted parents, at 46% (social competence) to 84% (communication skills) increased risk. Comparisons between children of incarcerated parents and children of parents who had served community orders were compatible with an increased risk of vulnerability associated with parental incarceration, but none of the *ORs* were statistically significant (Table 8-4).

Table 8-4

Fully-adjusted^a Odds of Children Being Classified as Developmentally Vulnerable/At-risk on the Australian Early Development Census as an Outcome of Highest Level of Parental Justice Contact

AEDC Domain	Community order			Prison			Prison vs community order		
	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b	<i>OR</i>	95% CI	<i>p</i> ^b
Physical Health & Wellbeing									
Maternal offending	1.52	[1.21, 1.90]	.001	1.91	[1.40, 2.61]	.001	1.26	[0.88, 1.81]	.64
Paternal offending	1.11	[0.90, 1.38]	.33	1.56	[1.31, 1.86]	.001	1.40	[1.08, 1.82]	.06
Social Competence									
Maternal offending	1.38	[1.10, 1.73]	.017	2.00	[1.47, 2.74]	.001	1.46	[1.01, 2.10]	.17
Paternal offending	1.29	[1.05, 1.59]	.044	1.46	[1.22, 1.74]	.001	1.13	[0.87, 1.46]	.53
Emotional Maturity									
Maternal offending	1.20	[0.96, 1.50]	.21	1.32	[0.96, 1.80]	.08	1.10	[0.76, 1.59]	.99
Paternal offending	1.29	[1.05, 1.59]	.044	1.54	[1.29, 1.83]	.001	1.19	[0.92, 1.54]	.53
Communication Skills & General Knowledge									
Maternal offending	1.21	[0.96, 1.53]	.21	1.84	[1.34, 2.53]	.001	1.52	[1.05, 2.21]	.14
Paternal offending	1.43	[1.16, 1.77]	.004	1.84	[1.54, 2.20]	.001	1.29	[0.99, 1.67]	.23
(Language & Cognitive Skills									
Maternal offending	1.59	[1.26, 2.00]	.001	1.78	[1.28, 2.47]	.001	1.12	[0.76, 1.65]	.99
Paternal offending	1.51	[1.24, 1.85]	.001	1.77	[1.48, 2.10]	.001	1.17	[0.90, 1.51]	.53

Note. AEDC=Australian Early Development Census, *OR*=Odds ratio, *CI*=Confidence Interval.

^a Adjusted for criminal offending history of other parent; child Aboriginality; parent age; mother's marital status; child's ESL status; and local community socioeconomic disadvantage and remoteness indices. ^b Adjusted *p* values after Holm's correction applied.

Discussion

This study examined the early developmental outcomes of children of parents with a history of criminal offending, using population-level administrative data. We hypothesised that children whose parents had any criminal history would be at increased risk of poor outcomes compared to children whose parents had no record of criminal activity. We also hypothesised that when we examined the outcomes of children whose parents had a criminal record, children whose parents had been incarcerated would have poorer outcomes compared to children whose parents had been convicted but not incarcerated. We also aimed to investigate whether the gender of the incarcerated parent had a bearing on children's developmental outcomes, by including both mothers and fathers who had been to prison.

In support of our first hypothesis, the results showed that children whose parents had a history of criminal justice involvement were at risk of developmental vulnerability, compared to children whose parents had no criminal justice involvement. This is in agreement with other studies investigating the outcomes of young children of incarcerated parents (Craigie, 2011; Haskins, 2014; Wakefield & Wildeman, 2011), and adds to this literature by showing that children are at risk of difficulties across multiple developmental domains (physical, social, emotional, communication, and cognitive). Without supportive interventions, it is possible that these difficulties will compound as children age, particularly if they experience the cumulative effects of exposure to the cycle of parental crime, arrest, incarceration, release, and recidivism (Johnston, 1995; Reed & Reed, 1997).

Contrary to our expectations, however, we did not find a significantly greater risk of developmental vulnerability for children of incarcerated parents, compared to children of parents who had been convicted but not incarcerated. This finding differs from the conclusions made by Hissel (2011), who found that children of incarcerated mothers had significantly more social problems than children of mothers on probation. Of note, the

Hissel study used a sample of convenience and a parent-reported measure of children's outcomes, which may have biased the results (Hissel, 2011). Conversely, our study used a teacher-reported measure of children's early development, and we were able to identify all parents of children in our sample who had criminal justice involvement. As such, our results are likely to provide a more robust estimate of the association between parental criminal offending and children's developmental outcomes. It must be acknowledged that some of our results were compatible with there being an increased risk for children's developmental vulnerabilities associated with parental incarceration compared to parental community service; however these differences were not statistically significant. Therefore, additional research with even larger population samples than our own, using a comparison group of convicted but non-incarcerated parents, will help to build the evidence base regarding the particular impact of parental incarceration on children's developmental outcomes.

We also aimed to extend the currently limited literature by examining the outcomes associated with both maternal and paternal criminal offending. The results did not show any significant differences in the magnitude of the effect associated with maternal and paternal offending on children's developmental outcomes, with children's developmental outcomes observed to be similar, regardless of the gender of the criminally-convicted parent. Previous research on the association between children's early developmental outcomes and parental incarceration has focused on convicted fathers (Craigie, 2011; Haskins, 2014; Wakefield & Wildeman, 2011), and so no direct comparisons with this literature can be made in terms of the gendered effects of parental incarceration. Of the limited literature comparing the effects of paternal and maternal incarceration on children's outcomes, one study found that the gender of the parent did not have a significant effect on youth offending behaviour (Besemer et al., 2011), and another found that parent gender was a significant predictor of the type of mental health

difficulties children experienced (Foster & Hagan, 2013). These variable findings, and the limited number of studies examining this association, indicate that it is an area of research that requires further investigation.

We also found that children whose parents had criminal justice involvement had a markedly different sociodemographic profile to children whose parents had not had contact with the criminal justice system. Relative to non-convicted parents, children whose parents had been convicted were disproportionately born to young, unmarried mothers, were of Aboriginal or Torres Strait Islander descent, and lived in more remote and socioeconomically disadvantaged areas. The majority of other studies on parental incarceration have similarly found that prison populations are primarily characterised by young, unmarried individuals from low socioeconomic backgrounds, and that individuals from minority backgrounds are over-represented (Hairston, 1991; Kemper & Rivara, 1993; Kjellstrand & Eddy, 2011). The high proportion of Aboriginal children in our sample of children with convicted parents is particularly striking. National estimates indicate that Indigenous Australians make up around 2% of the entire Australian adult population, but 27% of the prisoner population (Australian Bureau of Statistics, 2015). In our one year birth cohort, Aboriginal children made up around 6% of the entire sample, but more than 60% of the children of incarcerated mothers and 40% of children of incarcerated fathers. Aboriginal people are more likely to experience stigmatising and discriminatory practices within the criminal justice system (Krieg, 2006), as well as other institutional and social challenges that can act to increase adversity (De Maio et al., 2005; Priest et al., 2012, 2014; Williams et al., 2016). Support for children of incarcerated parents must be culturally sensitive, and should acknowledge the different experiences Aboriginal and non-Aboriginal children and families may face within the criminal justice system.

Untangling the mechanisms of risk transmission through which parental

incarceration exerts its effects on children's developmental outcomes is not possible from the information available in this study. However, our analyses do go some way to addressing the question of whether child effects are due to the separation from the parent as a consequence of incarceration, or whether they are due to the sociodemographic risk factors common to individuals involved in criminal activity. Our results suggest that the sociodemographic background of children whose parents are involved in the criminal justice system does make a large contribution to observed developmental difficulties these children have. However, there remains a unique and significant effect of parental criminal offending – and not just incarceration – on children's developmental outcomes, once these sociodemographic factors have been taken into account. The developmental difficulties these children experience are likely to be the consequence of a number of direct and indirect effects of their parent's criminal offending (Murray, Bijleveld, Farrington, & Loeber, 2014), with incarceration just one of many adverse experiences these children may be faced with.

Our finding that children of parents with a history of criminal offending are at risk of having poorer physical, social, emotional, communicative, and cognitive development than their peers has important implications for interventions. Children in our sample were in their first year of formal schooling, which constitutes an important transition in the child's life. Vulnerabilities in development at the start of school predict later school outcomes, including poor academic achievement, social and emotional difficulties, poor school attendance, and out-of-school suspensions (Bell, Bayliss, Glauert, & Ohan, this thesis; Brinkman et al., 2013; Duncan et al., 2007; Guhn, Gadermann, Almas, Schonert-Reichl, & Hertzman, 2016; Kurdek & Sinclair, 2001; La Paro & Pianta, 2000). Many studies have found that children of incarcerated parents have a higher probability of experiencing school problems, such as low academic achievement, social difficulties, poor attendance, and out-of-school suspensions (Cho, 2011; Foster & Hagan, 2007; Fritsch &

Burkhead, 1981; Hagan & Foster, 2012; Hanlon et al., 2005; Myers, Smarsh, Amlund-Hagen, & Kennon, 1999). Children who experience these difficulties at school are at risk of school disengagement (Hirschi, 2002; Moore & McArthur, 2014; Roberts & Loucks, 2015; Rumberger, 2001), which in turn is associated with an increased probability of participating in delinquent or criminal behaviour (Hirschfield & Gasper, 2011; Lochner & Moretti, 2004; Moore & McArthur, 2014), and higher rates of school drop-out (Balfanz, Herzog, & Mac Iver, 2007; Rumberger, 2001). In turn, school disengagement and drop-out are both risk factors for criminal behaviour in adulthood (Alexander, Entwisle, & Horsey, 1997; Farrington, 2015; Hirschfield & Gasper, 2011). Provision of extra support to children of convicted parents in order to maximise their chances of success at school may help to prevent the intergenerational cycle of crime (Lochner & Moretti, 2004; Machin, Marie, & Vujić, 2011). Our results suggest that providing broad support at the transition to school for children of convicted parents may improve children's early school outcomes, and thus reduce the likelihood of future school difficulties occurring. This may be one of many interventions required to ensure these children experience school success, despite the adversity they face.

Although the incarceration of a parent seems to be a logical trigger for the provision of services to dependent children, the reality is that these children are likely to have been exposed to adverse circumstances long before the incarceration (Johnson & Waldfogel, 2002). Incarceration of the parent may create new stressors for the child, or exacerbate existing adversity, but it is likely to be only one event among many that put children's development at risk (Murray et al., 2014). Our finding that children whose parents had been convicted, but not incarcerated, were also developmentally vulnerable supports this assertion. Intervention, therefore, should take place when the adult is convicted, and involve collaborative approaches that consider the whole family and social/cultural context (Trotter et al., 2016). The factors predicting risk and resiliency for

children of offenders are likely to be many and varied, and as such, trying to disentangle direct and indirect effects of parental criminal activity may be less important than simply recognising that these children constitute a particularly vulnerable, and currently underserved, group.

A critical step in improving the response to the needs of children of offenders is the establishment of procedures for identifying offenders who are parents. In Australia, there are currently no standard procedures at arrest, sentencing, or reception into prison to determine which offenders have dependent children (Flynn, Naylor, & Fernandez Arias, 2016). There also needs to be appropriate resources available to respond to the needs of these children (Flynn et al., 2016). Currently, the safety and wellbeing of children of convicted parents is not seen as the responsibility of any one government department, with many children ‘falling between the cracks’ of a fragmented service system (Dallaire, 2007; Flynn et al., 2016). Some experts have commented that the criminal justice system needs to shift away from a sole focus on the punishment of individuals as separate entities, and recognise the individual as a member of a family system (Nesmith & Ruhland, 2008; Trotter et al., 2016). The results of our study support these contentions, as there was a consistent negative association between parental offending and children’s early developmental outcomes, even after sociodemographic risk factors were taken into account. Parental criminal activity therefore has an independent association with children’s physical, social, emotional, communicative, and cognitive maladjustment. Whilst it is not necessarily appropriate to determine the severity of a sentence based on the fact that an individual has dependent children, the needs of the children should always be taken into account. Addressing the issues facing families of offenders requires a whole-of-government approach that takes into account family, social, economic, cultural, educational, and health perspectives (Woodward, 2003).

It should be noted that there are a number of factors associated with parental

incarceration that we have not taken into account in our analysis, and which may have a bearing on children's outcomes. Factors such as the timing of the incarceration, the length of the sentence, the relationship between the child and the parent before and during incarceration, the care arrangements for the child, and the level of family and social support available to the family during incarceration and after release may all mediate the relationship between parental incarceration and the developmental outcomes of young children (Andersen, 2016; Arditti, 2012; Foster & Hagan, 2013; Murray & Farrington, 2008b; Parke & Clarke-Stewart, 2002; Wakefield & Powell, 2016). Although length of sentence, number of contacts with the criminal justice system, and type of offence information were available from the DCS dataset, we did not examine these dimensions in the study because of concerns regarding the quality of this information identified in a recent audit (Office of the Auditor General, 2016). However, it is hoped that with improvements to the processes for capturing such information, these dimensions of parental incarceration can be investigated in the future. Furthermore, there may be mediating effects of the particulars of the Australian criminal justice system (e.g., prison policies, recidivism prevention programs) on the outcomes studied here (Murray & Murray, 2010). Cross-national comparisons using similar outcome measures will be important for establishing whether our results are replicated in the context of the criminal justice system of other countries.

Strengths of this study include the use of linked administrative data, which is a more robust method of identifying offenders than relying on offenders or their family members to report criminal activity, and ensures the anonymity of parents and children. Identification of both mothers and fathers in prison, and linking this information to a teacher-reported measure of early child development, were also strengths of this study. A limitation is that we were unable to determine which children were residing with their parent prior to their incarceration. However, it has been shown that even if children have

little involvement with their parent, incarceration of that parent can still result in financial or social harms to children (Geller et al., 2012; Geller, Garfinkel, & Western, 2011). As such, we do not consider that inclusion of children who were not residing with their parent in the sample has biased our conclusions. In addition, given that previous research has found that teachers may stigmatise children of incarcerated parents (Dallaire, Ciccone, & Wilson, 2010), it is possible that our teacher-reported measure contained some bias. However, this assumes that teachers were aware of the incarceration of parents of children in this sample. It is common for children and families to keep the event of incarceration of a parent secret from people outside of the immediate family (Nesmith & Ruhland, 2008), making it unlikely that all teachers were aware of the parent's imprisonment. Bias in the outcome measure is therefore assumed to be minimal. There are also likely to be several un-measured sociodemographic variables influencing the association between parental criminal offending and children's school readiness, which could not be controlled for in this study

In conclusion, this study found that children of convicted parents are at increased risk of poorer early development in multiple domains, regardless of whether or not the parent has been incarcerated, and regardless of the gender of the parent. Although it is not possible to conclude that the parent's criminal activity causes the poor outcomes we see for children in our sample, our results reinforce the importance of recognising the influence of the family context in which these children's development is occurring. Our results suggest that children whose parents are involved in criminal activity are in need of additional support to promote their positive adjustment in the face of the risks associated with their developmental context. Preferably, this support should occur when the parent comes into contact with the criminal justice system.

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Chapter 9 - General Discussion

It is now widely accepted that both the experiences children have during the early childhood period, and the socioeconomic conditions of their early developmental contexts, are critical influences on later life outcomes (Hertzman, 1999). The transition from home to full-time schooling is an important stage of a child's life. How 'ready' children are to make this transition can have implications for their ongoing achievement and development in the school context. Ensuring that children are exposed to the conditions and experiences in early childhood that support their developmental growth is critical for establishing a strong foundation from which children can take on this challenge. Identifying groups at risk of poor developmental outcomes, as a consequence of their experiences and contexts, is central to developing effective strategies to improve the developmental health of the population of young children. This thesis aimed to identify such groups by investigating features of the early developmental context that may significantly disrupt children's interactions with the people and/or objects within their developmental contexts, and thus reduce children's readiness for school.

School readiness measures provide an indicator of children's preparedness to take on the challenges of full-time school. This thesis used a population-level measure of school readiness, merged with longitudinal administrative and registry data, to examine antecedents to, and consequences of, poor school readiness. The antecedents examined were of a complex and sensitive nature, such as physical and mental illness, child maltreatment, and parental criminal convictions, and were captured across the child's entire life-course. Data linkage enabled the collection of information on individuals with a number of risk factors, from the whole of the population, thus providing representative samples of high-risk groups. This research demonstrates the utility of administrative data to complement evidence on risk factors for early child development obtained from person-level and survey methods. The current research therefore significantly contributes to the

existing evidence base regarding risk factors for poor school readiness by highlighting the developmental outcomes of children who have been exposed to a range of adverse circumstances, which are not easily captured by other research methods.

This final chapter presents a summary of the main research findings of the thesis, considered in the context of existing research. There is then a discussion of the theoretical, clinical, and policy implications of these findings. Also discussed are the strengths and limitations of the research design, and possible directions for future research.

Main Findings

Understanding how developmental vulnerabilities at school entry relate to later school outcomes can provide targets for interventions. The school outcomes examined in this thesis included factors that may impact on a child's motivation to engage with school, such as academic difficulties; reduced exposure to learning and social opportunities due to poor attendance; and conflict with peers and/or teachers that lead to suspension or exclusion from the school community. Low academic achievement, poor school attendance, and out-of-school suspensions are early indicators of disengagement from school (Balfanz, Herzog, & Mac Iver, 2007), with associations between these factors and later disengagement evident from as early as third grade (Cratty, 2012). The first study of this thesis, reported in Chapter 3, found that children's developmental vulnerabilities at school entry were associated with all three of these indicators of school disengagement. Skill deficits that emerge during early childhood may have significant negative implications for the child's transition into formal schooling, which potentially sets the stage for children experiencing adverse school outcomes in subsequent years.

The findings of Chapter 3 indicated that children experiencing difficulties across any of the measured developmental domains at school entry were at increased risk of low academic achievement by grade 3, emphasising the importance of a range of skills and abilities for educational success. However, in agreement with a number of other studies

(D'Angiulli, Warburton, Dahinten, & Hertzman, 2009; Duncan et al., 2007; Forget-Dubois et al., 2007; Kurdek & Sinclair, 2001; Pagani, Fitzpatrick, Archambault, & Janosz, 2010), language and cognitive difficulties were the strongest predictor of low grade 3 academic achievement, even after demographic characteristics were taken into account. This finding supports the assertion, made by a number of experts, that a child's cognitive readiness for school is a particularly important predictor of later educational achievement (Duncan et al., 2007; Kurdek & Sinclair, 2001; Pagani et al., 2010). Difficulties with language and cognitive tasks may negatively impact on children's early experiences at school if they struggle to meet academic demands. Children who receive persistent negative feedback about academic competence often become withdrawn and lose motivation for school work (Rumberger, 2001). Therefore, children who commence school with significant language and cognitive skill deficits that cause them to struggle academically may be at risk of school disengagement.

Children's cognitive difficulties were also associated with poor school attendance, as were early physical difficulties. This suggests that children who start school with lower levels of pre-academic skills and/or greater difficulties in fine- and gross-motor skills, may experience barriers to regular attendance at school in the early years. Regular school attendance is necessary for school engagement, as it ensures children are exposed to learning and social opportunities, which in turn can influence school liking and motivation to participate in school (Finn, 1993; Ladd, Birch, & Buhs, 1999). Children who are frequently absent in the early years of school tend to continue to have poor attendance in later schooling (Hancock, Shepherd, Lawrence, & Zubrick, 2013; Hancock & Zubrick, 2015), highlighting the importance of intervening early to improve attendance rates. The findings of this study suggest that children's physical and cognitive difficulties may be appropriate targets for such interventions.

Chapter 3 also presented the finding that children with early social and emotional

difficulties had an increased risk of being suspended from school by grade 3. Children who are suspended from school generally experience significant interpersonal and/or behavioural difficulties that contribute to their exclusion from school (Brantlinger, 1991; Frick et al., 1993; Haight, Gibson, Kayama, Marshall, & Wilson, 2015; Schaeffer, Petras, Ialongo, Poduska, & Kellam, 2003). Suspension is associated with a raft of poor outcomes in the upper years of school, such as disengagement, academic failure, and dropout (Butler, Bond, Drew, Krelle, & Seal, 2005; Hemphill, Plenty, Herrenkohl, Toumbourou, & Catalano, 2014; Raffaele Mendez, 2003). Given the seriousness of these outcomes, and the strong association identified in this study between early socio-emotional difficulties and out-of-school suspensions, the current research suggests that efforts to enhance the social and emotional competence of children at risk of suspension may be an important focus of interventions in the early years.

The findings reported in Chapter 3 extend previous research on the associations between school readiness and later school outcomes by demonstrating that developmental vulnerabilities at school entry predict the occurrence of three factors that have been identified as early indicators of disengagement (Balfanz et al., 2007; Cratty, 2012). Although school disengagement can occur for a number of reasons (Hancock & Zubrick, 2015), if future research indicates that the findings of Chapter 3 reflect, in part, causal, then improving children's school readiness may be one pathway to preventing student disengagement. Early developmental difficulties may be associated with barriers to regular attendance, academic problems, and serious behaviour problems in the school context. Whether or not developmental vulnerabilities at school entry predict disengagement and dropout from school in later years remains to be seen; however, this is an important area of future research. Linked administrative data facilitate long-term follow-up of children from school entry to school completion, making it possible to conduct these investigations.

Having established that poor school readiness is associated with low grade 3

academic achievement, poor attendance, and suspensions, the subsequent studies in this thesis investigated potential antecedents to poor school readiness. Investigating predictors of poor school readiness enables us to understand whether the effects of risk factors in early childhood are evident at school entry, or emerge later on in schooling. Such information helps to identify potential areas of intervention for improving early child development. The overall aim of these studies was to add to the existing literature on factors that are associated with school readiness, by examining a number of factors during the early childhood period that have been identified by previous research, but have been historically difficult to investigate, due to the complex and sensitive nature of the information. Achieving this aim was aided by the use of the linked data methodology, which enables identification of individuals from high-risk groups that are generally not adequately captured in survey data.

Negative early childhood experiences that influence the ways in which children interact with people and engage in activities in the developmental environment are potential sources of risk for school readiness (Bronfenbrenner & Morris, 2007). For instance, chronic physical illness can limit children's capacity to engage in social and learning activities by reducing energy levels and emotional resources (Currie, 2005). In Chapter 4, the association between school readiness and chronic illness occurring in the early childhood period was investigated. Use of administrative data enabled the identification of children across diagnostic groups, rather than focusing on specific chronic conditions, and also improved identification of chronic illnesses through use of clinically coded data, rather than relying on self-report. More than 12% of children had a diagnosed chronic illness during the study period. Chronically ill children were found to be at increased risk of developmental vulnerability on all AEDC domains, compared to children without a chronic illness, even after controlling for sociodemographic characteristics. Chronic illness was associated with developmental vulnerability regardless of the

diagnosis, which supports previous research suggesting commonalities in the impact of chronic conditions on the functioning and wellbeing of individuals (Stein & Jessop, 1989). The associations between chronic illness and developmental vulnerability were also found for children regardless of the type or number of chronic illness diagnoses they had during the early childhood period. This implies that just having one diagnosis of any of the chronic conditions studied was sufficient to confer a risk for children's readiness for school. Whilst differences between diagnoses are important for medical intervention, similarities amongst diagnoses may be more meaningful for psychosocial interventions (Goldfeld, O'Connor, Sayers, Moore, & Oberklaid, 2012; O'Connor, Howell-Meurs, Kvalsvig, & Goldfeld, 2015; Perrin et al., 1993).

Chronic illness in other family members, particularly parents, can also influence children's normative development (e.g., Bogosian, Moss-Morris, & Hadwin, 2010; Kaasbøll, Lydersen, & Indredavik, 2012). However, most of these conclusions are based on research with adolescents, with relatively little research into the outcomes for young children. Furthermore, very few studies have examined the impact of chronic illness in both parents, with the majority of research focused on the outcomes of children with chronically ill mothers. Facilitated by the use of administrative data, the study reported in Chapter 5 aimed to address some of these gaps in the existing literature, by examining developmental vulnerabilities in young children who had either a mother or father with a diagnosed chronic illness. This study found that daughters of chronically ill mothers were at significantly increased risk of physical, social, emotional, and communication difficulties, and that their sons were at increased risk of cognitive difficulties. Conversely, there was no evidence of an association between paternal chronic illness and children's developmental outcomes: children with chronically ill fathers were no more or less at risk of developmental vulnerability than their peers with healthy fathers on any domain. Previous research into the impact of paternal chronic illness on children's outcomes is

limited, and further research in this area is required before conclusions about the effects of paternal chronic illness on children can be made. Importantly, however, the findings of the current research add to the evidence base indicating that children are at risk of maladjustment when their mother is physically unwell. Persistent and serious physical illness may limit an individual physically, cognitively, emotionally, and financially, and can create or exacerbate emotional distress (Bogosian, Hadwin, Hankins, & Moss-Morris, 2016; Romer, Barkmann, Schulte-Markwort, Thomalla, & Riedesser, 2002); thus the stressors and limitations experienced by chronically ill mothers may mean that they are less able to support the healthy development of their children.

Previous research has also shown that children whose parents have serious and persistent psychiatric illness are at risk of maladjustment (e.g., Baker & Iruka, 2013; Shen et al., 2016). Of particular interest is the association between parental psychiatric hospitalisation and children's developmental outcomes, as hospitalisation of a parent is reported by children to be one of the most stressful events they experience in relation to their parents' psychiatric illness (Fudge & Mason, 2004; Handley, Farrell, Josephs, Hanke, & Hazelton, 2001; Maybery, Ling, Szakacs, & Reupert, 2005). Administrative data provide a unique opportunity to investigate the possible predictive relationship between parental psychiatric hospitalisation and children's school readiness, by capturing information on all psychiatric hospitalisations in a population, without the requirement for individuals to disclose this information. The association between parental psychiatric illness and children's school readiness was examined in Chapter 6. In this study, children with a mother or father who had been hospitalised for psychiatric care were at increased risk of vulnerability across all developmental domains. Of note, a similar negative effect was seen for children's developmental outcomes regardless of the frequency and/or duration of the parent's psychiatric hospitalisation, and regardless of the gender of the parent. This suggests that, if a parent's psychiatric symptoms are severe enough to require

hospitalisation, even if only for a single day, children are at increased risk of adverse outcomes. The effect on children's development may therefore reflect the disruption to the child's life as a consequence of the acute episode of their parents' illness preceding the hospitalisation (Blanch, Nicholson, & Purcell, 1994; Fudge & Mason, 2004; Maybery et al., 2005; Mordoch & Hall, 2008), more so than the event of separation from the parent. This acute episode may lead to disruptions in parent-child relationships, or increased family stress, that may contribute to children's maladjustment (Baker & Iruka, 2013; Belsky, Woodworth, & Crnic, 1996).

Child maltreatment is another sensitive topic that is difficult to investigate with traditional research methods. Administrative data facilitate research into child maltreatment by providing large unbiased samples and prospective collection of maltreatment information, whilst protecting the anonymity of the individuals involved (Brownell & Jutte, 2013). In Chapter 7, the results of a study examining the association between different dimensions of child maltreatment (type, timing, and chronicity) and school readiness were presented. These investigations were conducted for children with both substantiated and unsubstantiated allegations of maltreatment. Results showed that children with allegations of maltreatment were at risk for lower school readiness, regardless of whether the maltreatment was substantiated or unsubstantiated. This effect was seen across all developmental domains, and supports the argument that children with unsubstantiated allegations are at similar risk of maladjustment as children whose maltreatment has been substantiated (Barth et al., 2008; Fantuzzo, Perlman, & Dobbins, 2011; Hussey et al., 2005).

Once analyses were broken down according to different dimensions of maltreatment, there was some evidence of differences in outcomes for children with substantiated and unsubstantiated maltreatment allegations. In particular, children with substantiated maltreatment were more likely to experience social and emotional

difficulties, compared to both children with unsubstantiated allegations, and children with no recorded allegations. Children with unsubstantiated maltreatment allegations experienced more heterogeneous developmental outcomes. A significantly increased risk of social and emotional difficulties associated with substantiated maltreatment was consistently found in all analyses, regardless of maltreatment type, timing or chronicity. These difficulties were evident right at the start of school. Children with a history of maltreatment have previously been identified as at risk of school suspension, school disengagement, and school dropout (Fantuzzo et al., 2011; Kendall-Tackett & Eckenrode, 1996; Lansford et al., 2002; Wulczyn, Smithgall, & Chen, 2009). In Chapter 3 of this thesis, socio-emotional difficulties at school entry predicted later out-of-school suspensions. As such, the socio-emotional difficulties observed for maltreated children in Chapter 7 may indicate that these children are at risk of being suspended from school. Taken together, these findings suggest that it is important to intervene early to address any social and/or emotional difficulties maltreated children are experiencing. Addressing these difficulties early, rather than waiting to address more serious behavioural infringements in later years, may help to mitigate later school problems.

Additional dimensions of maltreatment investigated in this study included the timing of the first maltreatment event (infancy-toddlerhood or preschool), and the chronicity of maltreatment (single or multiple maltreatment allegations). These investigations found that children with unsubstantiated or substantiated allegations of maltreatment during either developmental stage were at risk of developmental vulnerability, as were children with single or multiple allegations of unsubstantiated or substantiated maltreatment. These results show that a single allegation of maltreatment is a marker for a broad range of developmental difficulties, even if that allegation is not substantiated. As such, all children with an allegation of maltreatment should be considered as at-risk for poor development, and support services should reflect this

understanding.

In the final empirical study of this thesis (Chapter 8), the association between parental criminal history and children's school readiness was examined. There is currently limited reliable evidence on the outcomes of children of incarcerated parents (Nesmith & Ruhland, 2008; Reed & Reed, 1997). Research on this population has historically been difficult, due to a reliance on criminally convicted parents to disclose their parent status, with many reluctant to do so due to fears of child welfare involvement (Black, 1992; Murray & Farrington, 2008). Previous findings may also be biased due to a dependence on parent-reports of children's outcomes (Dallaire, 2007). Existing evidence may therefore not represent the children of the average prison population. Using linked administrative data, it was possible to identify the proportion of children in a one year birth cohort with a parent who had criminal justice contact during the child's early developmental period. More than 7% of children had a mother or father with a criminal conviction. Results showed that these children were at risk of vulnerability on all developmental domains (physical, social, emotional, communicative, and cognitive), compared to children whose parents had no criminal justice involvement. This risk was evident regardless of the gender of the parent, and regardless of whether the parent had been to prison, or served a community order only. There was no evidence of an increased risk for children with incarcerated parents over the risk seen for children with convicted but not incarcerated parents, suggesting parental criminal offending, generally, is a risk factor for children's early development.

Although the studies included in this thesis did not specifically examine the association between school readiness and sociodemographic factors, a number of child, parent, and community demographic characteristics were included in the analyses. In the investigations into parental psychiatric illness, child maltreatment, and parental criminal offending, there was a significant reduction in the strength of the association between the

risk factor and the outcome (i.e., AEDC scores) after adjusting for sociodemographic factors. With the exception of child and parent chronic illness, children who had been exposed to the adverse events examined in this research were more frequently Aboriginal, spoke English as a second language, were born to young and/or unmarried parents, lived in more remote areas, and lived in communities with the highest levels of socioeconomic disadvantage, relative to non-exposed children. This suggests that children experiencing adverse events are also likely to experience family and neighbourhood sociodemographic risk factors. Furthermore, children who had poor academic achievement, poor attendance, and had been suspended from school also had high levels of sociodemographic risk. The finding that child, family, and community sociodemographic factors were associated with school readiness and later school outcomes suggests that features of the developmental context are important influences on developmental and educational outcomes.

Summary

Taken together, the findings of this thesis suggest that negative features (experiences and conditions) of the developmental context can have detrimental impacts on children's early development, most likely through the impact of these events on parental resources and/or the interactions between the child and the people and objects in his/her developmental settings. In turn, these developmental vulnerabilities may lead to adverse outcomes at school. Many studies have found that academic underachievement, frequent absences, and out-of-school suspensions are problems frequently experienced by children of incarcerated parents (Cho, 2011; Foster & Hagan, 2007; Myers, Smarsh, Amlund-Hagen, & Kennon, 1999), maltreated children (Crozier & Barth, 2005; Trocmé & Cauce, 1995), children whose parents have a serious psychiatric (Shen et al., 2016; Somers, 2007) or physical illness (Chen & Fish, 2012; Sieh, Visser-Meily, & Meijer, 2013), and children who themselves are chronically ill (Case, Fertig, & Paxson, 2005; Jackson, 2009). The findings of the current research suggest that these school problems

may in part be a consequence of the developmental difficulties children have at the start of school, which may set them on a trajectory towards poor school outcomes. The need for intervention prior to the commencement of formal schooling was supported by this research, as difficulties were observed in children as early as 6 months into the first year of formal schooling.

Although the research findings do not permit any causal interpretations, previous research has demonstrated that problematic outcomes are generally the result of multiple and interacting risks, rather than a single cause (Farmer & Farmer, 2001). The findings presented in this research support this notion, as sociodemographic factors and adverse child and parent circumstances were associated with poor school readiness, and in turn, poor school readiness was associated with poor school outcomes. In some of the studies, the risk for developmental outcomes associated with adverse child and parent circumstances was quite small; however, the fact that these effects are evident at school entry, are pervasive across domains, and are likely to be additive over the child's trajectory, suggests that early intervention may be required to ensure that these children do not fall behind their peers as they progress through school. Although some of the risk factors identified in this research cannot be easily modified (e.g., socioeconomic disadvantage) and others are difficult to prevent (e.g., occurrence of chronic illness), an understanding of how these factors may influence developmental and educational outcomes is important for provision of effective support services. The impact of these factors on the family's resources for providing nurturing and stimulating environments for children's development may be an important consideration in providing these services.

Implications of the Research

The findings of this research demonstrate links between children's early physical, social, emotional, communicative, and cognitive development, and characteristics of their developmental settings. These findings have implications for our theoretical

understandings of human development, for targeting and implementation of clinical interventions, and for developing and reforming policy for supporting early child development. The following sections present a discussion of these implications.

Theoretical Implications

Although this research did not directly test bioecological theory (Bronfenbrenner, 1994; Bronfenbrenner & Morris, 2007), the conclusions of the research support a number of the assertions put forward by this developmental framework. For instance, the findings presented in Chapter 3 support the notion that children's physical, socio-emotional, and cognitive abilities are both products and producers of development (Bronfenbrenner & Morris, 2007). This study demonstrated that children who have cognitive, communicative, social, emotional, and/or physical difficulties at the start of school are at risk of low academic achievement 3 years later. These broad-ranging difficulties may therefore be impacting on the processes involved in children's learning. Although no information was available on children's school outcomes beyond grade 3, previous research has demonstrated that educational trajectories are largely stable from grade 3 onwards (Entwisle & Alexander, 1993). It is therefore reasonable to expect that these early developmental difficulties may reduce children's educational achievement throughout later years of school, consequently limiting future development. Furthermore, early cognitive and physical difficulties were associated with frequent school absences. School attendance is necessary for exposure to learning and social opportunities; thus, any circumstances that create a barrier to regular attendance, such as developmental difficulties, may influence later developmental outcomes through reduced exposure to conditions that enhance developmental growth.

Early developmental difficulties may also influence the proximal processes between the child and his/her peers and teachers. In Chapter 3 it was found that children who have social and emotional difficulties have higher odds of being suspended early on

in schooling than their peers who demonstrate social and emotional competence.

Suspension is used as discipline for disruptive behaviours, and these behaviours are often linked to interpersonal difficulties with peers and teachers (Brantlinger, 1991; Haight et al., 2015). This suggests that children's early socio-emotional abilities may be important influences on the interpersonal interactions they have in the school context. Exclusion from school also results in missed academic content and disconnection from peers (Haight et al., 2015). Social and emotional vulnerabilities may therefore indirectly influence later development by constraining the learning and social activities children are exposed to as a consequence of school suspension.

The findings of this thesis also support the proposal from bioecological theory that characteristics of the ecology influence human development. In Chapters 4 to 8, a number of risk factors for children's school readiness were identified. The results of these studies consistently showed that a combination of child-, parent-, and neighbourhood-level factors representing adversity were associated with an increased risk for poor school readiness. Whilst sociodemographic factors made a sizeable contribution to developmental outcomes for the children in the cohort, particularly those who had allegations of maltreatment and those whose parents had criminal convictions, all predictors examined in this thesis made a significant contribution to children's developmental outcomes over and above the association with the demographic characteristics included in the analyses. This suggests that both the sociodemographic features of the child's developmental context and the adversities children and families experience, are important influences on development. Importantly, however, not all children exposed to these adverse circumstances had poor school readiness. This supports the proposition made by bioecological theory, that developmental processes are probabilistic, not deterministic. Developmentally generative characteristics of the child and the ecology may help to buffer children against the effects of adversity (Bronfenbrenner, 1994; Bronfenbrenner & Ceci, 1994; Bronfenbrenner &

Morris, 2007).

Bioecological theory would suggest that the vulnerabilities observed in the children in the study sample are not necessarily failures of the child, but rather failures of the ecology to provide the appropriate context for the child's development. This theoretical framework emphasises the importance of stability, safety, and predictability in children's developmental settings for positive developmental growth (Bronfenbrenner, 1994; Bronfenbrenner & Morris, 2007). Children who are not afforded access to safe and nurturing environments are at risk of maladjustment. The results of Chapters 7 and 8 showed that maltreated children and children of criminally convicted parents were at risk of vulnerabilities in multiple developmental domains. Although the current research did not measure any characteristics of the home environment, it is reasonable to assume that for at least some of these children, the home environment would not be experienced as safe and nurturing if it is characterised by maltreatment or criminal activity. Furthermore, the finding that children of parents with psychiatric or chronic physical illness were at risk for poor school readiness suggests some disruption to the child's developmental context, and possibly the proximal processes taking place within the ecology. Distress or adversity can result in negative parenting behaviours, such as hostility, limited responsiveness, or lack of warmth (Baker & Iruka, 2013; Carter, Garrity-Rokous, Chazan-Cohen, Little, & Briggs-Gowan, 2001). Strains in the parent-child relationship may influence the development of children's competencies for school. Adverse experiences within the family setting may therefore alter normative developmental pathways.

Clinical Implications

The findings presented in this thesis also have potential implications for developing new, and modifying existing, interventions to support early child development and education. The current research supports the notion that early childhood experiences are fundamental influences on development (Tayler, 2015), but importantly, these

experiences are susceptible to change and improvement. Early experiences are largely dictated by the child's developmental context (Hertzman, 1999), and so, a focus on the functioning of the many contexts in which the child develops is required. This study found that both stressors that children experience directly, such as chronic illness and maltreatment, and those that children experience through their parent/s, including parental physical and mental illness and incarceration, contribute to children's maladjustment. As such, interventions that fail to recognise features of the child's developmental context as antecedents and/or maintaining factors in children's maladjustment may not adequately address the issues. The characteristics of the developmental context identified as potential risk factors for early child development in this thesis may help to inform appropriate targeting of clinical interventions.

A key challenge in developing and applying intervention services to improve developmental outcomes is identification of children and families most in need of these services (Lynch, Law, Brinkman, Chittleborough, & Sawyer, 2010). The results of this thesis contribute to our knowledge on which groups of children are at risk of lower school readiness and poor school outcomes in grade 3. Children with chronic illness, those whose parents have serious physical or mental illness, those who have been maltreated or are at significant risk of harm, and those whose parents are involved in criminal activity, are all at risk of starting school without a strong foundation of skills and abilities to support their continuing development in the school context. If their adverse situation persists, it is possible that the gaps between these children and their peers will widen as they progress through school. Due to the cumulative nature of learning, children who struggle to master skills early on in schooling are likely to have difficulty mastering subsequent skills (Bailey, 2002). Evidence indicates that interventions for improved educational achievement provided during early childhood are generally more effective and deliver more economic return than interventions implemented later on in schooling (Temple &

Reynolds, 2007). Thus, interventions to bolster the cognitive and non-cognitive school readiness of children at risk of developmental vulnerabilities, such as the children identified in the current research, are best delivered prior to the commencement of formal schooling.

Although school readiness is an important predictor for later school outcomes, it is not an unchangeable characteristic that determines the child's educational trajectory. Rather, targeted intensive interventions can improve early developmental abilities and help children to catch up to their peers, and have long-term positive effects (Barnett, 1995; Hertzman & Wiens, 1996). The results of the current research support an emphasis of targeted interventions on supporting children's development of a range of competencies in preparation for the commencement of formal schooling. For instance, targeted interventions aimed at improving the home learning environment, involving education for parents about how to facilitate children's learning experiences in the home, are effective for supporting children's developing cognitive skills (Niklas, Cohrssen, & Tayler, 2016; Sénéchal & Lefevre, 2002; Sénéchal & Young, 2008; Sim & Bertheisen, 2014). Research has demonstrated that quality home learning environments exert a positive influence on children's later educational attainment, independent of both family socioeconomic status and parental education level (Melhuish et al., 2008). In addition, interventions focusing on enhancing the knowledge, skills, and confidence of parents have been effective in reducing behavioural and emotional problems in young children (e.g., the Triple-P Positive Parenting Program Sanders, 2012). Thus, a range of interventions tailored to the particular developmental difficulties children are experiencing may all be effective at improving children's preparedness for the school.

The findings of the studies presented in Chapters 4 and 7 suggest that there is a need to broaden the scope of eligibility for early intervention services. In Chapter 4, children experiencing a range of chronic illnesses were at risk of poor school readiness. In

Chapter 7, children with both substantiated and unsubstantiated maltreatment were found to be at increased risk of developmental vulnerabilities at school entry. Currently, intervention services are only provided to a sub-set of both chronically ill and maltreated populations. There may need to be a rethinking of the ways in which services are provided by systems of care. This may involve assessment of the needs of all children in contact with child-oriented agencies, with a goal of identifying children with multiple interacting risks, and ultimately to keep them from reaching a point where they meet eligibility criteria for current systems of care (Farmer & Farmer, 2001). Development of strategies to ensure interventions are provided to a wider range of children and families in need may help to improve the overall developmental health of the population.

Although the research reported in this thesis focused on the developmental outcomes of the children, a number of parent-level factors were found to be significantly associated with children's early development. The implication of this finding is that interventions at the level of the parent may need to also address difficulties in the child. Adult-focused services may better serve clients if they shift the emphasis away from the individual, and towards family-centred service models that incorporate collaborative relationships with the multiple services with which the family has contact (Blanch et al., 1994; Rishel, 2012). There is substantial evidence that family-centred interventions are successful in improving both child and parent outcomes, and decreasing the amount of overall family distress (Falloon, 2003; Horner, 2013; Rosenbaum, King, Law, King, & Evans, 1998; Thastum, Munch-Hansen, Wiell, & Romer, 2006). Furthermore, addressing difficulties in the parent-child relationship may improve the child's level of competence, and also decrease the likelihood of future difficulties occurring (Pianta & Stuhlman, 2004). For instance, interventions focused on improving parenting behaviours have been found to increase secure attachment in maltreated children, which is important for positive emotional and social development (Cicchetti, Rogosch, & Toth, 2006). Evaluations of

parent-oriented interventions have also demonstrated that improved outcomes can be achieved for children and parents involved with the criminal justice system (Welsh & Farrington, 2007) and mental health services (Hutchings, Bywater, Williams, Lane, & Whitaker, 2012). Thus, family-oriented interventions may help to improve children's developmental outcomes, and to create the conditions to sustain those improvements.

It should be acknowledged that there remain some challenges to implementing family-oriented services. Even when there are recommendations that adult-focused services include family-sensitive approaches to intervention, these recommendations are often not put into practice (Gorter, Visser-Meily, & Ketelaar, 2010; Umberger, Risko, & Covington, 2015), perhaps due to a lack of training, a lack of awareness, or a lack of clarity on roles and responsibilities (Laletas, Reupert, & Goodyear, 2017; Romer et al., 2007). In many adult-oriented services, there are no standard procedures for identifying which individuals have dependent children, nor any procedures as to how to address the needs of those children (Blanch et al., 1994; Flynn, Naylor, & Fernandez Arias, 2016; Gatsou, 2016; Nicholson, Geller, Fisher, & Dion, 1993; Nieto, 2002; Trotter, Flynn, & Baidawi, 2016). Furthermore, characteristics of families may hinder the successful implementation of family-oriented services. Throughout this thesis, study results found that children experiencing adverse circumstances frequently also experienced sociodemographic risk factors. The combination of these challenges may present barriers to children and families engaging in services (Romer et al., 2007). One way of addressing these issues may be the development of standard training, policies, and procedures relating to identifying and addressing the needs of dependent children in adult-focused services, and engaging families effectively.

Policy Implications

For clinical interventions to be most impactful, they need to be embedded within an equitable and effective policy context. Interventions can be effective for particular

groups, but the population-level picture of early child development may still be bleak due to the influences of social determinants (Hertzman et al., 2010). Broader social, economic, political, and cultural factors contribute to inequalities in family circumstances, thus driving inequalities in early child development (Irwin, Siddiqi, & Hertzman, 2010). Policies to improve social factors such as wealth and employment, or access to quality, affordable, family-focused primary prevention and intervention services, can all enhance the resources families have available for supporting the development of young children (Lynch et al., 2010). Governments have a responsibility for creating conditions in which children and families can thrive. The children with developmental vulnerabilities identified in the current research were at the onset of formal schooling, which indicates that the policy focus should be on the early developmental context and social factors that can affect that context, in addition to policies regarding education.

Access to environments that support healthy development and minimise vulnerability is of utmost importance for improving the state of early child development (Hertzman, 2009). As demonstrated by the findings of this thesis, and a range of other research, adverse child and parent experiences and/or circumstances can increase children's risk of maladjustment in a range of developmental domains. Bioecological theory posits that children who have sustained exposure to developmental contexts that provide resources and supports not available in their home environment may still experience positive developmental outcomes (Bronfenbrenner & Morris, 2007). This is supported by research showing the benefits of quality early childhood education programs for socioeconomically disadvantaged children in reducing achievement gaps and improving school readiness (Heckman, 2008; Magnuson & Waldfogel, 2005; Melhuish et al., 2013; Taylor, Gibbs, & Slate, 2000). In the United States of America, the Head Start program has provided millions of disadvantaged children and families with educational, health, and family services (Anderson et al., 2003). Head Start and other early childhood

development programs have led to significant improvements in children's cognitive development, decreases in children's social difficulties, and increases in their readiness for school (Anderson et al., 2003). Programs that also support parents to enhance their children's pre-academic, socio-emotional, and behavioural skills have shown some promise in providing additional benefits for children's early development (Magnuson & Schindler, 2016).

Although children from socioeconomically disadvantaged backgrounds disproportionately experience both developmental difficulties and family-level risk, early childhood adversity (ill health, maltreatment, parental criminal offending) occurs across all socioeconomic strata; thus, providing services primarily to socioeconomically disadvantaged children will not eliminate population health burdens (Hertzman & Boyce, 2010). Some experts have urged governments to provide universal, affordable access to effective early childhood programs, in order to improve the outcomes of all children (Hertzman & Williams, 2009; Melhuish, 2016). In the United Kingdom, the universal preschool program Sure Start has yielded benefits for children and families from all socioeconomic strata, with children experiencing improved social competence and fewer behaviour problems, reductions in negative parenting behaviours, and improvements to home learning environments (Melhuish, Belsky, & Barnes, 2010). For older children, reductions in school suspensions and unauthorised school absences, and improvements to academic achievement were also observed. In Australia, the National Partnership Agreement for Universal Access to Quality Early Childhood Education Programs has only been in place since 2008 (Council of Australian Governments, 2008), and although the number of families accessing these programs has increased considerably since that time (Deloitte Access Economics, 2014), the long-term effects for children's development are yet to be evaluated.

Children are more likely to be exposed to the benefits of early childhood programs

with regular attendance. Across Australia, however, only 69% of children attend kindergarten for the recommended 15 hours per week (Deloitte Access Economics, 2014), with rates even lower for Aboriginal children at 35% (Commissioner for Children and Young People WA, 2014). Families with high levels of socioeconomic disadvantage tend to access early childhood education and care services at lower rates (Baxter & Hand, 2013; Gilley, Tayler, Niklas, & Cloney, 2015). Children at risk of maltreatment and children with special health care needs are also less likely to participate in early childhood education programs (Baxter & Hand, 2013; Productivity Commission, 2014). The children who may benefit most from these interventions are therefore the least likely to receive them. Access issues arise for a number of reasons, including parents not seeing the value in early childhood programs, costs of attendance being prohibitive, and services not being in a local area (Productivity Commission, 2014). Parents who are involved with other services (e.g., social welfare) are more likely to engage with early childhood services (Grace, Bowes, & Elcombe, 2014). This demonstrates the critical role of other agencies and institutions that children and families are in contact with, in facilitating and supporting engagement with early childhood programs and services. Prior to school commencement, children are much more likely to be exposed to health, family, and community-based services than they are to education services. The findings from this thesis demonstrated that a number of children in contact with various government agencies are at risk of developmental vulnerability; thus, there are a range of potential avenues through which families can be supported in facilitating their children's access to quality early childhood services. Policy reform that highlights the responsibilities of all agencies to collaborate to improve the state of early child development may result in more holistic approaches to supporting families.

Schools also have an important role to play in sustaining the benefits of early childhood programs, and providing support to students who commence school behind their

peers. In Chapter 3, it was demonstrated that children with a broad range of developmental vulnerabilities were at risk of experiencing school outcomes that have been identified as early indicators of school disengagement. School disengagement is a process that occurs over a number of years (Anderman & Maehr, 1994), so if schools have the ability to track children at risk of disengagement from early on in schooling, preventative measures may be more effective. In Western Australia (WA), schools already monitor academic achievement, attendance, and behavioural data to identify students at risk of disengagement. This information is then used to implement personalised learning and behaviour plans, and/or risk management plans with the aim of preventing students' disengagement from school (Department of Education WA, 2015). However, this means that students need to already be experiencing difficulties with achievement, attendance, and/or behaviour in order for strategies to be implemented. A preventative approach would involve addressing barriers to engagement before the establishment of difficulties. Although the AEDC is not intended for the profiling of individual students, school profiles are available, and these provide information on the number and percentage of children within a school who are developmentally vulnerable. It would be possible, therefore, for schools to track how any school-wide strategies to improve student's early developmental outcomes relate to academic achievement, absence, and suspension rates over time. With longer term research into the association between school readiness and disengagement in middle and high school, the utility of using school-entry measures of developmental abilities to predict children at risk of disengagement may be revealed. Effective methods of preventing school disengagement are of utmost importance, as school disengagement often culminates in early school dropout, which in turn is associated with reduced opportunities in later life (Alexander, Entwisle, & Horsey, 1997).

Identification of children at risk of poor outcomes is one step in the process of improving school readiness; ensuring availability and affordability of appropriate quality

services is another critical step. This burden should not be the responsibility of any one government agency: it requires a whole-of-government approach. Currently, there are significant gaps in the availability of appropriate universal and targeted parenting programs and supports in WA, depending on the type of need as well as geographic location (Commissioner for Children and Young People WA, 2015). Accordingly, the Commissioner for Children and Young People in WA (2015) has recommended that there be development of strategies to ensure equitable access to quality early childhood services and parenting advice and support, including both universal and targeted services. The Commissioner also identified a need for better coordination and integration of these services, and for services to be evidence-based. In Australia, there is often a divide between child-oriented and adult-oriented services that impedes the capacity for providing holistic services. These two service streams are mostly separately governed and funded, and there can be confusion over the responsibilities of each stream. This can also create barriers for children and families accessing services, as the separation of services may involve additional financial and time resources that make ongoing engagement with these services prohibitive. Better integration of services, improved access to services, timely and effective referral procedures, and a greater emphasis on prevention and early intervention are all essential for supporting parents in the critical role they play in their children's development (Commissioner for Children and Young People WA, 2014).

Strengths of the Research

The main strength of the research reported in this thesis was the use of population-level administrative data, merged across multiple government agencies, at both the child- and parent-level. Furthermore, as these data were de-identified, investigations into high-risk groups often poorly captured in previous research were possible. When studying topics of a sensitive nature, such as maltreatment, illness, and incarceration, obtaining first-hand information from people impacted by these factors can be difficult (Lee, 1993).

This can be because disclosure of sensitive information is seen as threatening, and carries risk of embarrassment, judgement, intimidation, or publicity (Lee, 1993). The more sensitive the topic under investigation, the harder it is to include representative samples in research. The processes used in the Western Australian Data Linkage System to ensure that ethical and privacy standards are upheld means that the circumstances and outcomes of these “hidden populations” can be revealed. Furthermore, these events may be rare in a whole-of-population context; thus, obtaining information from widely dispersed geographical areas helps to improve representativeness. With traditional research techniques, the cost and time involved in obtaining such widely dispersed information may be a barrier to conducting research with these populations. As administrative data are already routinely collected by government agencies, and capture the entire population, the collection of this information can be done relatively inexpensively. Accordingly, the research comprised by this thesis was able to conduct investigations with representative samples of high-risk groups, providing robust estimates of the associations between adverse early childhood experiences and early developmental outcomes.

Another strength of the current research was the use of a population-level survey of children’s early development, which is a validated, standardised, teacher-reported measure. Use of observer-reported measures is preferable in situations where parents’ own circumstances may bias their responding when reporting on their child’s outcomes (Hissel, Bijleveld, & Kruttschnitt, 2011; Kinard, 2002; Larsson, Knutsson-Medin, Sundelin, & Von Werder, 2000; Luoma, Koivisto, & Tamminen, 2004; Shaffer, Yates, & Egeland, 2009). Teachers are also able to compare each child to other children in their class, which may raise some concerns regarding the “sorting” of children based on teacher opinion (Powell, 2010), but does help to address bias in parent responding. Furthermore, this measure provided information on the early developmental outcomes of the whole population of children, which would be difficult to obtain using parent-report. The scale

and quality of the information obtained by using a population-level measure of school readiness is a particular strength of the research.

Use of linked data allowed the tracking of individuals from the pre-natal period up to the time they commenced school, with all public service contacts in that period captured. This method eliminates recall bias, as events are captured in ‘real time.’ Furthermore, use of clinical codes for physical and mental illness helped to address issues of bias that can be introduced by self-report measures (Newson, Karlsson, & Tiemeier, 2011). These data also enabled the longitudinal follow-up of the cohort to examine how the early childhood period was related to school outcomes in grade 3. Linkage of AEDC data to other sources of information provides a unique opportunity to look backwards in time to understand the qualities of early development that influence developmental outcomes, as well as to look forward in time, to track the outcomes associated with developmental vulnerabilities at school entry. This information is useful to researchers, policymakers, practitioners, and communities for the development of initiatives and programs to promote positive early child development, and to translate evidence into action.

This thesis used a unique Australian dataset, including data currently only available for linkage in WA, made possible through the collaboration between researchers and the many government agencies involved in the overarching Developmental Pathways Project. Use of administrative data from government agencies facilitates communication of research findings back to the respective agencies, enhancing the potential for the translation of the research into evidence-based strategies and policies aimed at improving early child development. The relationships with the government agencies that made data available for this thesis provided a significant strength to the research. Throughout the study, the government agencies were kept informed of research findings through provision of manuscripts for review, presentations, and briefing papers. The insights the agencies

provided regarding the implications of the research also helped to inform the research conclusions.

Limitations of the Research

Although use of administrative data provided a number of strengths for this research, this methodology also has some limitations that should be acknowledged. As with all research using administrative data, the current research was affected by missing data, particularly on parental demographic variables. This is primarily due to incomplete information being recorded on the parents (particularly fathers) at the time of the child's birth, and thus, no information being available for linkage through the Family Connections Genealogy System. A previous investigation into the characteristics of families with missing paternal information in the Western Australian Data Linkage System found that these families were more likely to live in socioeconomically disadvantaged areas; be sole parent (mother) families; be of Aboriginal or Torres Strait Islander descent; and have high levels of health risk (Sims & O'Donnell, 2015). Exclusion of individuals with missing paternal information in administrative data may therefore bias analyses. To deal with missing data, the missing indicator method was used. Methods of imputation preferred by other scholars, such as multiple imputation and maximum likelihood methods (Graham, 2009), were not possible because fathers with missing information on one demographic variable were missing information on all demographic variables. The missing indicator method allowed the inclusion of children with missing parental demographic information in analyses, and the modelling of the effects of missing data on analyses, presumably reducing bias.

Furthermore, due to the nature of administrative data, the research only captured individuals who came into contact with the service. Sensitive topics that are seen as the domain of the family may only come to light through a family reaching out to services, which may occur rarely, or not at all (Lee, 1993). As such, the data may be subject to

selection bias, and may underestimate the incidence of the risk factors studied. For instance, the analyses did not include individuals seeking care for chronic illness in primary health care, individuals receiving psychiatric treatment through private services/general practitioners, children who have been maltreated but not notified to child welfare services, and individuals who have engaged in criminal activity but not been convicted. Inclusion of individuals in the comparison group who were actually exposed to the risk event, but not identified as such by the available data, would presumably lead to an underestimation of the association between the exposure and the outcome, relative to exclusive samples of exposed and not exposed. As such, it is expected that the estimates presented in this thesis are conservative estimates of the association between risk events and school readiness scores.

Although the research identified a number of family context variables that may be associated with school readiness, this was largely limited to dichotomous indicators of whether or not an event had occurred, based on service contacts. Administrative data generally do not contain information on mediating and moderating factors, such as parenting behaviours, family values, or social supports (Jutte, Roos, & Brownell, 2011). All of these factors may have influenced the association between the risk events and children's school readiness. Family contexts are complex and dynamic, and supplementation of administrative data with survey data on mediating and/or moderating variables would likely help to better characterise the nature of the relationship between family context variables and children's early developmental outcomes. Furthermore, administrative data often do not include information on the severity of an exposure. Accordingly, a limitation of the research presented in this thesis is that no measures of severity were included in analyses. Chronic physical illness, psychiatric illness, child maltreatment, and criminal offending all occur on a continuum of severity, which may mean that associations with school readiness differ at opposite ends of the spectrum.

Moreover, the administrative data used in this research permitted only predictive, and not causal, interpretations. As such, whilst this study presented evidence of an association between early risk factors and developmental vulnerabilities, and school readiness and early indicators of disengagement, there are likely to be a number of other unmeasured characteristics of the developmental context that will influence these developmental pathways.

Lastly, previous research has found that teachers' opinions and expectations of students can be influenced by the characteristics of the student (Pianta, Rimm-Kaufman, & Cox, 1999). Therefore, teacher ratings of school readiness may be subject to bias. However, this limitation is far out-weighted by the scale of the data, as the collection of such a broad range of information on a large sample would be hugely expensive and time consuming if carried out by parent interview or direct assessment.

Future Directions

It was the original intention of this thesis to also examine the adaptive processes that are associated with educational resilience in the face of risk. However, the administrative data available for this thesis did not permit such evaluations. A number of protective factors for children's early development have been identified in previous research, but these factors are not captured in administrative data. For instance, positive social support (peer and/or family), emotional and behavioural self-regulation, helpful coping strategies, stability of the home environment, positive parenting behaviours, and school connectedness (DuMont, Widom, & Czaja, 2007; Haskett, Nears, Sabourin Ward, & McPherson, 2006; Iwaniec, Larkin, & Higgins, 2006; Masten et al., 2004; Nichols, Loper, & Meyer, 2016) have all been associated with resilient functioning in children exposed to traumatic events and/or sociodemographic risk. Future research involving the combination of administrative and survey data would go a long way towards identifying the adaptive and resilient characteristics of children exposed to the risk events highlighted

by this research, who experience school success despite the adversity of their situation. In addition, linking intervention data to outcome data would help to evaluate the effectiveness of targeted and universal early childhood programs provided to children experiencing these risk events, with long-term follow-up of these children possible through the use of linked data (Lynch et al., 2010). With ongoing government commitment to fund the collection of the AEDC, there is an opportunity to identify at-risk groups, implement services for these groups, and evaluate their outcomes over time.

Population-level linked data that capture information on the individual and his/her social ecology (home, school, community) across the life-course, and from multiple domains (e.g., education, health, welfare), are key to establishing a robust system for monitoring the association between early child development and lifetime wellbeing (Hertzman & Williams, 2009). Ideally, this information should go beyond just administrative data, to more nuanced information from population-based, large-scale longitudinal surveys, and the use of social indicators. As yet, no country has established a comprehensive coordinated system of measuring developmental outcomes across all four appropriate methodologies: social indicators, population-based surveys, longitudinal surveys, and linked data (Hertzman & Williams, 2009). A combination of methodological approaches for monitoring and measuring early developmental outcomes, that capitalises on the strengths and addresses the limitations of each approach, is critical to enhancing the capacity for identifying risk factors for poor developmental outcomes, and to evaluate the impact of interventions implemented to address these developmental difficulties (Hertzman & Williams, 2009).

Final Comments

This thesis provided a snapshot of ‘communities’ not defined by geographical lines, but by early childhood experiences that each group had in common. It is indisputable, however, that these factors alone do not cause poor school readiness. These

early childhood experiences – child and/or parent chronic illness, parental psychiatric illness, maltreatment, and parental conviction – are likely to be only one of many factors that put children at risk of maladjustment. These experiences may create new stressors for the child, or exacerbate existing adversity, or they may not confer any risk on the child's development. However, there is substantial evidence that exposure to risk factors in early childhood can have important implications for children's long-term health and wellbeing. An evaluation of how these factors may be negatively influencing children's early development is therefore essential. The developmental vulnerabilities identified in this research were evident at school entry, which points to the influence of developmental settings outside of the school context in shaping developmental pathways. Ensuring children experience the conditions necessary to promote positive developmental and educational growth is a community responsibility involving families, neighbourhoods, schools, community groups, and government agencies.

There is considerable evidence that intervening early to address developmental difficulties can positively influence children's developmental and educational trajectories. The research in this thesis, and an array of previous research, has demonstrated that both cognitive and non-cognitive abilities are important for school outcomes, and supports an emphasis on developing a range of children's competencies for future school success. An over-reliance on test scores for evaluating children's school success may result in efforts focused on promoting early cognitive abilities, at the expense of social, emotional, and physical abilities. Although language and cognitive skills are important, the ways in which children behave in the classroom and interact with peers and adults are also important for school success. Importantly, efforts to improve school outcomes must also address the features of the developmental context that maintain developmental difficulties, so that the child's ecology helps to sustain improvements over time.

In early childhood, the family provides the primary developmental context, and

communities play an important role in providing family supports. In turn, local, state, and federal governments have a significant opportunity to support families through provision of services and implementation of policies that help to alleviate family hardship and ensure safe and nurturing environments for children (Shonkoff, 2003). Ensuring families have the resources and capabilities to support their children's development is central to the health and wellbeing of both the child and the developmental context. The qualities of parents, families, caregivers, and communities that nurture and foster development have the most significant impact on children's outcomes (Irwin et al., 2010). Thus, interventions focused on improving relationships between children and parents, parents and their support networks, and linking parents into community networks and services are likely to be beneficial. Multidisciplinary collaboration will be crucial in responding to the complex needs of children and families. These children are the future adult population; thus, equitable policies and high-quality services for early childhood education and care are essential to the long-term economic and social functioning of society, and government investment should reflect that.

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Appendix I – Full table of results for Chapter 3

Full table of results for the parameters of the multi-level models estimated in Chapter 3: Developmental Vulnerabilities at School Entry Predict Early Indicators of Disengagement.

Parameter	Outcome				
	Numeracy	Reading	Writing	Suspensions	Attendance
Intra-class correlation coefficient					
Random intercept model	0.29	0.24	0.43	0.45	0.38
+ child-level variables	0.15	0.12	0.18	0.33	0.12
+ parent-level variables	0.09	0.06	0.12	0.26	0.10
+ school-level variables	0.08	0.04	0.09	0.23	0.07
Final model ^a	0.11	0.06	0.16	0.27	0.10
Model fit (-2 log Likelihood) ^b					
Random intercept model	9,322.40	9,483.61	5,308.44	3,690.30	7,546.31
+ child-level variables	8,842.82	9,047.15	4,732.85	3,274.26	6,590.61
+ parent-level variables	8,606.54	8,777.73	4,492.89	3,071.39	6,394.93
+ school-level variables	8,486.66	8,662.41	4,417.28	3,034.93	6,334.48
Final model ^a	7,624.63	7,990.34	4,047.99	2,843.30	6,271.16
Deviance value ^c	1,697.77***	1,493.27***	1,260.45***	847.00***	1,275.15***

^a Adjusted for child-, parent-, and school-level covariates, and with all Australian Early Development Census variables entered simultaneously. ^b Smaller values indicate better model fit. ^c Deviance value based on the difference in -2 log Likelihood value for the random intercept and final models. Significance testing based on a chi-square distribution with $df = 29$, at $\alpha = .001$.
*** $p < .001$.

Appendix II - ICD-10-AM codes used in Chapter 4

ICD-10-AM codes and corresponding diagnoses used in Chapter 4 to identify child chronic illness.

Major diagnostic category	Specific diagnosis	ICD10-AM Code
Diseases of the circulatory system	Chronic rheumatic heart disease	I05-I09
	Ischaemic heart disease	I25
	Congestive heart failure	I50
	Hypertension	I10-I15
	Other chronic heart disease	I27, I31, I34-I37, I39, I44, I45, I51
	Cerebrovascular disease	I60-I69
Cancer	Malignant neoplasms	C00-C96
	Unspecified neoplasms	D37-D48
	Pharmacotherapy for neoplasm	Z51.1
	History of malignant neoplasm	Z85
Respiratory disease	Chronic asthma	J45
	Emphysema	J43
	Chronic bronchitis	J41-J42
	Chronic airway obstruction	J44
Diseases of the blood	Aplastic and haemolytic anaemias	D55-D64
Diseases of the nervous system	Epilepsy	G40
Nutritional and metabolic disorders	Cystic Fibrosis	E84
	Diabetes mellitus	E10-E14
	Malnutrition	E40-E43, E45, E46
	Obesity	E65-E68
Diseases of the ear	Chronic otitis media	H65.2-4, H66.1-3, H66.9
Musculoskeletal disorders	Juvenile arthritis	M08-M09
	Osteoarthritis	M15-M19
	Osteoporosis	M80-M85
Diseases of the digestive system	Chronic hepatic failure,	K72.1
	Chronic hepatitis	K73
	Fibrosis and cirrhosis of liver	K74
Diseases of the genitourinary system	Chronic nephritis	N11
	Chronic renal failure	N18
	Unspecified renal failure	N19

Appendix III – Full table of results for Chapter 4

Results of the full logistic regression models for Chapter 4: Chronic Illness and Developmental Vulnerability at School Entry

	Physical Health & Wellbeing		Social Competence		Emotional Maturity		Communication Skills & General Knowledge		Language & Cognitive Skills	
	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI
Child chronic illness										
No	REF		REF		REF		REF		REF	
Yes	1.34	[1.22, 1.46]	1.36	[1.25, 1.49]	1.33	[1.22, 1.45]	1.30	[1.18, 1.42]	1.19	[1.09, 1.30]
Parent chronic illness										
Mother	1.21	[1.10, 1.32]	1.22	[1.12, 1.34]	1.20	[1.10, 1.31]	1.20	[1.10, 1.32]	1.26	[1.16, 1.37]
Father	1.09	[0.97, 1.24]	1.07	[0.95, 1.21]	0.99	[0.88, 1.12]	1.01	[0.89, 1.15]	1.02	[0.91, 1.14]
Child's ethnicity										
Aboriginal	1.41	[1.24, 1.61]	1.19	[1.05, 1.36]	1.46	[1.27, 1.64]	1.69	[1.48, 1.93]	2.25	[1.99, 2.56]
Other	REF		REF		REF		REF		REF	
Child's primary spoken language										
English	REF		REF		REF		REF		REF	
Other	1.33	[1.19, 1.49]	1.53	[1.37, 1.69]	1.42	[1.28, 1.58]	3.62	[3.28, 4.00]	1.85	[1.67, 2.04]

(continued)

	Physical Health & Wellbeing		Social Competence		Emotional Maturity		Communication Skills & General Knowledge		Language & Cognitive Skills	
	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI
Mother's marital status at child's birth										
Married	REF		REF		REF		REF		REF	
Never married	1.34	[1.18, 1.53]	1.42	[1.25, 1.62]	1.44	[1.27, 1.64]	1.30	[1.13, 1.49]	1.19	[1.05, 1.35]
Divorced/widowed	1.49	[1.12, 1.98]	1.37	[1.03, 1.83]	1.68	[1.27, 2.21]	1.41	[1.05, 1.89]	1.67	[1.27, 2.20]
<i>Missing</i>	1.03	[0.65, 1.63]	1.58	[1.03, 2.44]	1.29	[0.83, 2.00]	1.19	[0.75, 1.89]	1.26	[0.81, 1.94]
Paternal age at child's birth										
< 20 years	1.22	[0.94, 1.59]	1.24	[0.96, 1.61]	1.11	[0.85, 1.43]	1.33	[1.02, 1.74]	1.35	[1.04, 1.74]
20-29 years	1.05	[0.95, 1.15]	1.11	[1.01, 1.22]	1.01	[0.92, 1.10]	0.95	[0.87, 1.05]	1.07	[0.99, 1.17]
30-39 years	REF		REF		REF		REF		REF	
40 years +	1.13	[1.00, 1.28]	1.08	[0.96, 1.22]	1.14	[1.02, 1.28]	1.06	[0.93, 1.19]	1.13	[1.01, 1.26]
<i>Missing</i>	1.65	[1.38, 1.97]	1.59	[1.33, 1.90]	1.32	[1.10, 1.57]	1.25	[1.04, 1.51]	1.72	[1.44, 2.06]
Maternal age at child's birth										
< 20 years	1.33	[1.11, 1.59]	1.57	[1.32, 1.87]	1.65	[1.38, 1.96]	1.40	[1.17, 1.69]	1.57	[1.32, 1.86]
20-29 years	1.20	[1.10, 1.31]	1.19	[1.09, 1.29]	1.23	[1.13, 1.34]	1.31	[1.20, 1.43]	1.27	[1.18, 1.37]
30-39 years	REF		REF		REF		REF		REF	
40 years +	1.02	[0.82, 1.27]	1.29	[1.05, 1.58]	1.20	[0.98, 1.47]	1.27	[1.02, 1.57]	1.28	[1.06, 1.55]
<i>Missing</i>	0.64	[0.32, 1.04]	0.49	[0.31, 0.78]	0.75	[0.47, 1.19]	0.84	[0.51, 1.36]	0.59	[0.37, 0.93]

(continued)

	Physical Health & Wellbeing		Social Competence		Emotional Maturity		Communication Skills & General Knowledge		Language & Cognitive Skills	
	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI
Geographic location of child's community of residence										
Metropolitan area	REF		REF		REF		REF		REF	
Regional area	1.12	[1.04, 1.21]	1.01	[0.93, 1.09]	1.00	[0.93, 1.08]	1.06	[0.98, 1.15]	1.19	[1.11, 1.27]
Remote area	0.87	[0.78, 0.98]	0.92	[0.82, 1.03]	1.00	[0.90, 1.12]	0.70	[0.62, 0.79]	0.88	[0.79, 0.98]
Local community level of socioeconomic disadvantage										
1 (Most)	1.81	[1.62, 2.02]	1.95	[1.75, 2.18]	1.78	[1.61, 1.98]	1.59	[1.42, 1.78]	1.62	[1.47, 1.80]
2	1.27	[1.15, 1.40]	1.45	[1.32, 1.60]	1.33	[1.21, 1.46]	1.33	[1.21, 1.47]	1.39	[1.28, 1.52]
3	1.47	[1.34, 1.61]	1.59	[1.45, 1.74]	1.50	[1.37, 1.64]	1.55	[1.41, 1.71]	1.48	[1.36, 1.61]
4	1.09	[0.99, 1.21]	1.21	[1.09, 1.34]	1.19	[1.08, 1.31]	1.01	[0.92, 1.13]	1.15	[1.05, 1.27]
5 (Least)	REF		REF		REF		REF		REF	

Note. Significant results at $p < .05$ after Holm's p -value correction indicated in bold. REF=Reference category.

Appendix IV – ICD-10-AM codes used in Chapter 5

ICD-10-AM codes and corresponding diagnoses used in Chapter 5 to identify parental chronic illness.

Major diagnostic category	Specific diagnosis	ICD10-AM Code
Diseases of the circulatory system	Chronic rheumatic heart disease	I05-I09
	Ischaemic heart disease	I25
	Congestive heart failure	I50
	Hypertension	I10-I15
	Other chronic heart disease	I27, I31, I34-I37, I39, I44, I45, I51
	Cerebrovascular disease	I60-I69
Cancer	Malignant neoplasms	C00-C96
	Unspecified neoplasms	D37-D48
	Pharmacotherapy for neoplasm	Z51.1
	History of malignant neoplasm	Z85
Respiratory disease	Chronic asthma	J45
	Emphysema	J43
	Chronic bronchitis	J41-J42
	Chronic airway obstruction	J44
Nutritional and metabolic disorders	Diabetes mellitus	E10-E14
Diseases of the nervous system	Multiple sclerosis	G35
	Epilepsy	G40
Musculoskeletal disorders	Inflammatory arthropathies	M05-M14
	Arthrosis	M05-M19
	Osteopathies	M80-M85
Diseases of the digestive system	Chronic hepatic failure	K72.1
	Chronic hepatitis	K73
	Fibrosis and cirrhosis of liver	K74
Diseases of the genitourinary system	Chronic nephritis	N11
	Chronic renal failure	N18
	Unspecified renal failure	N19

Appendix V – Full table of results for Chapter 5

Results of the full logistic regression models for Chapter 5: Developmental Vulnerabilities in Children of Chronically Ill Parents

1. Results for Girls

	Physical Health & Wellbeing		Social Competence		Emotional Maturity		Communication Skills & General Knowledge		Language & Cognitive Skills	
	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI
Maternal chronic illness										
No	REF		REF		REF		REF		REF	
Yes	1.32	[1.11, 1.58]	1.42	[1.18, 1.71]	1.25	[1.03, 1.50]	1.48	[1.24, 1.78]	1.18	[1.00, 1.39]
Paternal chronic illness										
No	REF		REF		REF		REF		REF	
Yes	1.14	[0.93, 1.40]	1.10	[0.88, 1.38]	0.97	[0.78, 1.22]	1.08	[0.87, 1.34]	1.04	[0.86, 1.25]
Child chronic illness										
No	REF		REF		REF		REF		REF	
Yes	1.28	[1.09, 1.49]	1.36	[1.16, 1.60]	1.19	[1.01, 1.41]	1.33	[1.13, 1.57]	1.18	[1.02, 1.36]
Child's ethnicity										
Aboriginal	1.52	[1.24, 1.85]	1.15	[0.93, 1.42]	1.31	[1.07, 1.62]	1.88	[1.53, 2.30]	2.23	[1.86, 2.68]
Other	REF		REF		REF		REF		REF	

(continued)

	Physical Health & Wellbeing		Social Competence		Emotional Maturity		Communication Skills & General Knowledge		Language & Cognitive Skills	
	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI
Child's primary spoken language										
English	REF		REF		REF		REF		REF	
Other	1.34	[1.08, 1.65]	1.45	[1.16, 1.80]	1.32	[1.06, 1.65]	3.04	[2.50, 3.68]	1.57	[1.30, 1.90]
Mother's marital status at child's birth										
Married	REF		REF		REF		REF		REF	
Never married	1.43	[1.18, 1.75]	1.45	[1.18, 1.78]	1.42	[1.15, 1.74]	1.23	[1.00, 1.52]	1.18	[0.98, 1.42]
Divorced/widowed	1.24	[0.78, 1.99]	1.37	[0.85, 2.22]	2.03	[1.30, 3.15]	1.20	[0.74, 1.94]	1.79	[1.18, 2.71]
<i>Missing</i>	1.26	[0.64, 2.45]	2.79	[1.50, 5.19]	1.37	[0.69, 2.73]	1.78	[0.93, 3.40]	1.42	[0.76, 2.64]
Paternal age at child's birth										
< 20 years	1.20	[0.80, 1.79]	1.47	[0.99, 2.20]	1.10	[0.73, 1.66]	1.34	[0.89, 2.02]	1.35	[0.93, 1.95]
20-29 years	1.12	[0.98, 1.29]	1.24	[1.06, 1.44]	0.99	[0.85, 1.15]	1.02	[0.88, 1.18]	1.12	[0.99, 1.27]
30-39 years	REF		REF		REF		REF		REF	
40 years +	1.17	[0.97, 1.41]	1.03	[0.83, 1.27]	1.08	[0.88, 1.16]	1.09	[0.90, 1.33]	1.20	[1.02, 1.41]
<i>Missing</i>	1.82	[1.40, 2.36]	1.78	[1.36, 2.34]	1.36	[1.04, 1.79]	1.41	[1.07, 1.86]		
Maternal age at child's birth										
< 20 years	1.26	[0.96, 1.65]	1.58	[1.20, 2.08]	1.75	[1.33, 2.30]	1.42	[1.07, 1.88]	1.65	[1.29, 2.11]
20-29 years	1.24	[1.09, 1.42]	1.19	[1.03, 1.38]	1.24	[1.08, 1.43]	1.33	[1.16, 1.53]	1.33	[1.18, 1.49]
30-39 years	REF		REF		REF		REF		REF	
40 years +	1.10	[0.79, 1.54]	1.54	[1.10, 2.16]	1.46	[1.05, 2.04]	1.26	[0.90, 1.78]	1.34	[1.00, 1.79]

(continued)

	Physical Health & Wellbeing		Social Competence		Emotional Maturity		Communication Skills & General Knowledge		Language & Cognitive Skills	
	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI
Geographic location of child's community of residence										
Metropolitan area	REF		REF		REF		REF		REF	
Regional area	1.15	[1.01, 1.30]	1.03	[0.89, 1.18]	1.01	[0.88, 1.16]	1.01	[0.88, 1.16]	1.19	[1.06, 1.33]
Remote area	0.91	[0.75, 1.10]	0.96	[0.79, 1.17]	1.17	[0.97, 1.41]	0.68	[0.55, 0.84]	0.86	[0.73, 1.02]
Local community level of socioeconomic disadvantage										
1 (Most)	1.82	[1.51, 2.19]	2.29	[1.88, 2.79]	2.06	[1.69, 2.50]	1.40	[1.15, 1.71]	1.67	[1.41, 1.98]
2	1.34	[1.14, 1.58]	1.70	[1.42, 2.03]	1.54	[1.30, 1.84]	1.35	[1.14, 1.60]	1.37	[1.19, 1.59]
3	1.50	[1.28, 1.76]	1.71	[1.43, 2.03]	1.62	[1.36, 1.92]	1.59	[1.35, 1.87]	1.56	[1.35, 1.79]
4	1.14	[0.95, 1.36]	1.25	[1.03, 1.52]	1.20	[0.99, 1.45]	1.03	[0.85, 1.24]	1.11	[0.95, 1.29]
5 (Least)	REF		REF		REF		REF		REF	

Note. Significant results at $p < .05$ after Holm's p -value correction indicated in bold. REF=Reference category.

2. Results for boys

	Physical Health & Wellbeing		Social Competence		Emotional Maturity		Communication Skills & General Knowledge		Language & Cognitive Skills	
	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI
Maternal chronic illness										
No	REF		REF		REF		REF		REF	
Yes	1.15	[0.98, 1.35]	1.08	[0.92, 1.27]	1.09	[0.93, 1.27]	1.08	[0.91, 1.27]	1.32	[1.13, 1.53]
Paternal chronic illness										
No	REF		REF		REF		REF		REF	
Yes	1.07	[0.89, 1.27]	1.02	[0.86, 1.21]	0.94	[0.79, 1.11]	1.02	[0.85, 1.22]	1.01	[0.86, 1.19]
Child chronic illness										
No	REF		REF		REF		REF		REF	
Yes	1.33	[1.18, 1.50]	1.24	[1.10, 1.40]	1.27	[1.13, 1.42]	1.21	[1.07, 1.37]	1.12	[1.00, 1.26]
Child's ethnicity										
Aboriginal	1.26	[1.04, 1.53]	1.19	[0.98, 1.44]	1.61	[1.34, 1.95]	1.66	[1.37, 2.01]	2.26	[1.86, 2.75]
Other	REF		REF		REF		REF		REF	
Child's primary spoken language										
English	REF		REF		REF		REF		REF	
Other	1.32	[1.11, 1.58]	1.39	[1.17, 1.65]	1.40	[1.18, 1.66]	3.41	[2.88, 4.03]	1.74	[1.47, 2.06]

(continued)

	Physical Health & Wellbeing		Social Competence		Emotional Maturity		Communication Skills & General Knowledge		Language & Cognitive Skills	
	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI
Mother's marital status at child's birth										
Married	REF		REF		REF		REF		REF	
Never married	1.27	[1.06, 1.52]	1.38	[1.16, 1.65]	1.52	[1.28, 1.81]	1.30	[1.08, 1.56]	1.15	[0.96, 1.37]
Divorced/widowed	1.63	[1.13, 2.37]	1.31	[0.90, 1.90]	1.47	[1.02, 2.13]	1.50	[1.03, 2.20]	1.53	[1.05, 2.21]
<i>Missing</i>	0.67	[0.31, 1.47]	0.84	[0.41, 1.72]	1.01	[0.50, 2.02]	0.75	[0.35, 1.62]	1.38	[0.68, 2.81]
Paternal age at child's birth										
< 20 years	1.26	[0.88, 1.80]	1.07	[0.75, 1.53]	1.08	[0.75, 1.53]	1.33	[0.92, 1.90]	1.36	[0.95, 1.95]
20-29 years	1.01	[0.89, 1.14]	1.05	[0.93, 1.19]	1.03	[0.92, 1.15]	0.92	[0.81, 1.04]	1.05	[0.93, 1.17]
30-39 years	REF		REF		REF		REF		REF	
40 years +	1.11	[0.94, 1.30]	1.12	[0.96, 1.31]	1.19	[1.02, 1.38]	1.05	[0.89, 1.23]	1.08	[0.94, 1.25]
<i>Missing</i>	1.68	[1.30, 2.16]	1.70	[1.33, 2.19]	1.43	[1.11, 1.84]	1.32	[1.02, 1.71]	1.94	[1.48, 2.52]
Maternal age at child's birth										
< 20 years	1.43	[1.12, 1.84]	1.68	[1.32, 2.15]	1.73	[1.36, 2.21]	1.46	[1.13, 1.88]	1.64	[1.29, 2.10]
20-29 years	1.18	[1.05, 1.32]	1.19	[1.06, 1.33]	1.23	[1.11, 1.37]	1.31	[1.17, 1.47]	1.26	[1.13, 1.40]
30-39 years	REF		REF		REF		REF		REF	
40 years +	0.94	[0.70, 1.26]	1.10	[0.84, 1.45]	1.01	[0.77, 1.32]	1.23	[0.93, 1.63]	1.20	[0.93, 1.56]

(continued)

	Physical Health & Wellbeing		Social Competence		Emotional Maturity		Communication Skills & General Knowledge		Language & Cognitive Skills	
	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI
Geographic location of child's community of residence										
Metropolitan area	REF		REF		REF		REF		REF	
Regional area	1.06	[0.95, 1.18]	0.93	[0.84, 1.04]	0.95	[0.85, 1.05]	1.00	[0.89, 1.12]	1.14	[1.03, 1.27]
Remote area	0.87	[0.74, 1.03]	0.88	[0.75, 1.02]	0.87	[0.74, 1.01]	0.73	[0.61, 0.86]	0.87	[0.74, 1.01]
Local community level of socioeconomic disadvantage										
1 (Most)	1.79	[1.52, 2.10]	2.04	[1.74, 2.38]	1.74	[1.49, 2.03]	1.62	[1.37, 1.90]	1.55	[1.33, 1.81]
2	1.24	[1.08, 1.42]	1.46	[1.28, 1.67]	1.35	[1.18, 1.53]	1.30	[1.13, 1.49]	1.35	[1.19, 1.54]
3	1.47	[1.28, 1.68]	1.61	[1.42, 1.84]	1.54	[1.36, 1.75]	1.50	[1.31, 1.72]	1.37	[1.21, 1.55]
4	1.03	[0.89, 1.20]	1.22	[1.06, 1.40]	1.23	[1.07, 1.40]	0.95	[0.82, 1.11]	1.12	[0.98, 1.28]
5 (Least)	REF		REF		REF		REF		REF	

Note. Significant results at $p < .05$ after Holm's p -value correction indicated in bold. REF=Reference category.

Appendix VI – ICD-10-AM codes used in Chapter 6

ICD-10-AM codes and corresponding diagnoses used in Chapter 6 to identify parental psychiatric illness.

Major diagnostic category	Specific diagnosis	ICD10-AM Code
Substance abuse disorders	Alcohol-induced mental disorders	F10
	Drug-induced mental disorders	F11-19
	Non-dependent abuse of drugs	F55
Anxiety disorders	Neuroses	F48
	Anxiety, dissociative, and somatoform disorders	F41, F42, F44, F55
	Acute reaction to stress	F43.0, F43.1, F43.8, F43.9
	Phobic anxiety disorders	F40
	Habit and impulse disorders	F63
	Adjustment disorders	F43.2
	Mood disorders	Episodic mood disorders
Depressive disorder		F32-F34
Postnatal/postpartum depression		F530, F53.8, F53.9
Other mood disorders		F38, F39
Other	Organic disorders	F00-F07, F09
	Psychotic disorders	F20-F29, F53.1
	Childhood disorders	F90-F94, F98.0-F98.3, F98.8-F98.9
	Personality disorders	F60-F62, F68-69
	Speech and learning disorders	F80, F81, F83, F98.5, F98.6
	Motor disorders	F82, F95, F98.4
	Sleep disorders	F51
	Eating disorders	F50
	Not otherwise specified	F54, F59, F99
Codes used to determine self-injury	Self-harm and sequelae of intentional self-harm	X60-X84, Y87.0
	Event of undetermined intent and sequelae of event with undetermined intent	Y10-Y34, Y87.2

Appendix VII – Full table of results for Chapter 6

Results of the full logistic regression models for Chapter 6: Parental Psychiatric Hospitalisation is Associated with a Risk for Children's School Readiness

	Physical Health & Wellbeing		Social Competence		Emotional Maturity		Communication Skills & General Knowledge		Language & Cognitive Skills	
	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI
Mother's psychiatric hospitalisations										
None	REF		REF		REF		REF		REF	
One or more	1.46	[1.24, 1.72]	1.37	[1.16, 1.61]	1.45	[1.24, 1.71]	1.33	[1.12, 1.58]	1.45	[1.24, 1.70]
Father's psychiatric hospitalisations										
None	REF		REF		REF		REF		REF	
One or more	1.38	[1.11, 1.71]	1.37	[1.10, 1.69]	1.40	[1.14, 1.73]	1.31	[1.05, 1.63]	1.31	[1.07, 1.61]
Child's ethnicity										
Aboriginal	1.35	[1.19, 1.55]	1.14	[0.99, 1.31]	1.39	[1.21, 1.59]	1.71	[1.49, 1.96]	2.16	[1.89, 2.47]
Other	REF		REF		REF		REF		REF	
Child's primary spoken language										
English	REF		REF		REF		REF		REF	
Other	1.36	[1.19, 1.55]	1.45	[1.27, 1.65]	1.41	[1.24, 1.61]	3.24	[2.86, 3.67]	1.69	[1.49, 1.91]

(continued)

	Physical Health & Wellbeing		Social Competence		Emotional Maturity		Communication Skills & General Knowledge		Language & Cognitive Skills	
	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI
Mother's marital status at child's birth										
Married	REF		REF		REF		REF		REF	
Never married	1.32	[1.16, 1.51]	1.38	[1.21, 1.58]	1.42	[1.25, 1.62]	1.26	[1.10, 1.44]	1.15	[1.01, 1.30]
Divorced/widowed	1.46	[1.09, 1.95]	1.35	[1.01, 1.80]	1.65	[1.25, 2.18]	1.39	[1.04, 1.87]	1.63	[1.24, 2.14]
<i>Missing</i>	0.90	[0.54, 1.50]	1.50	[0.94, 2.39]	1.07	[0.66, 1.73]	1.15	[0.70, 1.88]	1.29	[0.81, 2.05]
Paternal age at child's birth										
< 20 years	1.25	[0.96, 1.63]	1.26	[0.97, 1.64]	1.14	[0.88, 1.47]	1.36	[1.04, 1.78]	1.38	[1.07, 1.79]
20-29 years	1.05	[0.95, 1.15]	1.11	[1.01, 1.21]	1.01	[0.92, 1.10]	0.96	[0.87, 1.05]	1.07	[0.98, 1.16]
30-39 years	REF		REF		REF		REF		REF	
40 years +	1.13	[1.00, 1.28]	1.08	[0.96, 1.22]	1.13	[1.01, 1.27]	1.06	[0.94, 1.20]	1.13	[1.02, 1.26]
<i>Missing</i>	1.71	[1.43, 2.05]	1.67	[1.40, 2.00]	1.37	[1.14, 1.63]	1.33	[1.11, 1.61]	1.80	[1.51, 2.16]
Maternal age at child's birth										
< 20 years	1.32	[1.10, 1.58]	1.57	[1.32, 1.87]	1.63	[1.37, 1.97]	1.40	[1.17, 1.69]	1.59	[1.34, 1.88]
20-29 years	1.20	[1.10, 1.31]	1.19	[1.09, 1.30]	1.23	[1.13, 1.34]	1.32	[1.21, 1.44]	1.28	[1.19, 1.39]
30-39 years	REF		REF		REF		REF		REF	
40 years +	1.02	[0.82, 1.26]	1.26	[1.02, 1.55]	1.17	[0.95, 1.43]	1.25	[1.01, 1.55]	1.27	[1.05, 1.53]

(continued)

	Physical Health & Wellbeing		Social Competence		Emotional Maturity		Communication Skills & General Knowledge		Language & Cognitive Skills	
	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI
Geographic location of child's community of residence										
Metropolitan area	REF		REF		REF		REF		REF	
Regional area	1.08	[0.99, 1.17]	0.96	[0.88, 1.04]	0.96	[0.88, 1.04]	0.99	[0.91, 1.08]	1.15	[1.07, 1.24]
Remote area	0.88	[0.78, 1.00]	0.91	[0.81, 1.03]	0.98	[0.87, 1.10]	0.71	[0.62, 0.80]	0.87	[0.77, 0.97]
Local community level of socioeconomic disadvantage										
1 (Most)	1.76	[1.56, 1.99]	2.03	[1.80, 2.29]	1.76	[1.57, 1.98]	1.49	[1.32, 1.69]	1.57	[1.40, 1.75]
2	1.27	[1.14, 1.41]	1.50	[1.35, 1.67]	1.37	[1.24, 1.52]	1.31	[1.17, 1.45]	1.34	[1.22, 1.48]
3	1.47	[1.32, 1.62]	1.59	[1.44, 1.77]	1.51	[1.37, 1.67]	1.52	[1.37, 1.68]	1.43	[1.30, 1.57]
4	1.08	[0.96, 1.21]	1.22	[1.09, 1.36]	1.20	[1.08, 1.34]	0.99	[0.88, 1.11]	1.11	[1.01, 1.23]
5 (Least)	REF		REF		REF		REF		REF	

Note. Significant results at $p < .05$ after Holm's p -value correction indicated in bold. REF=Reference category.

Appendix VIII – Full table of results for Chapter 7

Results of the full logistic regression models for Chapter 7: School Readiness of Maltreated Children: The Impact of Timing, Type and Chronicity of Maltreatment

	Physical Health & Wellbeing		Social Competence		Emotional Maturity		Communication Skills & General Knowledge		Language & Cognitive Skills	
	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI
Child's history of maltreatment allegations										
None	REF		REF		REF		REF		REF	
Unsubstantiated	1.81	[1.44, 2.27]	1.36	[1.08, 1.72]	1.47	[1.17, 1.84]	1.70	[1.35, 2.15]	1.63	[1.30, 2.05]
Substantiated	1.55	[1.23, 1.94]	2.23	[1.78, 2.79]	1.98	[1.58, 2.47]	1.26	[0.99, 1.59]	1.47	[1.17, 1.85]
Child's ethnicity										
Aboriginal	1.31	[1.14, 1.50]	1.11	[0.96, 1.27]	1.36	[1.19, 1.56]	1.67	[1.45, 1.92]	2.14	[1.88, 2.45]
Other	REF		REF		REF		REF		REF	
Child's primary spoken language										
English	REF		REF		REF		REF		REF	
Other	1.36	[1.19, 1.56]	1.44	[1.26, 1.64]	1.41	[1.24, 1.60]	3.23	[2.85, 3.66]	1.70	[1.50, 1.92]
Mother's marital status at child's birth										
Married	REF		REF		REF		REF		REF	
Never married	1.34	[1.17, 1.53]	1.40	[1.23, 1.60]	1.43	[1.25, 1.62]	1.29	[1.12, 1.47]	1.18	[1.04, 1.34]
Divorced/widowed	1.45	[1.09, 1.93]	1.32	[0.98, 1.76]	1.62	[1.23, 2.14]	1.39	[1.04, 1.87]	1.65	[1.26, 2.17]
<i>Missing</i>	0.91	[0.55, 1.50]	1.52	[0.96, 2.41]	1.10	[0.69, 1.77]	1.17	[0.71, 1.90]	1.34	[0.85, 2.11]

(continued)

	Physical Health & Wellbeing		Social Competence		Emotional Maturity		Communication Skills & General Knowledge		Language & Cognitive Skills	
	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI
Paternal age at child's birth										
< 20 years	1.24	[0.95, 1.61]	1.24	[0.96, 1.61]	1.11	[0.86, 1.44]	1.34	[1.03, 1.75]	1.36	[1.06, 1.75]
20-29 years	1.05	[0.95, 1.15]	1.10	[1.01, 1.21]	1.01	[0.92, 1.10]	0.96	[0.87, 1.05]	1.08	[0.99, 1.17]
30-39 years	REF		REF		REF		REF		REF	
40 years +	1.13	[1.00, 1.27]	1.08	[0.96, 1.22]	1.13	[1.01, 1.27]	1.06	[0.94, 1.20]	1.13	[1.02, 1.26]
<i>Missing</i>	1.59	[1.33, 1.91]	1.52	[1.27, 1.82]	1.27	[1.06, 1.52]	1.26	[1.04, 1.52]	1.72	[1.44, 2.05]
Maternal age at child's birth										
< 20 years	1.31	[1.10, 1.57]	1.54	[1.29, 1.84]	1.63	[1.37, 1.94]	1.41	[1.17, 1.69]	1.57	[1.32, 1.86]
20-29 years	1.20	[1.10, 1.31]	1.19	[1.09, 1.29]	1.23	[1.13, 1.34]	1.32	[1.21, 1.44]	1.28	[1.18, 1.38]
30-39 years	REF		REF		REF		REF		REF	
40 years +	1.02	[0.82, 1.27]	1.28	[1.04, 1.58]	1.20	[0.98, 1.47]	1.26	[1.02, 1.56]	1.28	[1.06, 1.55]
Geographic location of child's community of residence										
Metropolitan area	REF		REF		REF		REF		REF	
Regional area	1.08	[1.00, 1.18]	0.96	[0.88, 1.04]	0.96	[0.89, 1.04]	0.99	[0.91, 1.08]	1.16	[1.07, 1.25]
Remote area	0.89	[0.79, 1.01]	0.92	[0.81, 1.03]	0.98	[0.87, 1.10]	0.71	[0.62, 0.80]	0.88	[0.78, 0.98]

(continued)

	Physical Health & Wellbeing		Social Competence		Emotional Maturity		Communication Skills & General Knowledge		Language & Cognitive Skills	
	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI
Local community level of socioeconomic disadvantage										
1 (Most)	1.76	[1.57, 1.99]	2.02	[1.79, 2.27]	1.75	[1.23, 1.51]	1.49	[1.31, 1.68]	1.55	[1.39, 1.73]
2	1.26	[1.14, 1.41]	1.50	[1.35, 1.67]	1.37	[1.23, 1.51]	1.30	[1.17, 1.45]	1.33	[1.21, 1.46]
3	1.46	[1.32, 1.62]	1.59	[1.43, 1.76]	1.51	[1.37, 1.67]	1.50	[1.36, 1.67]	1.42	[1.29, 1.55]
4	1.07	[0.96, 1.20]	1.22	[1.09, 1.36]	1.20	[1.08, 1.34]	0.98	[0.87, 1.10]	1.11	[1.00, 1.23]
5 (Least)	REF		REF		REF		REF		REF	

Note. Significant results at $p < .05$ after Holm's p -value correction indicated in bold. REF=Reference category.

Appendix IX – Full table of results for Chapter 8

Results of the full logistic regression models for Chapter 8: Using Linked Data to Investigate Developmental Vulnerabilities in Children of Criminally Convicted Parents.

	Physical Health & Wellbeing		Social Competence		Emotional Maturity		Communication Skills & General Knowledge		Language & Cognitive Skills	
	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI
Mother's highest level of criminal justice involvement										
None	REF		REF		REF		REF		REF	
Community order	1.36	[1.09,1.68]	1.26	[1.02, 1.57]	1.10	[0.88, 1.36]	1.11	[0.89, 1.39]	1.43	[1.15, 1.79]
Incarcerated	1.71	[1.20, 2.43]	2.09	[1.46, 2.98]	1.50	[1.05, 2.13]	1.85	[1.29, 2.66]	1.39	[0.95, 2.02]
Father's highest level of criminal justice involvement										
None	REF		REF		REF		REF		REF	
Community order	1.16	[0.94, 1.42]	1.37	[1.12, 1.67]	1.42	[1.17, 1.73]	1.44	[1.18, 1.77]	1.59	[1.32, 1.93]
Incarcerated	1.86	[1.53, 2.24]	1.65	[1.36, 2.00]	1.62	[1.34, 1.96]	2.11	[1.74, 2.55]	1.95	[1.61, 2.36]
Child's ethnicity										
Aboriginal	1.21	[1.05, 1.40]	1.03	[0.89, 1.18]	1.28	[1.12, 1.47]	1.41	[1.22, 1.63]	1.90	[1.66, 2.17]
Other	REF		REF		REF		REF		REF	
Child's primary spoken language										
English	REF		REF		REF		REF		REF	
Other	1.34	[1.20, 1.49]	1.53	[1.38, 1.70]	1.43	[1.29, 1.58]	3.64	[3.29, 4.02]	1.85	[1.68, 2.04]

(continued)

	Physical Health & Wellbeing		Social Competence		Emotional Maturity		Communication Skills & General Knowledge		Language & Cognitive Skills	
	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI
Mother's marital status at child's birth										
Married	REF		REF		REF		REF		REF	
Never married	1.28	[1.12, 1.46]	1.36	[1.19, 1.55]	1.39	[1.22, 1.58]	1.22	[1.06, 1.40]	1.12	[0.98, 1.27]
Divorced/widowed	1.42	[1.07, 1.90]	1.32	[0.99, 1.76]	1.62	[1.23, 2.14]	1.33	[0.99, 1.80]	1.59	[1.21, 2.09]
<i>Missing</i>	1.00	[0.63, 1.59]	1.56	[1.01, 2.41]	1.28	[0.82, 1.98]	1.16	[0.73, 1.84]	1.20	[0.77, 1.86]
Paternal age at child's birth										
< 20 years	1.11	[0.85, 1.45]	1.13	[0.87, 1.47]	1.01	[0.78, 1.31]	1.18	[0.90, 1.55]	1.19	[0.92, 1.54]
20-29 years	1.02	[0.93, 1.12]	1.09	[0.99, 1.19]	1.00	[0.91, 1.09]	0.93	[0.84, 1.02]	1.05	[0.97, 1.14]
30-39 years	REF		REF		REF		REF		REF	
40 years +	1.14	[1.01, 1.29]	1.09	[0.97, 1.23]	1.14	[1.02, 1.28]	1.06	[0.94, 1.20]	1.14	[1.02, 1.27]
<i>Missing</i>	1.73	[1.44, 2.09]	1.68	[1.39, 2.01]	1.44	[1.20, 1.72]	1.40	[1.16, 1.70]	1.86	[1.55, 2.23]
Maternal age at child's birth										
< 20 years	1.32	[1.10, 1.58]	1.54	[1.30, 1.84]	1.61	[1.36, 1.92]	1.38	[1.14, 1.66]	1.53	[1.29, 1.81]
20-29 years	1.20	[1.10, 1.31]	1.18	[1.09, 1.29]	1.23	[1.13, 1.33]	1.30	[1.19, 1.43]	1.27	[1.17, 1.37]
30-39 years	REF		REF		REF		REF		REF	
40 years +	1.02	[0.82, 1.27]	1.28	[1.04, 1.58]	1.19	[0.98, 1.46]	1.26	[1.02, 1.56]	1.28	[1.06, 1.54]
<i>Missing</i>	0.60	[0.37, 0.98]	0.45	[0.29, 0.72]	0.67	[0.42, 1.07]	0.75	[0.46, 1.22]	0.55	[0.35, 0.88]

(continued)

	Physical Health & Wellbeing		Social Competence		Emotional Maturity		Communication Skills & General Knowledge		Language & Cognitive Skills	
	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI	<i>OR</i>	95%CI
Geographic location of child's community of residence										
Metropolitan area	REF		REF		REF		REF		REF	
Regional area	1.12	[1.04, 1.21]	1.00	[0.93, 1.08]	1.00	[0.93, 1.08]	1.06	[0.98, 1.15]	1.19	[1.11, 1.27]
Remote area	0.87	[0.78, 0.98]	0.92	[0.82, 1.03]	1.00	[0.90, 1.12]	0.70	[0.62, 0.80]	0.88	[0.79, 0.98]
Local community level of socioeconomic disadvantage										
1 (Most)	1.79	[1.61, 2.00]	1.94	[1.74, 2.16]	1.77	[1.59, 1.97]	1.57	[1.40, 1.75]	1.60	[1.44, 1.77]
2	1.26	[1.14, 1.39]	1.44	[1.31, 1.59]	1.32	[1.21, 1.45]	1.32	[1.20, 1.45]	1.38	[1.27, 1.51]
3	1.46	[1.33, 1.61]	1.59	[1.45, 1.74]	1.50	[1.37, 1.64]	1.55	[1.41, 1.70]	1.47	[1.35, 1.60]
4	1.10	[1.00, 1.22]	1.22	[1.10, 1.35]	1.20	[1.09, 1.32]	1.02	[0.92, 1.14]	1.16	[1.06, 1.27]
5 (Least)	REF		REF		REF		REF		REF	

Note. Significant results at $p < .05$ after Holm's p -value correction indicated in bold. REF=Reference category.