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How well are Australian infants and children aged 4 to 5 years doing?

Findings from the Longitudinal Study of Australian Children Wave 1

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Executive summary

This report presents an analysis of the data from the first wave of the Longitudinal Study of Australian Children (LSAC) to explore the wellbeing of 5,107 children in the **infant cohort** of the study and the 4,983 children, aged 4 to 5 years, in the **child cohort**. Wave 1 of LSAC includes measures of multiple aspects of children's early development. These developmental measures are summarised in the LSAC Outcome Index, a composite measure which includes an overall index as well as three separate domain scores, tapping physical development, social and emotional functioning, and learning and cognitive development.

This report explores five specific aspects of infants' and children's experiences, exposures and environments in relation to their Outcome Index scores:

- key sociodemographic characteristics covering the child, mother, family and neighbourhood
- non-parental care experiences
- child health—prenatal and postnatal experiences and exposures
- maternal physical and mental health
- the early educational experiences of the **child cohort** in the home and out-of-home contexts.

This executive summary provides an overview of key emergent themes of the analyses.

Most children are doing well and few have pervasive difficulties

- Most of the children in both cohorts were making good developmental progress. Around two-thirds of infants and children did not score below the negative cut-off (that is, in the bottom 15 per cent of the distribution) on any of the three domains, and around one-quarter of the children in both cohorts were below the negative cut-off on only one domain.
- The findings revealed that development does not occur uniformly across all domains at these ages. Less than 1 per cent of infants and less than 2 per cent of children showed pervasive developmental difficulties, being below the cut-off on all three domains.

The findings highlight the dangers in drawing conclusions about children's developmental status from information on limited aspects of their early development.

Sociodemographic factors are more strongly related to child than infant developmental outcomes

- In the **infant cohort**, child, family and neighbourhood characteristics had minor associations with outcomes. This may in part reflect less sensitivity in the Outcome Index itself for this age group, but also the fact that contextual factors impact on children's development in a cumulative process over time.
- Girls in the **child cohort** consistently had more positive outcomes than boys. This well-replicated finding is thought to involve both biological dispositions and differences in parenting practices and societal expectations for boys and girls. Policy consideration of the implications of these sex differences for early childhood services may be warranted.
- In the **child cohort**, Aboriginal and Torres Strait Islander children had poorer outcomes in all but the physical domain; and children in families where a language other than English was spoken tended to have poorer outcomes. These data suggest that these children are encountering environmental circumstances which are not optimally supporting their development. An important task will be to track these children's trajectories in future waves of LSAC.

- Children in the **child cohort** were more likely to have positive outcomes in the context of higher maternal education, higher family income, higher parental occupational status, and in the absence of financial stress.
- Family type (single or two-parent family) and neighbourhood disadvantage did not make unique contributions to child outcomes for the **child cohort**, suggesting that their influence is mediated through family variables such as income, financial stress and family functioning.

These data provide clear evidence of a socioeconomic gradient, with poorer outcomes in the context of greater family disadvantage.

Different forms of non-parental care and early education programs have differential effects on developmental outcomes

- Children in the **infant cohort** participating in group-based child care programs were at most risk for impaired physical outcomes in the first year, probably due to exposure to infectious diseases. Later waves of LSAC will be very valuable in determining the longer-term implications of this.
- Children in the **infant cohort** who experienced only informal care tended to have higher learning scores than infants not in care. Since most of this care was provided by grandparents, this finding suggests the value of further research on the influences of extended family as care givers.
- Children in the **child cohort** attending pre-Year 1 early education programs had higher overall and learning outcomes than children who had only informal care arrangements. These results highlight the possible beneficial effects of attendance at programs with more strongly focused educational curricula.

Child health variables affect developmental outcomes

- While most mothers had breastfed their children, few mothers had met the current National Health and Medical Research Council (NHMRC) recommendations for exclusive breastfeeding for at least six months. The majority of the children had diets that did not meet nutritional guidelines and many preferred less physical activities. These findings suggest the need for ongoing public health initiatives regarding breastfeeding and nutrition.
- Many child health variables were associated with child social–emotional and learning outcomes, emphasising the importance of children's health to all aspects of their functioning and wellbeing.

Breastfeeding is associated with better health in both cohorts

- Being breastfed for more than six months reduced the risk of wheeze in the **infant cohort** compared to no breastfeeding. Mothers' daily intake for fruit and vegetables, child low birth weight and maternal smoking also predicted infant wheeze.
- Asthma was strongly predicted by the duration of breastfeeding in the **child cohort**.

Maternal physical and mental health affects child outcomes

- Mothers of LSAC children were broadly representative of all Australian mothers on parameters such as smoking and alcohol in pregnancy, mental health status, and prevalence of overweight and obesity.
- Current maternal general health, serious psychological distress and enjoyment of physical activity were related to children's outcomes, especially in the physical and social–emotional domains of the Outcome Index.

Family learning environments are strongly associated with children's learning outcomes

- For the **child cohort**, children's overall and learning outcomes were associated with family factors such as being read to by a family member, the number of children's books in the home, and the child's access to a computer at home.

- Overall Outcome Index scores tended to decrease as time spent watching television increased.

These findings highlight the significance of a home environment which encourages and supports early learning, and imply an important role for parenting education.

Overall implications: children's environments do matter

- The pattern of results supports an ecological model of child development in which the child's own attributes, along with their family and community context, exert influence on developmental trajectories. While the effects were weaker for the infant cohort, this is likely due to the smaller amount of time such influences had to impact on development. The findings underscore the importance of using a broad conceptual framework when trying to understand the complex nature of children's development.
- The findings indicate that most children are faring well. However, a considerable number of children do show poorer developmental outcomes, and the distribution of these children is not evenly spread across the Australian population. Policy initiatives should ensure that there are effective systems to ensure family, community and service-based support for parenting and early child development across all families, particularly those encountering disadvantage and distress. Early intervention to support optimal outcomes for children in the early years is essential.

1 Introduction

The Longitudinal Study of Australian Children is the first comprehensive national study examining the lives of Australian children as they grow up. LSAC aims to contribute to a stronger understanding of children's development in Australia's current social, economic and cultural environment. The study was commissioned by and is funded by the Australian Government Department of Families, Housing, Community Services, and Indigenous Affairs. It was announced in the 2000–01 Budget and work commenced on its development shortly after. Wave 1 of the survey was undertaken in 2004 and the data was released for analysis and research in May 2005. LSAC will help governments develop effective policies on early childhood issues, particularly on early intervention and prevention strategies in the areas of health, parenting, family relationships, early childhood education, child care and family support.

LSAC is following the lives of two cohorts of approximately 5,000 children: an infant cohort (0 to 1 years old in Wave 1) and a child cohort (4 to 5 years old in Wave 1). This paper aims to explore how LSAC infants and 4 to 5 year-old children are doing, and to identify factors associated with variations in their functioning. It is based on Wave 1 data, and hence cross-sectional and exploratory in nature. This precludes drawing any implications about causal connections or pathways linking correlates and child outcomes. However, a broad range of factors are examined, ranging from sociodemographic characteristics of families to children's care and educational experiences. A multivariable approach to analysis is adopted, so that unique associations between child outcomes and these factors can be identified. Given the large and representative nature of the two LSAC cohorts, these data provide initial indications about a number of issues of policy relevance, although stronger tests of these must await later waves of LSAC data.

This paper uses the LSAC Outcome Index as the principal indicator of children's current developmental status. The development of the Outcome Index was commissioned by FaHCSIA, to provide an overall summary measure of child functioning (see Sanson, Misson & the LSAC Outcome Index Working Group 2005). The Outcome Index is a composite measure that includes an overall index as well as three separate domain scores, tapping physical development, social and emotional functioning, and learning and cognitive development. The development and characteristics of the Outcome Index are described in detail below, along with discussion of its strengths, limitations, and appropriate and inappropriate uses.

Given that 'outcomes' and their correlates can be more meaningfully assessed at 4 to 5 years than in infancy, the report focuses predominantly on the child (4–5 year-old) cohort, but draws attention to salient findings in the infant cohort also.

1.1 Report overview

This section includes a brief literature review on existing research on Australian children's development and wellbeing, factors identified in previous research as important contributors to development, and their policy relevance. This is followed by an overview of the design of LSAC Wave 1, and a description of the Outcome Index.

This section is followed by five analytic sections (Sections 2–6). Section 2 describes some of the key demographic characteristics of both the infant and child cohorts, and relationships between these and child outcomes in both cohorts, examining all three Outcome Index domains as well as the overall Index. Nine of these variables are then chosen for multivariable analysis to examine their combined contributions to the overall index.

Section 3 explores the associations of a number of aspects of child care experiences with outcome scores. Sections 4 and 5 examine the roles of the child's prenatal and postnatal health and exposures, and of maternal physical and mental health on their overall and health outcomes. Section 6 addresses the educational experiences of the child cohort in the home and out-of-home contexts and relates these to overall and learning outcomes.

Section 7 draws these analytic sections together to discuss conclusions and implications of the data.

1.2 Literature and policy overview

There is extensive international and national attention directed to the development of social policies that focus on 'getting it right' for children during the early years. Children's early experiences are of significant consequence for their later development and learning (McCain & Mustard 1999; McCain, Mustard & Shanker 2007; eds Shonkoff & Phillips 2000). Keating and Hertzman (eds 1999) drew attention to the paradox that, while many post-industrial nations are skilled at creating wealth, there are increasing social and economic disparities resulting in concerns for the health and wellbeing of children who are socially and economically disadvantaged in developed countries. Universal support programs, as well as early identification of children at risk and effective early intervention, can alter developmental outcomes and reduce financial and emotional costs to children, families and communities over time (Williams et al. 2005). Heckman (2000, p. 4) also noted that childhood is a multi-stage process where early investments feed into later investments: '… human capital has fundamental dynamic complementarity features. That is, learning begets learning and skills acquired early on make later learning easier'.

Thus, the early years are an important developmental period that have consequences for children's health and wellbeing across their life course. To make a difference for many outcomes, evidence indicates that the most effective time to intervene to ensure positive long-term outcomes for individuals is in early childhood (McCain, Mustard & Shanker 2007). There is recognition that prevention and early intervention is more cost-effective than later treatment (eds Shonkoff & Phillips 2000). Effective prevention and early intervention are predicated on a good understanding of the complex aetiologies involved in such problem outcomes, as well as an understanding of the pathways to healthy development.

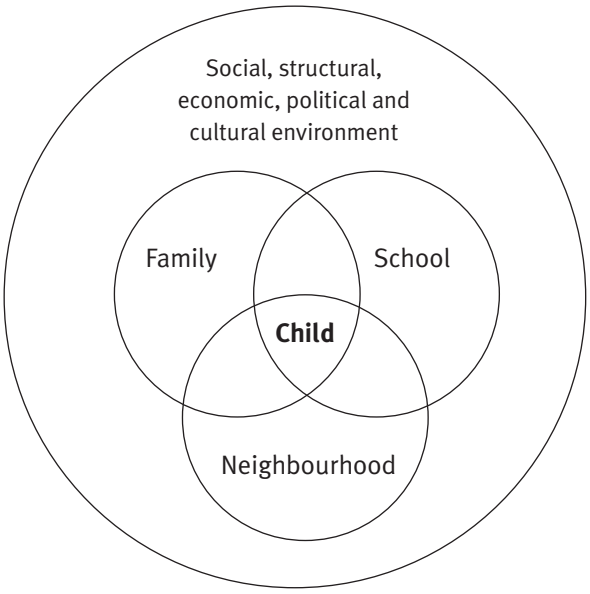
In recent years, governments in Australia have responded to social concerns about children's health and wellbeing. This is reflected in the Australian Government's development of the National Agenda for Early Childhood (Department of Families and Community Services (FACS) 2004b) as well as in the significant investment in the Stronger Families and Communities Strategy (FaCS 2004a). State and territory governments have also sought to improve the coordination and delivery of services to families with young children through a range of policy initiatives that include: Families First in New South Wales; Best Start in Victoria; Putting Families First in Queensland; Our Kids Action Plan in Tasmania; Every Chance for Every Child in South Australia; the ACT Children's Plan in the Australian Capital Territory; and the Vision for Territory Children in the Northern Territory. Besides comprehensive evaluation of existing policies, a strong evidence base developed from research about Australian families and their children is needed to help inform further policy development designed to support young children's development.

Key drivers for LSAC revolve around this need for a strong evidence base, and hence the need to capture information about how children in Australia are faring in the current social, economic and cultural environment, and to understand the factors that impact on their development. As noted in the Australian Institute of Health and Welfare's (AIHW) report, *A picture of Australia's children* (AIHW 2005), the evidence suggests that most children in Australia are faring well but that there are significant areas of concern. While indices such as infant and child mortality have fallen over the last 20 years, other conditions such as mental health disorders, asthma and allergy, obesity, diabetes, neurological problems such as the cerebral palsies, and learning difficulties have increased or remained at relatively high levels (Stanley, Sanson & McMichael 2002). These problems are not equally distributed across the population but are concentrated in disadvantaged and other vulnerable groups.

To shed light on the multiplicity of influences on children's development, the conceptual model underlying LSAC is a pathways socio-ecological model (Bronfenbrenner 1979; Sanson et al. 2002). As shown in Figure 1, this model situates children's development within the contexts of their family, school and community environments, identifies the interactions that can occur amongst these environments, and points to the influence of broader socioeconomic, structural, cultural and political factors on each context. From each level in the model, the child can be exposed to risk or protection. These influences are understood to occur over time, and to involve both direct and indirect pathways (for example, more distal factors such as parents' work conditions may impact on a child through their influence on more proximal factors such as the parents' relationship with the child or the child's child care experiences). Further, the child is understood to be an active contributor to their own

development, with intrinsic characteristics such as genetic endowment and temperamental characteristics shaping their responses to their environments as well as eliciting differential responses from people in these environments (Sanson, Hemphill & Smart 2004).

Figure 1: Socio-ecological contexts shaping children's development



Source: Bronfenbrenner (1979).

Correlates of child development outcomes

Here we provide a brief review of current knowledge about a number of key factors thought to impact on early childhood development, and which are examined in this paper.

Sociodemographic factors

It is clearly important in developing policy and practice to understand how child health and development outcomes are distributed across the Australian population according to background characteristics of the child and family. Adopting an ecological model, these can be categorised as within-child characteristics—such as gender and ethnicity; parental human capital which includes factors like education and occupation; family characteristics such as income and family type (single, two-parent, for example), and neighbourhood characteristics such as liveability and disadvantage which tap aspects of social capital. Previous research indicates that each of these can be related, directly or indirectly, to developmental outcomes, although much remains to be learnt about the processes through which they exert their influence.

For example, international research shows that children from minority ethnic groups tend to have more adverse outcomes than those from the majority culture, although separating out the effects of ethnicity, culture and immigrant status is complex (Quintana et al. 2006). An ethnic background can impact on children's development in various ways, including less exposure to English along with exposure to other languages, differing parental human capital and patterns of child-rearing, lower access to services, and the experience of stigma, disadvantage and discrimination (Helman 2000; Williams et al. 1997). LSAC offers an opportunity to examine both the extent of any developmental disadvantage being experienced by children of non–Australian born parents, as well as potential mediators of these effects.

It is well recognised that Aboriginal and Torres Strait Islander children are faring much worse than non-Indigenous children on most health and wellbeing indicators (ABS 2003a; Silburn et al. 2006). Although the LSAC sampling methodology could not guarantee a representative sample of Indigenous children, the numbers

recruited were marginally above population rates (Soloff et al. 2006) (see Section 2), and the rich set of data collected allow some preliminary insights into the factors contributing to outcomes for this group.

Parental human capital has been consistently linked to child outcomes, particularly in the educational arena (for example, Zubrick et al. 1997). Mothers' educational background provides a key resource for children as they develop, and is a critical component of psychological capital. Similarly, the occupational status of parents' work is linked not only to financial security but also to psychological capital, offering a range of experiences and social connections to the growing child. The labour force participation of mothers of young children has been implicated in both positive and negative outcomes, varying by child gender and type of outcome (Hoffman & Youngblade 1999; Sanson et al. 2002).

Due largely to high rates of divorce and separation, there is increasing diversity of family types in Australia and, hence, a need to understand the implications for child development. While children in single-parent and stepfamilies tend to have more adverse outcomes, existing research suggests that the relationship between family type and child outcomes is mediated by factors such as parent–child relationships, social support, family instability and financial stress (Wise 2003). LSAC provides an opportunity to gather national data on the strength of associations between family type and child outcomes, and to identify important intervening variables. Such data can then provide policy guidance to inform family support strategies.

National and international research documents strong negative associations between low income and financial stress and children's development, although theories emphasise different pathways to explain this association (Bradbury 2003; eds Keating & Hertzman 1999). For example, 'investment' theories emphasise deprivation of material resources such as good housing, adequate nutrition, availability of health and support services, and good quality child care; whereas 'parental stress' theories posit indirect paths through parents' psychological and physiological responses to stresses, perceived inequality, limited control over personal circumstances, and social exclusion (Bradbury 2003; Wilkinson 1999). LSAC can, firstly, document the association between income and financial stress and child outcomes and, secondly, explore a number of competing hypotheses to explain such associations. Findings will have relevance to policy options such as directing resources to children and families, or seeking to improve labour market outcomes for parents (Bradbury 2003).

Further, characteristics of the neighbourhood have been shown to be associated with child outcomes, often indirectly through their impact on family functioning and differential access to services (Brooks-Gunn et al. 1997). LSAC includes a number of relevant measures including parents' perceptions of the liveability of their neighbourhood; urban or rural location; remoteness; and the *ABS Socio-Economic Indexes for Areas 2001* (ABS 2003b).

There are a number of parent and family factors which have less well-established links to child outcomes, but which are nevertheless important to investigate for their associations in a population study such as LSAC. The number of siblings a child has and the size of their household could similarly have positive or negative effects. Large households can be noisy and stressful, and may entail less parental contact and support for each individual child, but can also provide the child with more social interaction and social support. Analyses of the British National Child Development Study, which has followed a 1958 birth cohort, have found relatively strong family size and sibling number effects on children's cognitive, physical and social development, with effects strongest in the early years (Fogelman 1975; Grawe 2005). Grawe interpreted findings as supporting an economic 'quantitative–qualitative trade-off' model, with effects being due not to financial constraints but the constraints of parental time investment in each child. In contrast, the Dunedin Multidisciplinary Child Development Study (Silva, McGee & Williams 1982) found no associations between family size and birth order and socioeconomic status, height and intellectual development. Overcrowding could make the household more chaotic and stressful and a few studies have found a link to poorer health and other outcomes (Office of the Deputy Prime Minister 2004; Reynolds 2005).

Section 2 reports analyses of the association of outcomes with these sociodemographic factors. The data can speak to important policy questions through identification of their relative contributions, for example: Which factors have unique associations with child outcomes, and which appear to be mediated by other influences? What is the relative contribution of parental human capital and community level factors? Are some domains of

development more influenced by sociodemographic variables than others? Can sociodemographic influences be detected in the first year of a child's life, or do they only emerge in the older cohort? Do sociodemographic variables act by increasing the numbers of children with adverse outcomes (that is, in the bottom 15 per cent of the LSAC range) in the context of disadvantage; and/or are children from more advantaged backgrounds more likely to have particularly positive outcomes (that is, in the top 15 per cent of the LSAC range); and/or can the effects of sociodemographic variables be seen across the whole range of outcome scores? As noted above, the reader is cautioned that these cross-sectional data do not support causal interpretations, which must await longitudinal data.

Non-parental child care

The experience of non-parental care is common for many Australian children in the first few years of life. According to figures released by the AIHW (AIHW 2003), 34 per cent of infants under 1 year of age experience regular non-parental care, and this figure rises to 88 per cent for 4 year olds. However, there is much variation in the type of care settings children experience (for example, home-based versus centre-based care), in the amount of time they spend in care, in the stability of their care arrangements—which is reflected in the number of different care arrangements they experience at any one time, and in changes to care over time—and in the quality of the care they receive (in terms of structural aspects of quality, like staff training, group size, and child–staff ratios, or process aspects of quality like the activities provided for children and the responsiveness and emotional quality of staff–child interactions). These different characteristics of child care each affect the experience of children in care and, therefore, must be considered in any analysis of the impact of child care on the health and development of young children. Different characteristics of care are also linked to important policy related issues, including what types of care and what aspects of care quality are most beneficial for children at different ages, whether care in the earliest years of life is detrimental to children's development, and whether long hours of care or unstable care pose risks for children's health and development in the early years.

Results of research from overseas indicate both benefits and risks associated with child care. However, findings across studies are often inconsistent and vary with the specific outcomes investigated. For example, while few studies have investigated children's general physical health in relation to child care, it is generally accepted that attendance at centre-based care settings exposes children to more communicable diseases (like ear, gastrointestinal and upper respiratory tract infections) than attendance at home-based care or care by parents. This association was confirmed by the NICHD Study of Early Child Care and Youth Development (NICHD Early Child Care Research Network 2005a), which reported that 3 year-old to 4 year, 6 month-old children in large group care had higher rates of infection than children in home-based care settings.

Studies of child care in relation to cognitive and language development in young children show more mixed results, with some studies reporting cumulative positive impacts of high quality centre-based care on children's cognitive and language development (Duncan 2003; NICHD Early Child Care Research Network 2000, 2002), and others reporting negligible or non-significant effects (Merrigan & Lefebvre 2002). Studies investigating aspects of children's social–emotional development have produced similarly mixed findings. The NICHD study (NICHD Early Child Care Research Network 1997, 2001) and a smaller-scale Australian study (Harrison & Ungerer 1997) found no negative impact of child care on mother–child attachment relationships in the early years. However, studies of problem behaviours like aggression and non-compliance in children at 4 to 8 years of age have reported more problem behaviours linked to the experience of early, extensive and continuous care (NICHD Early Child Care Research Network 2003).

While the results of overseas research provide an important framework for Australian studies of child care, the results cannot be assumed to generalize directly to the Australian context. Furthermore, in order for the effects of child care on children's health and development to be clearly understood, child care influences must be evaluated within the context of other important influences on children's development that include the child, parent and family characteristics discussed above, as well as family functioning measures such as parenting and family conflict. For example, Burchinal and colleagues (Burchinal et al. 2000) analysed three large North American data sets to investigate the hypothesis that high quality care would be particularly beneficial for children from high risk families (for example, poor, minority ethnic background). They reported that while good

quality care enhanced developmental outcomes for all children, the positive effects of quality were stronger for measures of language development for children from primarily African American and Hispanic backgrounds compared to children from white, non-Hispanic backgrounds. Finally, it is important to acknowledge that child, parent and family influences sit within broader social, economic and political contexts that affect parents' working lives and access to child care services, as well as providing a framework of cultural values regarding appropriate parenting and outcomes for children. Research must acknowledge this diversity of influences in order to provide a meaningful assessment of the impact of child care. LSAC represents the first large scale, nationally representative study of child care to address these issues in the Australian context. The analyses reported in Section 3 provide an indication of the concurrent relationships between child care experiences and children's outcomes, taking account of much of this complexity.

Children's health

The right of every child to enjoy the highest attainable standards of health is enshrined in the United Nations Convention on the Rights of the Child (United Nations 1989). Over the last century, there have been remarkable gains in children's physical health—including reductions in infectious diseases, malnutrition, perinatal mortality, and death rates in children experiencing chronic conditions. Nonetheless, physical health remains of considerable concern to parents and to policy makers and some morbidities have risen markedly. Children continue to experience high levels of disability and its effects, with survivors of very preterm births contributing significantly to this pool. Children who live with, rather than die from, chronic conditions such as cancer, cystic fibrosis and diabetes experience lifelong impacts (some of which are only now being delineated) which extend into all aspects of their wellbeing. Like other nations, Australia is in the grip of an obesity epidemic. Although its outcomes are yet to be realised, Australia now has one of the steepest rates of increase in childhood obesity in the developed world (Lobstein et al. 2004). Rates of asthma may have peaked, but diabetes and anaphylaxis are continuing to rise. Social disparities in physical health appear to be widening, and links between physical and psychological health and wellbeing are becoming more evident and their biologic bases more clearly delineated.

Understanding the overall impact of health conditions on children's life experience, and using this and other information to improve outcomes through both prevention and appropriate, effective intervention at the earliest possible stage, are important challenges for population health care systems. With the availability of new measures of health and wellbeing, it is now possible to examine the impact of various physical and mental health conditions. Importantly, LSAC offers an opportunity to explore contextual influences on multiple aspects of health and wellbeing. Factors that are considered to be important contributors to children's overall health include preterm birth and low birth weight; early growth patterns and nutrition, particularly breastfeeding; prevention of disease through full immunisation; good oral health from an early age; illnesses such as asthma, and injuries; and healthy lifestyles, including health nutrition and physical activity at all ages (Victorian Government DoHS 2006). Though not all could be considered in this first cross-sectional wave of data, all will be able to be considered as the study matures. Importantly, use of a single but multi-dimensional measure such as the Outcome Index means that their impacts on children's physical health, social–emotional wellbeing and learning can all be examined simultaneously. This is in keeping with the holistic conceptualisation of children's health as 'a state of complete physical, mental, and social wellbeing and not merely the absence of disease or infirmity' (World Health Organisation 1948).

Mothers' health

The development of life-course epidemiological techniques has focused attention on the intergenerational transmission of both good and ill-health. Parental behavioural choices such as smoking and alcohol intake may directly influence both the physical and mental health of their children (for example, the known direct links between maternal smoking during pregnancy and small-for-gestational-age in infancy, attentional problems in childhood and asthma), which can then be compounded by the increased likelihood of children's own later behavioural choices (that is, to take up similar risky health behaviours as young adults), thus potentiating the problem across multiple generations. This first wave of LSAC offers opportunities to probe existing baseline relationships between such variables, with a view to tracking longer-term relationships as the children mature to a point where they may themselves commence similar risky behaviours.

Much attention has been given to how social circumstances impact on children's development and other outcomes and how maternal factors during pregnancy impact on specific perinatal outcomes such as preterm birth. Perhaps surprisingly, the literature regarding the **overall** impact of a range of past and current maternal health and lifestyle indicators on children's outcomes has received very little attention, possibly because of the lack in most studies of composite measures such as the Outcome Index. LSAC offers the opportunity to consider intergenerational relationships between mother and child on indicators including pregnancy-related problems, current maternal global health, mental health, habitual fruit and vegetable intake, enjoyment and frequency of physical activity, weight status, and smoking and alcohol intake. A particular strength is the potential to see in which domains health in one generation (the mother) is most strongly related to outcomes in the next (the child).

Children's home learning environments

A significant issue for social policy in relation to children's early learning and development relates to the nature of early educational opportunities available to children before they begin school. LSAC provides a unique source of data to examine the variations in children's home learning environments and how these variations relate to children's development. Important research questions include: What is the nature of family activities and resources that support children's early learning at home? How do children's early learning opportunities in the home environment relate to developmental outcomes? Such analyses that investigate the effects of home learning environments on children's development also need to take account of child characteristics (for example, gender), parental characteristics (for example, maternal education), as well as family sociodemographic characteristics (for example, income) in accounting for variations in children's competence.

Early home learning experiences have been shown to make significant contributions to young children's early learning competence and subsequent educational success (Foster et al. 2005). At the heart of Bronfenbrenner's ecological model (Bronfenbrenner 1989, 1993) are 'proximal processes' which are the everyday interactions between the children and the symbols, objects, and other people in their everyday contexts. Typically occurring activities that involve children and those around them (for example, parent–child interactions around routine activities, reading, watching television) are the 'engines of development' (Bronfenbrenner 1995).

Judge (2005), in an analysis of data from the Early Childhood Longitudinal Study-Kindergarten (ECLS-K) in the United States, found strong links between children's early learning competence and the home literacy environment. The combination of frequent reading and access to books was linked to children's learning competence in reading and mathematics, as well as resilience among children at risk, as measured by sociodemographic factors of mothers' education, welfare support, primary language other than English and family structure. In a large international study of children's early literacy competencies, it was found that children who had higher reading achievement were read to more often at home prior to beginning school, and had many more children's books in their home than children who had lower reading achievement; higher achieving children were also more likely to have access to a computer at home (Mullis et al. 2003). Bus, van Ijzendoorn and Pellegrini (1995) reviewed the literature related to parent–child book reading prior to school, and concluded that such activities contributed to child outcomes such as language growth, emergent literacy, and reading achievement. In this report, the nature of home learning environments, including literacy activities, are examined and related to how children's experiences predict developmental outcomes.

To conclude this review, we reiterate that analyses of Wave 1 are of necessity exploratory and do not allow causal connections to be drawn. By reporting both univariate and multivariable analyses, it is possible to identify factors which appear to have direct associations versus those with indirect (possibly mediated) associations with child outcomes. However, in many cases there may be some ambiguity about the direction and nature of effects. Hence we discuss 'associations' rather than 'influences' or 'causes'. Subsequent waves of LSAC data will support more confident statements about causal directions and hence will provide stronger answers to the sorts of policy questions raised here.

1.3 LSAC sampling and design overview

Full descriptions of the background, sampling and design of LSAC can be found in Sanson et al. (2002) and Soloff, Lawrence and Johnstone (2005).

In brief, a cross-sequential design was chosen for LSAC, with two cohorts each to be followed over four biennial waves of data collection. The Health Insurance Commission (now Medicare Australia) agreed that the sampling frame for LSAC could be based on the Medicare database, the most comprehensive database of Australia's population. Children in the scope of the survey were infants aged 3 to 19 months (infant cohort) and children aged 4 to 5 years (child cohort). A target sample of 10,000 was sought, equally divided between these two cohorts.

A two-stage clustered design, based on postcodes, was chosen to permit community level effects to be measured and analysed, and to allow cost-effective face-to-face interviewing. Every effort was made to ensure that the sample chosen would be as representative as possible of Australia's infants and 4 to 5 year olds. The first stage of sampling entailed selecting postcodes; the second stage sampled children within these postcodes. Children in both cohorts were selected from the same 311 postcodes. An average of 40 children per postcode in the larger states and 20 children per postcode in the smaller states and territories were selected for the study.

Stratification was used to ensure proportional geographic representation for states/territories and capital city statistical division/rest of state areas. Postcodes were randomly selected with probability proportional to size selection where possible, and with equal probability for small population postcodes. Children were randomly selected with approximately equal chance of selection for each child (about one in 25). Due to difficulties of recruitment and excessive data collection costs, some remote postcodes were excluded from the design, and the population estimates have been adjusted accordingly.

The selection of children and corresponding fieldwork occurred in four phases. This was done to enable sample selection of children born across all months of the calendar year, to attempt to reduce the age range of children at interview, and also because some of the target population had not been born at the time of the first phase selection.

After excluding non-contacts, the achieved response rate for the infants was 64 per cent and 57 per cent for the 4 to 5 year-old children. Broadly, the LSAC sample is representative of the Australian population with no large differences from Australian Bureau of Statistics (ABS) census data on most characteristics. Children with mothers or fathers who had completed Year 12 are a little overrepresented in the final sample. Infants with no siblings are underrepresented (by 3 percentage points), while 4 to 5 year olds in couple families are overrepresented and those in sole parent families underrepresented (by 4 percentage points each). Sample weighting has been used to account for these small differences (see Soloff et al. 2006 for details of weighting procedures, and Soloff, Lawrence and Johnstone (2005) for further details on the design and sample).

Study informants for Wave 1 included:

- the primary care-giving parent (Parent 1)
- other resident parent or step-parent (Parent 2)
- child care provider (formal or informal)
- pre-school or school teacher
- the child her/himself (physical markers and, for the child cohort, direct assessment tasks)
- some interviewer observations of the child, family and external environment.

The primary respondent is the child's primary parent (Parent 1) or main care giver. This person is typically the child's biological mother, but is defined as the person who knows most about the child and their birth, history and current routines.

For the first wave of the study, the base design data collection entailed an interviewer spending one to two hours in the home to:

- obtain detailed information about the child, plus some information on the parent(s), from Parent 1; this information covers the key areas of health, family functioning, parenting, education, child care and social support
- obtain sociodemographic information on the family (such as household structure and parental labour force status, educational attainment and income); this could be obtained from either Parent 1 or Parent 2
- introduce the leave-behind self-complete modules for both Parent 1 and Parent 2, covering other aspects of family functioning, health and support that took about 20 minutes to complete; where time permitted, these modules were completed while the interviewer was in the home
- undertake physical measurement of the child (such as height, weight, girth and head circumference)
- explain the Time Use Diaries and leave for completion on two 24-hour periods (one week day and one weekend day)
- administer the 'Who am I?' school readiness test and Peabody Picture Vocabulary Test of receptive language to the 4 to 5 year-old children
- obtain consent to contact any child care provider or teacher (who was subsequently sent a self-complete questionnaire), plus contact details for the parents so that they could be located for future waves.

Full information about the interviews and their content is available in Soloff et al. (2003).

1.4 The LSAC Outcome Index

Before describing the Outcome Index created for LSAC, here we discuss a variety of other composite measures in more general terms to identify how they are derived, the purposes they can serve, and the limitations to their use.

Composite measures and children's developmental outcomes

Besides the ecological model adopted in LSAC to examine influences on the child, the study adopts a holistic view of children's development. It attempts to tap all developmentally-salient aspects of a child's development, from physical health through social and emotional functioning to cognitive development. Given the breadth of policy and scientific interest in the study, and of the research questions it is designed to address, it is important to have relatively fine-grained measures of each of these outcome domains. However, for a broader-brush understanding of how well children are faring and of the important influences on their development, a summary measure of developmental outcomes is also valuable. Nardo et al. (2005) note that a composite indicator provides a report on the 'big picture' and is easier to interpret than trying to find a trend in many separate measures. Composite indicators are designed to raise awareness, but cannot in their own right give the understanding that only individual indicators can reveal. Developing composite indicators of child development is challenging. Measures of child development are not always well understood and the measurement is often indirect, more complex, and less precise.

Most composite indices are based on data aggregated at the national or community level. The best known example may be the United Nations' Human Development Index, which is based on three national indicators: longevity (life expectancy at birth), educational attainment (adult literacy and enrolment ratios in educational institutions), and standard of living (Gross Domestic Product or GDP per capita). A widely used Australian example is the *ABS Socio-Economic Indexes for Areas 2001* (ABS 2003b) Index of Relative Socio-Economic Disadvantage, which incorporates census data, aggregated at the Collection District (CD) level or above, on multiple variables including levels of education, income, employment, occupational status, and living conditions.

Since the late 1970s, there has been significant attention to the use of social indicators to monitor children's wellbeing. They are now used in a variety of ways with increasing degrees of sophistication and complexity to inform understanding of the diversity in the lives of children. Social indicators are used to measure the social conditions of children's lives, their health status, and their cognitive and social–emotional competencies. These measures are primarily used to track population changes over time or draw comparisons between children's wellbeing across national contexts. The rationale for their use includes the importance of understanding the social conditions of children's daily lives, and changes in those social conditions over time, to monitor progress towards desired societal goals that relate to wellbeing, and to provide a means to evaluate social policies intended to improve outcomes for children (Land et al. 2007). While indicators can be single measures of social conditions or developmental competence, more consideration is now being directed to developing aggregated or composite indices which combine a number of indicators to provide an holistic picture of children's wellbeing (Ben-Arieh & Goerge 2001). Composite indices can be used descriptively to inform social policy development or relationships can be modelled between social conditions and other family influences that are hypothesised to affect child outcomes.

The use of composite indices of children's wellbeing is primarily used to inform policy development with respect to children and families (Ben-Arieh 2006). They can describe competencies and monitor and track outcomes over time. They can be used to set goals and focus policy directions and activities, as well as providing a means by which policies and programs can be evaluated (Brown & Corbett 2003). Communicating evidence on child outcomes through the use of composite indicators can provide a starting point for discussion about the lives of children. However, composite indices cannot on their own shed light on specific problems which single measures as indicators can reveal. In the development of composite indices, subjective decisions are required in the selection and weighting of individual indicators. Therefore, caution is needed in interpretation of many indices when multiple domains are included in their composition.

Most composite indices of children's wellbeing are based on aggregated statistical information from a variety of measurement sources, and used to measure children's wellbeing within countries. For example, the *Child Well-Being Index* (CWI) provides a composite index of trends in the wellbeing of America's children (Gilliam 2005). It draws its indicators from a range of national statistical surveys and uses 28 key indicators across seven quality of life domains (family economic wellbeing, health, safety and behavioural wellbeing, educational attainments, community connectedness, social relationships, and emotional and spiritual wellbeing). Similarly, the Bradshaw index of child wellbeing compares the wellbeing of children and youth across eight clusters of indicators for the purpose of making cross national comparisons about the lives of children in countries across the European Union (Bradshaw, Hoelscher & Richardson 2007). Like the CWI, it draws on many sources of data. It uses time series data and comparative surveys of children and young people to compare across countries in eight areas of wellbeing based on 51 indicators. The clusters are children's material situation, housing, health, subjective wellbeing, education, children's relationships, civic participation, and risk and safety. In the Australian context, the AIHW uses a large set of indicators to report on the health, development and wellbeing of Australian children aged 0 to 14 years, most recently in 2005 (AIHW 2005). While such national level indices are very valuable for benchmarking, monitoring trends, and understanding socioeconomic gradients, they are not useful for understanding an individual's current functioning or developmental pathways.

There are also examples of indicators which apply at the level of individuals. For example, most intelligence tests summarise scores on multiple subtests into an intelligence quotient for the individual. Similarly, multiple final school examination results are summarised as a Tertiary Entrance Rank score in several states of Australia. However, the only composite measure known to the authors which aims to capture individual children's behavioural and cognitive functioning is the Vulnerability Index that is constructed from data from the Canadian National Longitudinal Study of Children and Youth (NLSCY) (Brink 2003). This index was created to examine factors associated with childhood vulnerability, to describe the extent of variation across communities and provinces in Canada, and to monitor children's outcomes over time and across studies. It incorporates dichotomised (problem/no problem) scores on a range of measures of motor and social development, vocabulary, mathematics, temperament and behaviour problems. A child is considered vulnerable if one or more cognitive or behavioural outcomes are below these set thresholds. Because Wave 1 of NLSCY covers the age

range from infancy to 11 years, different measures are incorporated at different ages. As noted by Willms, from an analytic perspective, information is lost in converting continuous measures into dichotomies (ed. Willms 2002, p. 47); and the imposition of cut-offs between 'problem' and 'no problem' are essentially arbitrary (p. 16). However, Willms argued that the index can still be used for purposes such as monitoring, understanding socioeconomic gradients, and determining developmental pathways. Indeed, it has proven to be a very useful tool for such purposes (see ed. Willms 2002). This index now forms part of Canada's national assessment framework and is used to assess the extent of childhood vulnerability in each province.

Determining how childhood experiences shape developmental outcomes and how policy might reflect indices of wellbeing is at the edge of new knowledge. Much is still to be learned about the substantive issues in the value of composite indices and many methodological questions remain difficult to resolve. There appears to be no single best approach to measuring child outcomes through social indices. Different methods are likely to result in somewhat different answers due to different assumptions underlying the frameworks for construction. Therefore, the development and use of composite indices needs to be understood critically.

It should be noted that, with virtually all composite measures, the components are measured on different scales using different units (in the case of the Human Development Index, years lived, percentage rates of literacy, ratios of enrolments, and GDP) and are combined through standardisation procedures which ensure the distribution of all components has the same shape, allowing a meaningful combination of rankings across components. Thus they produce **relative** measures, rather than any **absolute** measure of composite attribute being assessed. An exception is the Canadian Vulnerability Index which uses cut-offs to classify children into problem/no problem on each domain, but, as noted above, its author acknowledges that these cut-offs are essentially arbitrary. A further observation is that the elements in a composite tend to have only modest intercorrelations, since they are intentionally tapping different aspects of the complex attribute they are concerned with. Nevertheless, as the review above indicates, they are proving to be very useful instruments for specified purposes.

The LSAC Outcome Index was commissioned by FaHCSIA to provide an overall measure of how well Australian children were doing. As discussed below, the LSAC Outcome Index is partially modelled on the Vulnerability Index, but attempts were made in its construction to improve upon it by (1) maintaining variables in continuous form wherever possible, hence minimizing the use of arbitrary cut-offs, and (2) incorporating measures of positive as well as problem functioning, recognising that most children are doing well and that it is as important to understand the pathways to better than average functioning as to understand the paths to sub-optimal outcomes (Sanson, Misson & the LSAC Outcome Index Working Group 2005). Further, rather than 'Vulnerability', the more neutral term 'Outcome' was adopted.

Conceptual framework for the LSAC Outcome Index

As noted above, the Outcome Index is intended to be a composite measure to reflect how LSAC children are developing. LSAC tracks the development of children across multiple domains, and the Outcome Index provides a means of summarising this complex information. In this context, an outcome is an attribute of the child at a particular point in time. As noted above and in contrast to the Vulnerability Index developed in the Canadian NLSCY, the LSAC Outcome Index wherever possible incorporates both strengths and weaknesses, reflecting the fact that most children have good developmental outcomes. Thus the Outcome Index has the ability to identify groups of children developing poorly and those developing well. Guiding principles in its development were that it should contain all dimensions of developmental interest, and that it should focus on actual developmental status and exclude distal factors (income, family structure, for example) that are predictively related to child outcomes.

A full description of the background and calculation of the Outcome Index is contained in LSAC Technical paper no. 2 (Sanson, Misson & the LSAC Outcome Index Working Group 2005). In brief, three domains are proposed to be the major components of current wellbeing and the future capability to be a successful civic and economic participant: health and physical development; social and emotional functioning; and learning and academic competency. Summary scores for each of these domains are calculated, and they are combined into the overall index. Since each of these domains is roughly equally important for a child's developmental wellbeing, they are

equally weighted in the overall index. It is acknowledged that children's development is multidimensional and interactive, and that there are 'fuzzy boundaries' between these domains of functioning. At the same time, a child's development may not be uniform across domains—for example, a child may be doing well in language, but have poorly developed motor skills. It is important to capture this variability.

The broad framework for the LSAC Outcome Index is shown in Figure 2. As can be seen, not all of the components that can be measured for the child cohort (4 to 5 year olds) can be measured for the infant cohort, since these outcomes are not observable at such a young age, and/or are not able to be assessed in LSAC. Hence the meaning of the Outcome Index varies to some extent across cohorts in Wave 1. This needs to be taken into consideration when interpreting the infant cohort, including making comparisons with the child cohort.

The final set of variables selected for inclusion in the Outcome Index is listed in Appendix A. In brief, available measures of physical outcomes in infancy were limited to parent report on two measures of health: an overall rating of the infant's health, and an assessment of whether the infant had greater health care needs than the average infant. Social–emotional outcome was assessed using three scales on the parent report: Short Temperament Scale for Infants (Sanson et al. 1987): which assesses the continuum from withdrawing/shy to approaching/sociable tendencies; Irritability, which assesses the degree to which the infant is calm or volatile, and irritable or not irritable; and Cooperativeness, which assesses the adaptability and amenability of the infant. The learning domain was assessed by parent report on the Communication and Symbolic Behavior Scale (Wetherby & Prizant 2001), which taps the infant's emerging communication skills.

For the child cohort, the physical domain has two subdomains: health, which was tapped by the same two items as for the infants' physical domain, with the addition of Body Mass Index (BMI) calculated from direct measurement of the child's height and weight; and motor, assessed through the parent report PedsQL (Varni, Seid & Rode 1999) physical health subscale, which largely assesses motor coordination but also more general health. There were three subdomains for social–emotional domain assessed by the parent report Strengths and Difficulties Questionnaire (SDQ) (Goodman 1997): Social Competence included the Prosocial subscale (assessing the child's propensity to be considerate and helpful to others) and Peer Problems subscale (assessing the child's ability to form positive relationships with other children); Internalising Problems was tapped by the SDQ Emotional Symptoms subscale (assessing the frequency of child displays of negative emotional states such as nervousness and worry); and Externalising Problems was tapped by the SDQ Hyperactivity subscale (assessing fidgetiness, concentration span and impulsiveness) and the SDQ Conduct subscale (assessing the child's tendency to display problem behaviours such as aggressiveness when interacting with others). The learning domain consisted of four subdomains: Language, assessed from a specially adapted form of the Peabody Picture Vocabulary Test (PPVT-III) (Dunn & Dunn 1997), a measure of receptive language directly administered to children; Literacy, derived from parent and teacher ratings of reading skills, and teachers' rating of writing skills; Numeracy, assessed from teacher ratings of five numeracy skills; and Approach to Learning, tapped by *Who Am I?*, a direct assessment of the child's ability to perform a range of skills underlying school readiness (ACER 1999).

Full descriptions of the variables in the Outcome Index can be found in the LSAC Wave 1 Data Dictionary ‹http://www.aifs.gov.au/growingup/data/datadictionary.html›.

Calculation of the Outcome Index

The calculation of the Outcome Index for the child cohort involved four stages. In Stage 1 all the outcome variables were standardised, by age where necessary (see Endnotes 1 and 2), and combined into subdomain scores. The process of standardisation is described in the text box below. The second involved standardising the subdomain scores (accounting for missing data where necessary) and combining them in domain scores. The third stage involved standardising the domain scores (again accounting for missing data where necessary), and obtaining cut-offs to identify the top 15 per cent and bottom 15 per cent of the sample for each domain. The final stage calculated the final Outcome Index by calculating a continuous index score from the average of the three domain scores. It is also possible to calculate the number of domains on which a child is in the top and in the bottom 15 per cent of the distribution, and to apply cut-offs to identify the top and bottom 15 per cent of the sample for the overall Outcome Index.

The calculation of the Outcome Index for the infant cohort was a slightly simpler process since there are no subdomains (see Figure 2). This means that Stages 1 and 2 for the child cohort could be merged, so that the outcome measures were standardised (by age, and accounting for missing data where necessary) and combined directly into domain scores. Stages 3 and 4 were identical to those described above.

Box 1: Standardisation

Standardisation of a set of variables, for example, BMI or SDQ, entails making the variables consistent in their mean and variability so that they can be more meaningfully compared or combined. The measure of variability used in the calculation is the standard deviation. A standardised value for a particular variable for each infant or child is calculated by subtracting the mean of the overall sample from the original value and then dividing the difference by the sample standard deviation. The resulting value tells us how many standard deviations it is away from the mean.

An empirical rule applies specifically to data that are approximately distributed according to a 'bell shaped' form, namely that: (1) about 68 per cent of values lie within one standard deviation of the mean, (2) about 95 per cent of observations lie within two standard deviations of the mean, and (3) more than 99 per cent of values lie within three standard deviations of the mean.

The new set of standardised (otherwise called z-score) values have a mean of zero and a standard deviation of 1. A z-score below 1 implies the child is below the average for the total sample, and a score above 1 implies they are above the average.

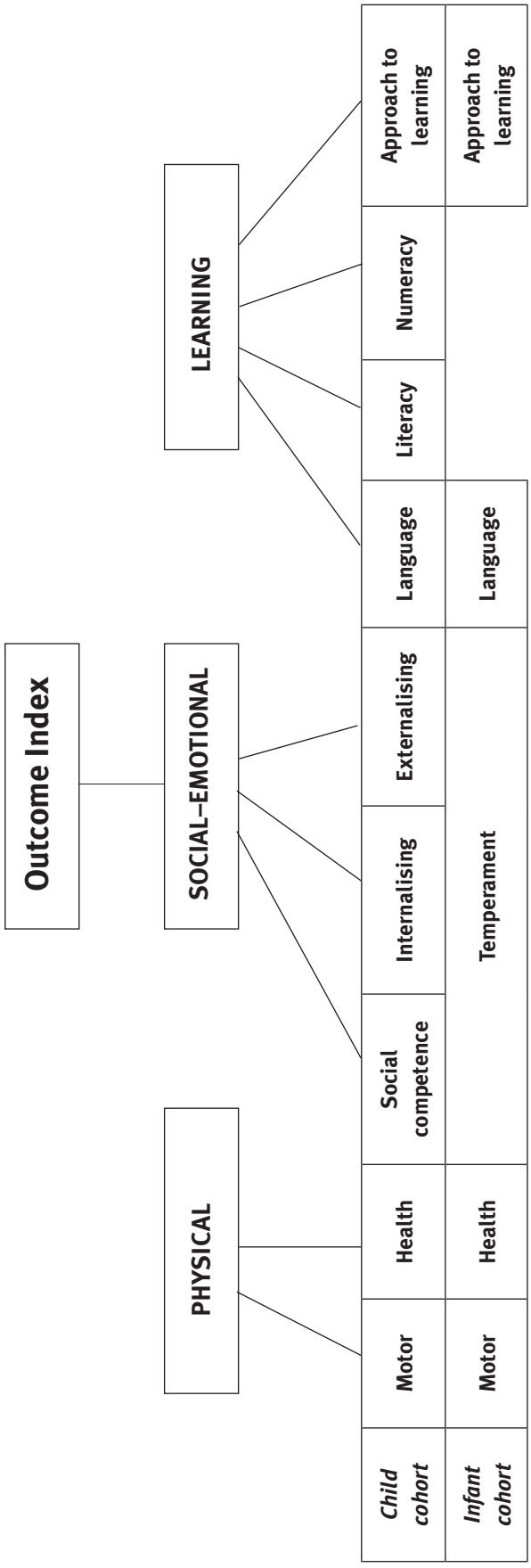


Figure 2: Conceptual framework for the Outcome Index for the infant and child cohorts, showing domains (in uppercase) and subdomains (in lower case)

The final suite of variables that comprises the LSAC Outcome Index is:

- three variables giving standardised continuous scores for each of the three domains; the mean of each of these scores is 100 and the standard deviation is 10
- three variables identifying the children in the top 15 per cent on each of these domains (that is, positive cut-offs), except for the physical domain for the infant cohort where infants with excellent health could not be separated from those with average health
- three variables identifying the children in the bottom 15 per cent on each of these domains (that is, negative cut-offs)
- the overall Outcome Index, a continuous score based on a standardised average of the three domain scores; the mean of this score is 100 and the standard deviation 10
- a categorical measure of positive and negative overall outcomes, calculated by identifying children in the top and bottom 15 per cent of the distribution, respectively
- two categorical scores based on the number of domains in which the child was in the top 15 per cent and the number of domains in which the child was in the bottom 15 per cent.

Details of how missing data were managed are provided in Sanson, Misson and the LSAC Outcome Index Working Group (2005). In brief, a score for a domain was calculated if the respondent had one of the component variables present. However, an overall score was only calculated if the respondent had valid data on all three domains. Using these procedures, overall Outcome Index scores were available on 3,783 of the total sample of 5,107 infants, physical domain scores on 5,106, social–emotional domain scores on 4,314, and learning domain scores on 4,476 infants. In the child cohort, overall Outcome Index scores were available on 4,969 of the total sample of 4,983 children, physical domain scores on 4,982, social–emotional domain scores on 4,969, and learning domain scores on 4,982 children.

Table 1 shows that approximately two-thirds of both infants and children did not score below the negative cut-off on any of the three domains, as might be expected. Around one-quarter in both cohorts were below the negative cut-off on only one domain, and about 7 per cent were below the cut-off on two domains. Only 0.8 per cent of infants and 1.7 per cent of children showed pervasive developmental difficulties, being below the cut-off on all three domains. These data indicate relatively low levels of cross over from problems in one domain to problems in another among children in these two age groups. Interestingly, a similar finding emerged using the Vulnerability Index in the NLSCY: only 3 per cent of children were below the cut-offs for both cognitive and behavioural problems (ed. Willms 2002). A similar pattern is apparent in relation to the positive cut-off, except fewer infants were above the cut-off on two domains (as noted above, it was not possible to define a positive cut-off in the physical domain for infants, and hence they could not be above the cut-off on three domains). Overall, these findings indicate that development does not occur uniformly across all domains at these ages, and they illustrate the need to make judgements about a child's overall development on the basis of information on all areas of their development, not a limited set of domains.

Table 1: Percentage of infants and children in bottom and top 15 per cent of scores across domains

	Infants		Children	
Characteristic	**n**	**%**	**n**	**%**
Number of domains on which infant/child scored below negative cut-off (that is, lowest 15%)	3,783		4,969	
None		63.5		66.2
One		28.7		24.5
Two		7.0		7.6
Three		0.8		1.7
Number of domains on which infant/child scored above positive cut-off (that is, highest 15%)	3,783		4,969	
None		73.3		63.8
One		24.1		28.0
Two		2.6		7.5
Three		–		0.7

Outcome Index limitations

The following characteristics of the Outcome Index derived from Wave 1 data have important implications for its use and interpretation:

- **Discrimination is stronger at the problem end than the positive end:** many variables in LSAC are designed to identify problematic or below average child functioning—their capacity to identify those with particular strengths or above average functioning is often weak. Hence the final distribution has greater negative discrimination than positive. This is particularly true for the physical domain for both cohorts, and to a lesser extent for the social–emotional domain for the child cohort (see Table 2). As a result of this, it was not possible to derive a meaningful index of positive physical outcomes for infants. Care is needed in the interpretation of the positive index.
- **Gaps in infancy data:** there are limited areas where it was possible or meaningful to collect 'outcome' information on the infant cohort.
- **Using measures with large amounts of missing data:** to cover some subdomains in the learning domain for 4 to 5 year olds it was necessary to use data from the teacher questionnaire, which was completed for only 65.4 per cent of the sample. However, it was considered important to calculate Outcome Index scores for as many of the sample as possible, so scores for children without these questionnaires were calculated based on the scores that were available. Care was taken not to give these children any greater or lesser chance of scoring higher or lower than those with full data; however, the learning scores for these children may be less indicative of the child's functioning.
- **Cut-offs are arbitrary:** the categorical form of the Outcome Index uses cut-offs to identify the top and bottom 15 per cent of the distribution. There is no claim that these proportions are clinically meaningful. They are statistically based, in accord with the common view that one standard deviation below the mean of a population represents significant difficulty. It is therefore not possible to make general claims about the sample overall, such as 'X per cent of children have low social competence' or 'Y per cent of children are in excellent physical health', since the proportions in all cases are predefined. However, statements about subgroups of the sample relative to each other are possible. This is the prime purpose of the Outcome Index.
- **Differences in outcome by age within each cohort are not identifiable:** as noted above, within-cohort differences in **child age** were taken into account in the development of the Outcome Index (Sanson, Misson & the LSAC Outcome Index Working Group 2005) and hence are not identifiable from the Index. Of course comparisons **across** cohorts can be made—for example, to compare the effect of family type on infants and 4 to 5 year olds.

- Because the Outcome Index is a composite measure designed to capture all of the most salient developmental outcomes assessed in LSAC, it has limited capacity for making comparisons among these outcomes. While the three domain scores can be compared, it is not possible to assess associations of the Outcome Index score with, for example, child health or cognitive development since these are incorporated into the Outcome Index itself.
- Importantly, due to the cross-sectional nature of the LSAC Wave 1 data, it is not possible to make causal assumptions about the associations between Outcome Index scores and other variables. These must await further waves of LSAC data.

More details on the conceptual basis and calculation of the LSAC Outcome Index can be found in LSAC Technical Paper No. 2 (Sanson, Misson & the LSAC Outcome Index Working Group 2005).

Table 2: Skewness of continuous score distributions for the Outcome Index

Score	Infant cohort	Child cohort
Physical domain	–2.24	–1.66
Social–emotional domain	–0.23	–0.79
Learning domain	0.11	–0.14
Full Outcome Index	–0.48	–0.85

1.5 Weighting

The analyses in this paper use sample-weighted data. The sample weights in LSAC allow for unequal probabilities of selection into the sample, and for non-response (to account for the known underrepresentation of female carers who did not speak English and/or had not completed high school in LSAC). Statistical methods were used to obtain estimates of standard error taking account of the correlation of responses within postcodes. More details on the LSAC weighting process can be found in LSAC Technical paper no. 3 (Soloff et al. 2006).

2 Outcomes for children in differing circumstances

Section summary

- Outcomes for 4 to 5 year-old children were quite powerfully related to broad characteristics of the child, mother, and family context, consistent with an ecological model of child development. In contrast, there was little evidence that these factors impacted on infants' outcomes, suggesting that these contextual factors impact on children's development through a cumulative processes over time.
- Particularly in the child cohort, there was strong evidence that child characteristics were associated with outcomes. The data suggest that girls consistently had better outcomes than boys (except in the physical domain). Aboriginal and Torres Strait Islander children appeared to have poorer outcomes, despite few differences in infancy. Similarly, children from families which spoke a language other than English tended to have poorer outcomes.
- Indices of parental and family psychological and material capital (maternal education, parental occupational status, income and financial stress) were related to child but not infant outcomes. Infants tended to do better in smaller families, while moderate-sized families were optimal for children. However, family type (either one or two parents) showed no evidence of an independent effect on outcomes.
- There was only weak evidence that neighbourhood effects (liveability, disadvantage, remoteness, metropolitan/non-metropolitan location) impact on child outcomes at these ages. Such effects can be expected to become stronger over time.
- The set of sociodemographic factors identified here are important to consider when assessing the impact of more fine-grained biological and environmental exposures, and are used as covariates in analyses in subsequent sections.

2.1 Introduction

As described in Section 1, the Outcome Index permits comparison on the physical, social–emotional and learning outcomes of children growing up in different circumstances. Identification of groups of children who are developing well and those doing less well provides important guidance to policy makers. It is also important to understand whether poor developmental outcomes for a group of children occurs across the spectrum of domains of development or is limited to one or two domains. LSAC provides an unusual opportunity to examine specific or general differences between groups, since it taps a much broader spectrum of child outcomes than is available in most research.

In this section, we describe the LSAC infants and children according to a broad range of sociodemographic characteristics, and then examine how these variables are distributed at both ends of the overall Outcome Index scores. We next examine these variables in multivariable analyses for overall Outcome Index scores as well as physical, social–emotional and learning domain scores. The final multivariable models include nine sociodemographic variables spanning the child, mother, family and community factors. Analyses in all subsequent sections adjust for these variables.

2.2 Findings

The sociodemographic variables

Table 3 describes important **sociodemographic characteristics** that broadly characterise the **child**, the **mother**, the **family** and the **community**. The rationale for examination of these variables in relation to child outcomes was outlined in Section 1, but is briefly reiterated below along with details about the derivation of variables and their distribution in the two cohorts. More specific variables (such as prenatal exposures, child care experiences, and educational activities in the home) are examined in later sections, adjusting for a common set of these broad sociodemographic characteristics. Other important influences on children, such as parenting practices and family functioning, are not examined here, since they are covered in detail in another report (Zubrick et al. 2008). The bivariate and multivariable analyses in this section assess the extent to which these sociodemographic variables predict Outcome Index scores, while noting that causal inferences cannot be drawn from cross-sectional analyses.

The characteristics of those who do markedly well or poorly are often of particular policy interest. Figure 3 shows the proportions within the infant cohort falling into the bottom (negative or 'problem') end of the overall Outcome Index distribution according to (a) child and maternal, (b) family and (c) neighbourhood characteristics. Figure 4 shows the corresponding proportion falling above the positive cut-off (that is, in the top 15 per cent of overall Outcome Index distribution) for these same variables. The bars on each variable indicate the 95 per cent confidence intervals for each proportion. Figures 5 and 6 follow the same approach for the child cohort. Findings are discussed below.

Child characteristics

- **Age**: the mean age for the infant cohort was 41 weeks (9.5 months), with a range of 14 to 83 weeks. The child cohort was on average slightly over 4 years, 6 months old, with a mean age of 250 weeks (4 years, 8 months) and a range of 223 to 295 weeks. Because of the way the Outcome Index is standardised, age is already taken into account in its calculation, so analysis by age **within** each cohort is not possible.

- **Gender**: both cohorts comprised approximately 51 per cent male and 49 per cent female children, reflecting the Australian population for children of this age. There is considerable evidence that boys are more vulnerable to developmental difficulties and develop more slowly than girls in the early years (see, for example, Ruble & Martin 1998); this can have policy implications in areas as diverse as health, child care and education. In the child cohort, almost twice as many boys as girls fell below the negative cut-off, and almost twice as many girls as boys scored above the positive cut-off (see Figures 5 and 6). However, as shown in Figures 3 and 4, this disparity was less marked in the infant cohort.

- **Ethnic and cultural background** can impact on children's development in multiple ways, as discussed in Section 1. The proportion of children who were described by their parents as being **Aboriginal or Torres Strait Islander** (ATSI) (5 per cent of infants and 4 per cent of children) was a little above population rates. In the child cohort, only 3 per cent of these children fell above the positive cut-off, whereas a third fell below the negative cut-off. Trends in similar directions in the infant cohort were less marked (10 per cent and 20 per cent respectively). As noted in Section 1, due to the sampling methodology employed in LSAC and the exclusion of some very remote postcodes, the sample of ATSI children in this study is unlikely to be fully representative of all ATSI children.

- Here the measure of non-Australian background was whether a child lived in a family which spoke a **language other than English** at home (LOTE). Approximately the same proportion of children in both cohorts lived in such families (13 per cent of infants, 14 per cent of children). In the child cohort, a greater proportion of these children were below the negative cut-off (21 per cent versus 16 per cent), and a smaller proportion were above the positive cut-off (10 per cent compared to 15 per cent); these differences were not evident for the infant cohort.

Maternal characteristics

- **Education**: a mother's educational status is a critical component of her psychological capital. For the purposes of LSAC, 'mother' is defined as any female guardian of the study child, or the one who knows the child best if there are two. In almost all cases the mother was the primary care giver. Mothers of infants tended to be a little better educated than those of the child cohort, with 59 per cent of mothers of the infant cohort having completed high school compared to 51 per cent of mothers of the child cohort. While the distribution of maternal education was not related to high and low Outcome Index scores in the infant cohort, a marked stepwise relationship was observed in the child cohort, with fewer children having low Outcome Index scores and more having high Outcome Index scores as the level of maternal education increased.

- **Employment**: the labour force participation of mothers of young children has increased markedly over recent decades and has been associated with both positive and negative outcomes (Hoffman & Youngblade 1999; Sanson et al. 2002). In the LSAC infant cohort, 61 per cent of mothers were not currently working and 11 per cent were working full-time (30 or more hours per week), compared to 46 per cent and 19 per cent for mothers of the child cohort. Maternal employment status was not related to positive and negative Outcome Index scores in the infant cohort. In the child cohort, a greater proportion of children whose mothers were not working scored below the negative cut-off, and a smaller proportion scored above the positive cut-off, than those whose mothers were working part or full-time. Outcomes for the latter two groups appeared similar.

Family characteristics

- **Family type**: research has consistently pointed to differences in outcomes across family types, although the causal relationships between them are unlikely to be direct. For young children, a salient distinction is whether there are one or two parents available in the home. For the purpose of LSAC, the primary parent was defined as the person who knows most about the child, and the secondary parent as anyone else with a parental relationship to the study child or a partner of the primary parent. By this definition, 11 per cent of infants and 15 per cent of children were in single-parent families. In the child cohort, only 9 per cent of children in single-parent families scored above the positive cut-off, and 27 per cent scored below the negative cut-off. In contrast, living in a family with one or two parents was not related to positive or negative outcomes for the infant cohort.

- **Siblings**: while siblings can provide emotional support and socialisation for children, they can also lead to rivalry and make competing claims on parents' resources. The number of siblings was calculated by counting the number of people living with the study child who had a sibling relationship (including full, step, half, foster and adopted siblings) with the child. Nearly 40 per cent of the infants were only children, compared to just 12 per cent of the children. Two-fifths of both cohorts (41 per cent) were the oldest or an only child. As shown in Figures 3 and 4, a greater percentage of infants who had no siblings fell above the positive cut-off than those with one or two siblings. In addition, a greater percentage of those with three or more siblings fell below the negative cut-off than those with no or one sibling. In contrast, number of siblings had similar distributions across high and low Outcome Index scores in the child cohort, except for children with three or more siblings, where a smaller proportion fell above (11 per cent) and a greater proportion fell below (22 per cent) the positive and negative cut-offs respectively. Similarly, more infants who were the **oldest child** in the family (which indicates they were only children) were above the positive cut-off (18 per cent) and fewer were below the negative cut-off (12 per cent) than those with older siblings, whereas being the oldest child was not related to positive or negative outcomes in the child cohort.

- **Household size**: the number of people in a household is a key element of the child's home environment, but evidence for its impact on child outcomes is mixed. Large households can be noisy and stressful, and may entail less parental contact and support for each individual child, but can also provide the child with more social interaction and social support. In LSAC, the number of people in the household is a count of all the people enumerated in the household grid. Most of these people were parents or siblings, but other relatives and non-related adults and children were also included. A greater proportion of infants in three person households scored above the positive cut-off compared to infants in households with four or more persons,

and a smaller proportion scored below the negative cut-off than those in households of six or more. For the child cohort, non-stepwise trends indicated that medium sized households (3 to 5 persons) may be optimal for children at this age. Fewer children in households of six or more scored above the positive cut-off than those in four person households, and substantially more of those in both two and more than six person households fell below the negative cut-off than those in four and five person households.

- **Overcrowding** has been linked to poorer health and other outcomes, and can make the household more chaotic and stressful (Office of the Deputy Prime Minister 2004; Reynolds 2005). Defining overcrowded households as those with at least twice as many people as bedrooms, just over 3 per cent of the LSAC children in each cohort lived in an overcrowded household (see Table 3). A higher proportion of infants in overcrowded households scored below the negative cut-off (26 per cent compared to 15 per cent, see Figure 3). In the child cohort also there were clear differences between those who did and did not experience overcrowding in the proportions falling above the positive and below the negative cut-offs (positive: 7 per cent versus 14 per cent; negative: 25 per cent versus 16 per cent, see Figures 5 and 6).
- **Combined parental income**: both low income and financial stress have negative and accumulating effects on children's development (Bradbury 2003; eds Keating & Hertzman 1999). Parents were asked what their combined present yearly income was, choosing among 16 categories which were subsequently aggregated for this report into approximate quintiles. In the infant cohort, income was similarly distributed across the high and low outcome cut-offs. However, for the child cohort, 9 per cent of those in the lowest quintile and 20 per cent of those in the highest quintile scored above the positive cut-off, whereas the comparable figures for children below the negative cut-off were 28 per cent and 9 per cent respectively (see Figures 5 and 6).
- **Financial stress**: families were defined as being financially stressed if they indicated that they had experienced four or more of seven different adverse financial situations in the last 12 months (for example, not being able to pay bills, skipping meals to save money), with 6 per cent of both the infant and child cohorts fitting this criterion. Although financial hardship data paralleled the data on income quite closely, the disparities in child cohort outcomes were even more marked for financial stress. Only 4 per cent of those in financially stressed households scored above the positive cut-off, whereas over one-third (36 per cent) were below the negative cut-off. Differences were not evident for the infant cohort.
- **Highest occupational status of parents**: parental occupational status is linked not only to financial security but also to parental psychological capital, and hence can impact on child outcomes. The *Australian Standard Classification of Occupations* (ASCO) (ABS 1997) assigns each occupation a number from 1 to 9, with occupations requiring a greater skill base receiving a higher code; for example, Code 1 refers to managers and administrators, Code 3 includes dental therapists and ambulance officers, Code 5 includes advanced clerical and service workers, and Code 9 includes labourers and related workers. For this report, the highest parental occupation of a household was categorised into one of four groups according to its ASCO Code (1–3, 4–7, 8–9, neither parent employed). Almost half of the LSAC children had one or more parents employed in the highest occupational grouping (ASCO Codes 1–3). Parental occupational status did not appear to differ with outcomes in the infant cohort, but for the child cohort there were marked, stepwise increases in outcome scores as parental occupational status rose. Only 6 per cent of children with neither parent in the workforce were above the positive cut-off, whereas this was true of 19 per cent of children in the highest parent occupational grouping; and almost one-third (31 per cent) of children of non-working parents were below the negative cut-off, compared to 10 per cent of children whose parents were in the highest category (see Figures 5 and 6).

Neighbourhood characteristics

Finally, characteristics of the neighbourhood have been shown to be associated with child outcomes, often indirectly through their impact on family functioning (Brooks-Gunn et al. 1997) and also through differential access to services.

- **Neighbourhood liveability**: the LSAC neighbourhood liveability scale asks respondents to rate their agreement to five statements about the condition of their neighbourhood (for example, cleanliness, availability of parks, quality of street lighting) on a four point Likert scale—from 'strongly agree' to 'strongly disagree'—and

takes the mean of these responses. High liveability neighbourhoods score from 1 to 2.5, while low liveability neighbourhoods score from 2.6 to 4. For both cohorts, more than 85 per cent of children were living in neighbourhoods rated by their parents as highly liveable. Liveability seemed to be weakly related to outcomes in both cohorts. In the infant cohort, 11 per cent of those in low liveability neighbourhoods were above the positive cut-off compared to 16 per cent of those with high liveability. In the child cohort, more children in low liveability neighbourhoods were below the negative cut-off (24 per cent versus 15 per cent) and fewer were above the positive cut-off (10 per cent versus 15 per cent).

- **Metropolitan or non-metropolitan residence**: household location is potentially important for children's development as it may affect access to and choice among medical, educational and other essential and support services, as well as determining their exposure to noise and air pollution. The LSAC non-metropolitan classification refers to the ABS definition of not living in a capital city statistical division. The proportions shown in Table 3 (with approximately one-third living in non-metropolitan areas) are exactly the national proportion for infants and children, reflecting the LSAC weighting process. There were no obvious differences in area of residence across the high and low outcomes for either cohort.

- **Remoteness**: this variable uses the ABS Australian Remoteness Indicator for Area (ARIA) (ABS 2001) linked to the LSAC data file at the postcode level. The ARIA is based on the distance of the location from key services such as food stores and doctors. As the LSAC sample design excluded some very remote postcodes, the numbers of children in very remote areas (2 per cent in each of the two cohorts) may underrepresent the population in these areas. Therefore, these findings may not be readily generalisable and comparisons between these groups and the three 'accessible' groupings need to be interpreted cautiously. Living in an accessible or remote area did not appear to be distributed differently across infants' outcomes, although only 9 per cent of those in very remote areas were above the positive cut-off. For the child cohort, the 'remote' category (as distinct from 'very remote') differed from the highly accessible and accessible groups in the proportion above the positive cut-off (only 4 per cent), but the 'very remote' group had a larger proportion above the positive cut-off and a lower proportion below the negative cut-off (12 per cent) than all other groups except 'accessible'. The highly accessible, accessible and moderately accessible groups did not appear to differ substantially from each other.

- **SEIFA Index of Disadvantage**: the *ABS Socio-Economic Indexes for Areas 2001* (ABS 2003b) provides a general indicator of neighbourhood advantage or disadvantage by combining information on the social and economic conditions of an area based on information collected at the 2001 Census. For LSAC this has been linked to the dataset by postcode rounded off to the nearest 10 (for example, 937 becomes 940) to protect the identity of respondents' postcodes. SEIFA scores were categorised into five groups defined by the quintiles of SEIFA scores of all Australian neighbourhoods, with the 'lowest' group representing the most disadvantaged and the 'highest' the most advantaged. As can be seen from Table 3, both cohorts are relatively evenly spread across the five quintiles. A smaller proportion of infants living in the most disadvantaged 20 per cent of neighbourhoods were above the positive cut-off than those in the second lowest quintile, but differences with other quintiles were not substantial, and there were no observed differences for the negative cut-off. In the child cohort, a general linear trend was observed on the negative cut-off, and substantially more children in the most disadvantaged quintile were below the negative cut-off than children in the middle, fourth and fifth quintiles (24 per cent compared to 2 per cent, 14 per cent and 9 per cent respectively). There was no linear trend for proportions above the positive cut-off, but fewer children in the most disadvantaged quintile were above the positive cut-off than children in the fourth and fifth quintiles (9 per cent compared 19 per cent and 19 per cent respectively, see Figure 6).

The analyses to this point examined relationships between the Outcome Index and each characteristic independently. Such analyses can be misleading since they do not take into account the interrelationships among the characteristics being examined. The next section reports multivariable analyses which, when calculating the effect of any one variable, account for the contribution of every other factor.

Table 3: Sociodemographic characteristics of the infant and child cohorts

Characteristic	Infants		Children	
	n	%	n	%
Study child				
Sex	5,107		4,983	
Male		51.3		51.2
Female		48.7		48.8
Age in weeks (95% CI)		40.7 (40.2, 41.2)		250.2 (249.7, 250.7)
Aboriginal/Torres Strait Islander	5,107	4.9	4,981	3.9
Main language not English	5,104	12.8	4,983	14.0
Mother				
Education	5,098		4,940	
Did not complete high school		41.1		49.1
Completed high school		29.8		26.6
Tertiary		29.1		24.3
Employment status	5,093		4,935	
Working full-time		10.6		19.4
Working part-time		28.2		35.0
Not currently working		61.2		45.6
Family				
Family type	5,107		4,983	
One parent		10.5		15.0
Two parents		89.5		85.0
Number of study child siblings	5,107		4,983	
None		39.1		11.5
One		36.4		47.5
Two		16.4		26.8
Three or more		8.1		14.2
Number of people in household	5,107		4,983	
Two		1.8		2.7
Three		34.5		12.7
Four		34.8		42.5
Five		17.8		26.5
Six or more		11.1		15.6
Study child the oldest or only child in household	5,107	40.8	4,983	41.1
Overcrowded household	5,101	3.4	4,974	3.8
Midpoint of gross combined parental income category in AUD (median [p25, p75])	4,835	$65,000 [$39,000, $91,000]	4,663	$65,000 [$39,000, $91,000]
Income category approximate quintile	4,835		4,663	
Lowest		20.2		19.3
2nd		13.7		12.2
3rd		13.9		12.6
4th		25.9		24.6
Highest		26.2		31.2
Financially stressed household	5,075	6.1	4,948	6.3
Highest occupational class	5,104		4,980	
Neither parent working		13.2		13.2
ASCO 8–9 (Unskilled labour)		7.2		6.7
ASCO 4–7 (Skilled labour & clerical)		31.8		32.9
ASCO 1–3 (Professional)		47.8		47.3

Neighbourhood				
Low neighbourhood liveability score	5,103	14.8	4,976	14.4
Non-metropolitan	5,107	33.5	4,983	36.3
Remoteness area classification	5,049		4,937	
Highly accessible		58.9		55.8
Accessible		22.1		24.2
Moderately accessible		15.2		16.2
Remote		2.1		2.0
Very remote		1.6		1.8
SEIFA Disadvantage Index quintile	5,107		4,983	
Highest disadvantage		18.5		18.5
2nd		21.5		23.7
3rd		20.8		20.2
4th		19.9		19.3
Lowest disadvantage		19.3		18.2

Note: p25=25th percentile, p75=75th percentile.
Due to rounding, percentages may not add to 100 per cent exactly.

Figure 3: Low Outcome Index: percentage of infant cohort by sociodemographic characteristics

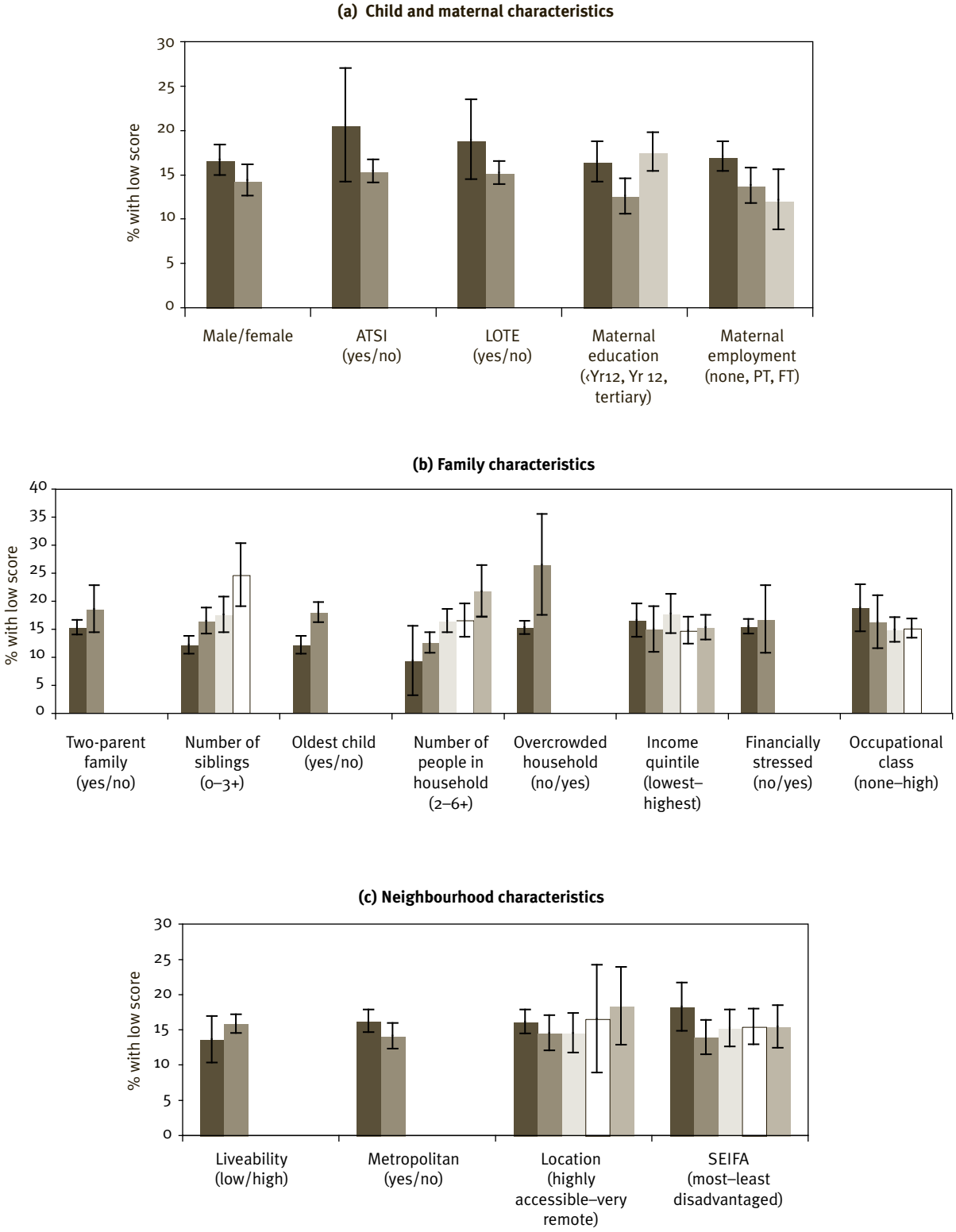


Figure 4: High Outcome Index: percentage of infant cohort by sociodemographic characteristics

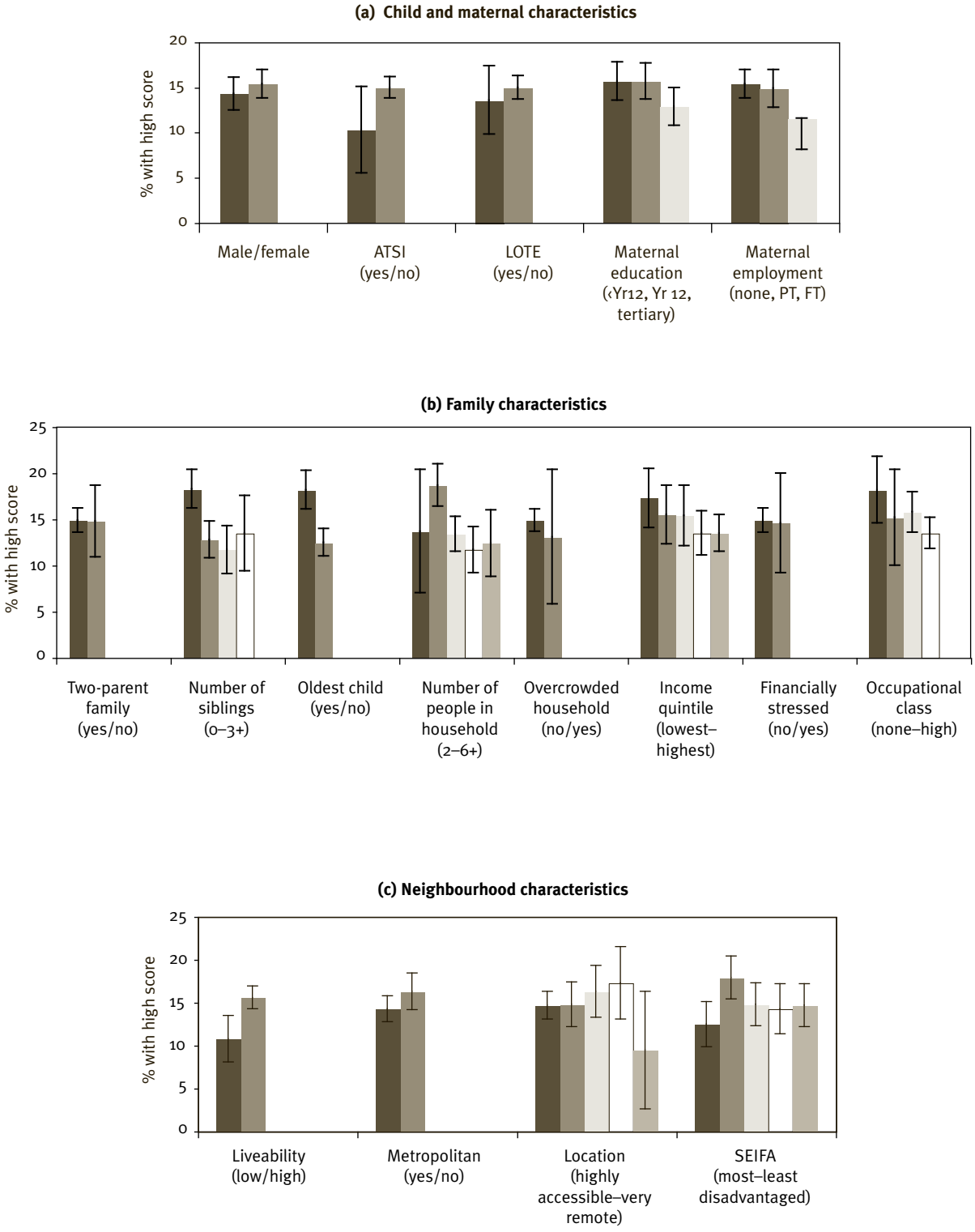


Figure 5: Low Outcome Index: percentage of child cohort by sociodemographic characteristics

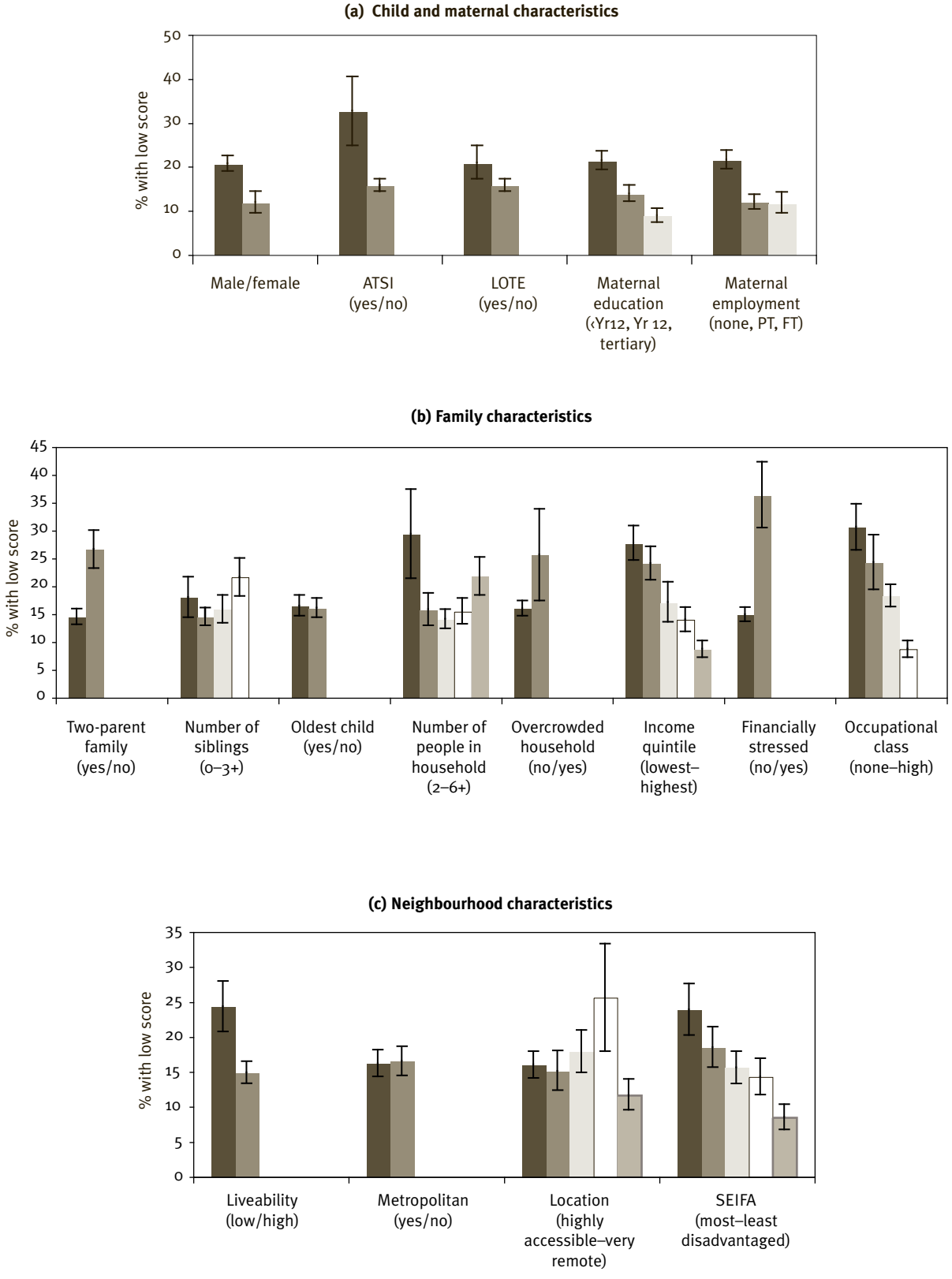
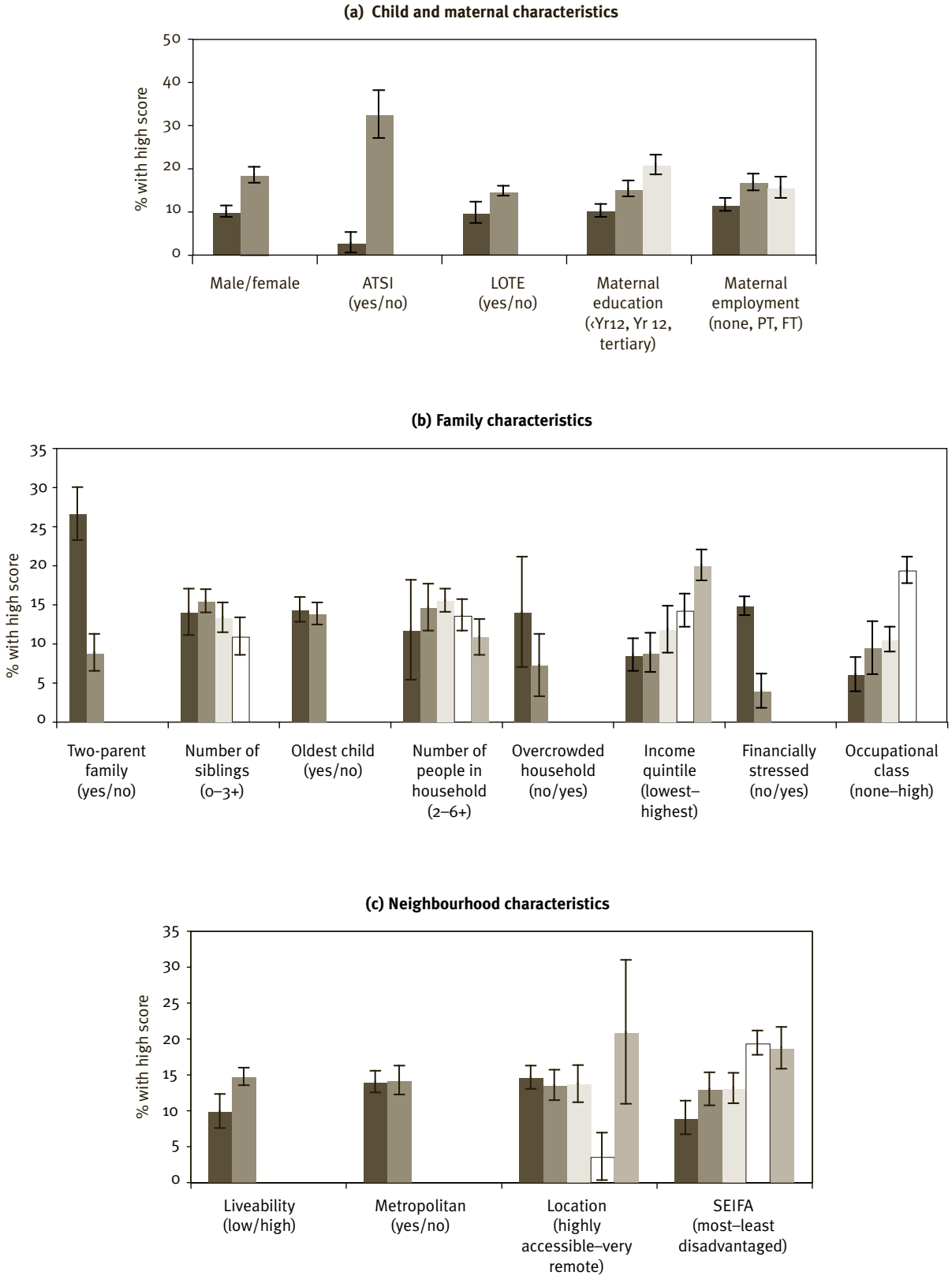


Figure 6: High Outcome Index: percentage of child cohort by sociodemographic characteristics



Impact of sociodemographic variables on outcomes: multivariable analyses

In these analyses, the multivariate associations of sociodemographic characteristics are examined for the overall Outcome Index and each of the three domain scores (physical, social–emotional and learning). In each case these outcome measures are treated as continuous with a mean of 100 and a standard deviation of 10.

Nine of the characteristics examined above were chosen for entry into this analysis. Criteria for selection included the strength of their theoretical contribution to children's outcomes, lack of redundancy with other measures, and representation of all four tiers of influence (child, mother, family and neighbourhood). All three child variables (gender, ATSI status and speaking a language other than English) were included. Maternal education was retained, but maternal employment was excluded because of its overlap with the 'no parent employed' category of the ASCO codes. Family type, family income, financial stress and parental occupational status were retained, but measures of family size (number of siblings, child is oldest sibling, number of people in household) were excluded due to lack of a clear theoretical rationale as well as lack of evidence in the bivariate analyses of strong relationships with child outcomes. Overcrowding was excluded because it was uncommon in the LSAC cohorts and, even when present, showed rather weak relationships to outcomes. SEIFA quintile was chosen as the most comprehensive and accurate measure of neighbourhood advantage or disadvantage; the subjective measure of liveability was excluded, as were metropolitan/non-metropolitan location and the remoteness indicator. The retained measures thus tapped key child, parent, family, and neighbourhood characteristics.

Table 4 shows the results of the multivariable analyses predicting the overall Outcome Index scores for each cohort. Tables 5 to 7 present comparable analyses for the physical, social–emotional and learning domains respectively. The results for the infant cohort are described first, followed by the child cohort.

Infant cohort

The left-hand parts of Tables 4 to 7 show that the nine variables which were entered into the analysis accounted for minimal amounts of variation in all four of the outcome measures examined here (1.4 per cent, 1.3 per cent, 1.8 per cent and 1.6 per cent respectively). Seven of the variables were associated, at least weakly, with at least one of these outcomes, as described below.

Child characteristics

- **Gender** was weakly associated with the overall Outcome Index ($p=0.03$) and learning domain ($p=0.05$), and more strongly with physical domain ($p<0.001$), in favour of girls, but differences were quantitatively very modest (1 point or less).
- Being an **Aboriginal or Torres Strait Islander** was associated only with physical domain scores ($p=0.008$), with a 2-point disadvantage for these infants in comparison to the rest of the cohort.
- Speaking a **language other than English** at home was associated only with social–emotional outcomes ($p=0.002$), with an average difference of 2 points.

Maternal, family and neighbourhood characteristics

- **Maternal education** was strongly associated with overall Outcome Index ($p<0.001$) and social–emotional domain ($p=0.003$) scores, but there was no linear trend (those whose mothers had not completed Year 12 had slightly lower outcomes than those whose mothers had completed school, but higher than those with tertiary education).
- **Highest occupational status of parents** showed a weak inverse relationship with infant learning, with highest scores for infants of non-working parents and lowest scores for those in the 'professional' category ($p=0.07$).
- **Financial stress** only showed a weak trend ($p=0.09$) towards an association with the social–emotional domain, where scores averaged 1.5 points lower than for infants from non-stressed families.

- **SEIFA Index of Disadvantage**: compared to being in the most disadvantaged SEIFA quintile, infants in the second lowest quintile scored an average of 2 points higher on the overall Outcome Index. Surprisingly, infants in the second most disadvantaged SEIFA quintile had overall Outcome (p=0.02) and social–emotional domain (p‹0.001) scores on average two points higher than those in the most disadvantaged quintile. On the overall Outcome Index, those in the fourth quintile scored 1.3 points higher than the most disadvantaged group. Differences with the reference category were small for the other quintiles.

Child cohort

The results for the child cohort are shown in the right hand columns of Tables 4 to 7, and show that the variables in the models generally accounted for substantially more variance than in the infant cohort—14.6 per cent for the overall Index, 11.5 per cent for the social–emotional domain, and 13.5 per cent for the learning domain, but notably only 2.1 per cent for the physical domain. All variables except family type contributed to the prediction of at least one of these scores, as described below:

Child characteristics

- **Gender**: girls were on average 3 points higher on the Outcome Index score (p‹0.001), 2.5 points higher on social–emotional scores (p‹0.001) and 4.4 points higher on learning scores than boys (p‹0.001), but with a difference of less than one point on the physical domain scale (p=0.001).
- **Aboriginal or Torres Strait Islander** children were on average 2.8 points lower on the overall Outcome Index (p‹0.001), 3.3 points lower on the social–emotional domain (p‹0.001), and 1.5 points lower on the learning domain (p=0.05).
- Speaking a **language other than English** at home was associated with an average decrease of 2.5 points on the Outcome Index (p‹0.001), 2 points on both the physical (p=0.001) and social–emotional domains (p‹0.001), and 1.4 points on the learning domain (p=0.004).

Maternal, family and neighbourhood characteristics

- **Maternal education**: children whose mothers had higher education had higher Outcome Index scores (p‹0.001)—in comparison to those whose mothers did not complete Year 12, those whose mothers did complete Year 12 were 1.7 points higher, and those whose mothers had a tertiary qualification were 2.4 points higher, on average. Similar differences were observed for the social–emotional (p‹0.001) and learning (p‹0.001) domains, while differences were less marked on the physical domain (p=0.04).
- **Occupational status of parents** contributed to the model for the overall Outcome Index (p‹0.001)—if the highest parental occupation was skilled labour or clerical, children scored on average 2.1 points higher than children with neither parent working; and where the highest occupation was professional, this difference was 3.7 points. It was quite strongly associated with learning scores (p‹0.001), with an average difference of 4.2 points between ‘neither parent working’ and ‘professional’ groups, and also with higher social–emotional scores (p‹0.001), with an average difference of 3.3 points, but not with physical outcomes.
- **Combined parental income**: there was strong evidence to suggest that income was associated with overall Outcome Index and social–emotional domain scores (both p‹0.001), with the contrast between the lowest and highest quintiles being most substantial (about 2 points). It was not associated with physical or learning domains.
- **Financial stress** made a substantial contribution to the models, with those classified as stressed scoring on average about 4 points lower on the Outcome Index and social–emotional domain (both p‹0.001), and about 2 points lower on the physical (p=0.002) and learning (p‹0.001) domains.
- **SEIFA Index of Disadvantage**: there were no strong associations with neighbourhood disadvantage, but trends for both social–emotional (p=0.06) and learning (p=0.07) domain scores to be higher as neighbourhood advantage increased.

Box 2: Interpretation of multivariable analyses

A multivariable analysis investigates associations between an outcome, for example, the overall Outcome Index, and characteristics of interest, for example, sex and mother's education, using statistical methods that allow the effect of a particular characteristic upon the outcome to be estimated while controlling for the effect of each of the other characteristics in the same analysis. This simultaneous investigation of multiple associations is referred to as a multivariable model.

For each category of the characteristic of interest, a value with a 95 per cent confidence interval (CI) is provided, representing the mean difference in outcome between the relevant category and a reference category for that characteristic. For characteristics with three or more levels, this reference category is briefly listed in the left-most column of the table as each characteristic is introduced; otherwise it is implicit.

For example, if the level of the characteristic of interest is female, then the reference category will be male. The magnitude of the value reflects the strength of the association after adjusting for the other characteristics.

For example in Table 4, the value for the characteristic 'study child is female' for the child cohort is 3.6, with a 95 per cent CI of (3.1, 4.2). This indicates that on average we would expect female Australian children of this age to score 3.6 points higher on the overall Outcome Index than male Australian children of this age. We are 95 per cent confident that the true difference in the population could plausibly be as low as 3.1 points or as high as 4.2 points.

Interpretation of confidence intervals

The value that you calculate from a sample, for example a mean or an odds ratio is unlikely to be exactly equal to the population value. The difference will depend on the size and variability of the sample. Statistical calculations use sample size and variability to calculate a CI that represents a range of plausible values around the estimate of the population value. If 100 random samples were drawn from the same underlying population and a 95 per cent CI were constructed for each sample, we would expect 95 of these 100 confidence intervals to contain the true population value that we are estimating. A wide CI indicates low precision of the estimate, whereas a narrow CI indicates high precision.

Interpretation of p-values

When investigating associations and differences using the sample of data under investigation, a p-value helps decide if the result you have found is more likely to reflect a true association or difference, or could just reflect chance variation in the context of the 'null hypothesis' of no true association or difference. It does this by using statistical calculations to answer the question 'What is the probability of obtaining results as extreme or more extreme than these if there is in fact no association/difference'. A p-value is a probability taking values between zero and one. The lower the p-value, the less likely it is that the result you found occurred purely by chance. In the multivariable analyses, **overall p-values** are provided for each characteristic of interest, and are interpreted in the text of each section. These provide information about the overall association of each characteristic with the outcome, after controlling for all other factors in the analysis. In the example of gender above, the p-value is less than 0.001, indicating that these results are very unlikely to be due to chance variation in the data.

Category versus baseline p-values are also presented **within** each characteristic. These represent evidence that the true difference between that category and the baseline category is not zero. These p-values must be interpreted with great caution. They are difficult to interpret when the categories are ordered, and a steadily increasing (or decreasing) difference from baseline is the likely pattern of any effects, because it is misleading to consider these tests in isolation from each other. Nor should these p-values be used to draw conclusions about the effect 'becoming significant' at a particular category but not at lower categories, since the point at which this occurs is determined by the sample size, if the true effect is a smooth trend across all categories. On the other hand, if the pattern of effects is not generally linear across categories, important differences between non-baseline categories may be obscured by focusing only on the category versus baseline comparisons.

Interpretation of the R^2 statistic

The R^2 statistic indicates the percentage of the variability in the outcome, for example, the overall Outcome Index score or domain score that can be explained by the characteristics in the model. All R^2 statistics must lie between the value of 0 per cent (indicating that the set of predictor variables explains none of the variability in the sample) and 100 per cent (indicating that the set of predictor variables explains all of the variability in the sample). For example, the R^2 statistic for the multivariable analysis presented in Table 4 indicates that the nine sociodemographic variables, as a whole, account for 14.6 per cent of the variability in overall Outcome Index scores within the child cohort.

Table 4: Multivariable relationships between sociodemographic variables and the overall Outcome Index for the infant and child cohorts

	Infants n=3,591 R^2=1.4%		Children n=4,592 R^2=14.6%	
Characteristic[a]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]
Study child				
Female	0.7 (0.1, 1.4)	**0.03**	3.6 (3.1, 4.2)	**‹0.001**
Aboriginal/Torres Strait Islander	–1.9 (–3.9, 0.1)	**0.07**	–2.8 (–4.4, –1.3)	**‹0.001**
Main language not English	–0.9 (–2.3, 0.6)	**0.23**	–2.5 (–3.5, –1.6)	**‹0.001**
Mother				
Education		**‹0.001**		**‹0.001**
Did not complete high school	0 (–,–)		0 (–,–)	
Completed high school	0.8 (–0.1, 1.7)	0.09	1.7 (0.9, 2.4)	‹0.001
Tertiary	–1.0 (–2.0, 0.0)	0.05	2.4 (1.7, 3.1)	‹0.001
Family				
2 parents in the home	0.9 (–1.1, 2.9)	**0.37**	–0.2 (–1.4, 1.0)	**0.71**
Combined parental income quintile		**0.57**		**‹0.001**
Lowest	0 (–,–)		0 (–,–)	
2nd	–0.5 (–2.1, 1.1)	0.55	–0.4 (–1.5, 0.7)	0.50
3rd	–1.2 (–2.7, 0.2)	0.10	0.2 (–1.2, 1.5)	0.78
4th	–0.8 (–2.2, 0.6)	0.28	0.8 (–0.4, 2.0)	0.20
Highest	–0.6 (–2.0, 0.8)	0.41	2.0 (0.8, 3.2)	0.001
Financially stressed household	–1.0 (–2.9, 0.9)	**0.30**	–4.1 (–5.5, –2.7)	**‹0.001**
Highest occupational class		**0.79**		**‹0.001**
Neither parent working	0 (–,–)		0 (–,–)	
ASCO 8–9 (Unskilled labour)	–0.8 (–3.0, 1.4)	0.48	1.3 (-0.4, 3.0)	0.12
ASCO 4–7 (Skilled labour & clerical)	–0.3 (–2.2, 1.7)	0.77	2.1 (0.7, 3.6)	0.005
ASCO 1–3 (Professional)	–0.6 (–2.6, 1.3)	0.55	3.7 (2.2, 5.2)	‹0.001
Neighbourhood				
SEIFA Disadvantage Index quintile		**0.02**		**0.09**
Highest disadvantage	0 (–,–)		0 (–,–)	
2nd	2.0 (0.8, 3.1)	0.001	0.8 (–0.3, 2.0)	0.15
3rd	1.1 (–0.1, 2.3)	0.06	0.9 (–0.1, 1.9)	0.06
4th	1.3 (0.1, 2.5)	0.03	1.3 (0.1, 2.4)	0.03
Lowest disadvantage	1.2 (–0.2, 2.6)	0.09	1.5 (0.4, 2.6)	0.007

(a) The reference category for each characteristic is italicised.

(b) The **overall p-value** represents evidence against the null hypothesis of no differences between groups (see text). Caution is urged when interpreting individual **category versus baseline p-values** (see Box 2: Interpretation of multivariable analyses).

Table 5: Multivariable relationships between sociodemographic variables and the physical domain score for the infant and child cohorts

	Infants n=4,800 R^2=1.3%		Children n=4,599 R^2=2.1%	
Characteristic[a]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]
Study child				
Female	1.2 (0.6, 1.7)	**‹0.001**	0.9 (0.4, 1.5)	**0.001**
Aboriginal/Torres Strait Islander	–2.2 (–3.8, –0.6)	**0.008**	–1.2 (–3.0, 0.6)	**0.18**
Main language not English	–1.1 (–2.2, 0.1)	**0.08**	–2.0 (–3.1, –0.8)	**0.001**
Mother				
Education		**0.61**		**0.04**
Did not complete high school	0 (–,–)		0 (–,–)	
Completed high school	0.1 (–0.6, 0.8)	0.70	0.9 (0.1, 1.7)	0.03
Tertiary	–0.2 (–1.1, 0.6)	0.60	0.1 (–0.7, 0.9)	0.82
Family				
Two parents in the home	0.3 (–1.2, 1.9)	**0.69**	0.1 (–1.1, 1.3)	**0.88**
Combined parental income quintile		**0.88**		**0.07**
Lowest	0 (–,–)		0 (–,–)	
2nd	–0.3 (–1.7, 1.0)	0.62	–0.4 (–1.8, 0.9)	0.55
3rd	–0.5 (–1.9, 0.9)	0.46	0.3 (–1.1, 1.7)	0.65
4th	–0.4 (–1.6, 0.8)	0.48	0.4 (–0.9, 1.7)	0.51
Highest	–0.1 (–1.5, 1.2)	0.84	1.2 (–0.1, 2.5)	0.07
Financially stressed household	–1.1 (–2.6, 0.4)	**0.15**	–2.5 (–4.1, –0.9)	**0.002**
Highest occupational class		**0.22**		**0.97**
Neither parent working	0 (–,–)		0 (–,–)	
ASCO 8–9 (Unskilled labour)	–0.7 (–2.3, 1.0)	0.43	–0.2 (–1.9, 1.6)	0.86
ASCO 4–7 (Skilled labour & clerical)	0.6 (–0.9, 2.1)	0.43	0.2 (–1.2, 1.6)	0.79
ASCO 1–3 (Professional)	0.7 (–0.8, 2.2)	0.37	0.2 (–1.3, 1.7)	0.82
Neighbourhood				
SEIFA Disadvantage Index quintile		**0.26**		**0.51**
Highest disadvantage	0 (–,–)		0 (–,–)	
2nd	0.5 (–0.5, 1.4)	0.31	0.8 (–0.3, 1.8)	0.17
3rd	1.1 (0.1, 2.1)	0.03	0.0 (–1.0, 1.0)	1.0
4th	0.8 (–0.2, 1.8)	0.14	0.6 (–0.5, 1.7)	0.27
Lowest disadvantage	0.7 (–0.4, 1.8)	0.19	0.3 (–0.9, 1.4)	0.62

(a) The reference category for each characteristic is italicised.

(b) The **overall p-value** represents evidence against the null hypothesis of no differences between groups (see text). Caution is urged when interpreting individual **category versus baseline p-values** (see Box 2: Interpretation of multivariable analyses).

Table 6: Multivariable relationships between sociodemographic variables and the social–emotional domain score for the infant and child cohorts

	Infants n=4,091 R^2=1.8%		Children n=4,592 R^2=11.5%	
Characteristic[a]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]
Study child				
Female	0.1 (–0.5, 0.7)	**0.80**	2.5 (1.8, 3.1)	**‹0.001**
Aboriginal/Torres Strait Islander	–0.8 (–2.6, 1.0)	**0.37**	–3.3 (–4.9, –1.7)	**‹0.001**
Main language not English	–2.2 (–3.5, –0.8)	**0.002**	–2.1 (–3.2, –1.0)	**‹0.001**
Mother				
Education		**0.003**		**‹0.001**
Did not complete high school	0 (–,–)		0 (–,–)	
Completed high school	0.3 (–0.6, 1.1)	0.51	1.2 (0.4, 1.9)	0.001
Tertiary	–1.1 (–2.0, –0.2)	0.01	1.7 (1.0, 2.5)	‹0.001
Family				
2 parents in the home	0.5 (–1.2, 2.1)	**0.58**	–0.1 (–1.4, 1.1)	**0.82**
Combined parental income quintile		**0.24**		**‹0.001**
Lowest	0 (–,–)		0 (–,–)	
2nd	–0.3 (–1.7, 1.1)	0.67	0.1 (–1.2, 1.3)	0.92
3rd	–0.3 (–1.7, 1.1)	0.68	0.4 (–0.9, 1.8)	0.53
4th	0.2 (–1.9, 1.5)	0.71	1.1 (–0.1, 2.4)	0.08
Highest	0.8 (–0.5, 2.1)	0.22	2.3 (1.1, 3.5)	‹0.001
Financially stressed household	–1.5 (–3.2, 0.3)	**0.09**	–3.9 (–5.4, –2.3)	**‹0.001**
Highest occupational class		**0.91**		**‹0.001**
Neither parent working	0 (–,–)		0 (–,–)	
ASCO 8–9 (Unskilled labour)	0.2 (–1.8, 2.2)	0.84	1.2 (–0.5, 2.9)	0.16
ASCO 4–7 (Skilled labour & clerical)	0.1 (–1.7, 1.8)	0.94	1.7 (0.3, 3.2)	0.020
ASCO 1–3 (Professional)	0.3 (–1.4, 2.1)	0.70	3.3 (1.8, 4.9)	‹0.001
Neighbourhood				
SEIFA Disadvantage Index quintile		**0.001**		**0.06**
Highest disadvantage	0 (–,–)		0 (–,–)	
2nd	2.1 (1.0, 3.3)	‹0.001	0.8 (–0.3, 1.9)	0.17
3rd	0.4 (–0.7, 1.5)	0.49	1.2 (0.2, 2.2)	0.02
4th	0.6 (–0.6, 1.8)	0.33	1.6 (0.4, 2.7)	0.006
Lowest disadvantage	0.5 (–0.8, 1.7)	0.44	1.4 (0.2, 2.7)	0.02

(a) The reference category for each characteristic is italicised.

(b) The **overall p-value** represents evidence against the null hypothesis of no differences between groups (see text). Caution is urged when interpreting individual **category versus baseline p-values** (see Box 2: Interpretation of multivariable analyses).

Table 7: Multivariable relationships between sociodemographic variables and the learning domain score for the infant and child cohorts

	Infants n=4,211 R^2=1.6%		Children n=4,599 R^2=13.5%	
Characteristic[a]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]
Study child				
Female	0.6 (0.0, 1.2)	**0.05**	4.4 (3.8, 4.9)	**‹0.001**
Aboriginal/Torres Strait Islander	–0.2 (–1.8, 1.4)	**0.83**	–1.5 (-3.1, 0.0)	**0.05**
Main language not English	1.0 (0.0, 2.1)	**0.05**	–1.4 (–2.3, –0.4)	**0.004**
Mother				
Education		**0.18**		**‹0.001**
Did not complete high school	0 (–,–)		0 (–,–)	
Completed high school	0.4 (-0.5, 1.2)	0.40	1.5 (0.9, 2.2)	‹0.001
Tertiary	–0.4 (–1.3, 0.5)	0.41	3.2 (2.4, 4.0)	‹0.001
Family				
2 parents in the home	0.6 (–0.9, 2.2)	**0.43**	–0.5 (–1.8, 0.8)	**0.46**
Combined parental income quintile		**0.11**		**0.21**
Lowest	0 (–,–)		0 (–,–)	
2nd	0.1 (–1.3, 1.5)	0.90	–0.5 (–1.6, 0.7)	0.41
3rd	–0.8 (–2.2, 0.6)	0.24	–0.3 (–1.6, 0.7)	0.62
4th	–0.9 (–2.2, 0.3)	0.15	0.2 (–1.0, 1.5)	0.70
Highest	–1.3 (–2.5, –0.1)	0.04	0.7 (–0.5, 2.0)	0.26
Financially stressed household	0.8 (–0.6, 2.3)	**0.27**	–2.3 (-3.6, -1.1)	**‹0.001**
Highest occupational class		**0.07**		**‹0.001**
Neither parent working	0 (–,–)		0 (–,–)	
ASCO 8–9 (Unskilled labour)	–1.2 (–3.1, 0.8)	0.23	1.8 (–0.1, 3.6)	0.06
ASCO 4–7 (Skilled labour & clerical)	–1.9 (–3.4, –0.3)	0.02	2.5 (1.1, 3.9)	0.001
ASCO 1–3 (Professional)	–2.3 (–4.1, –0.5)	0.01	4.2 (2.7, 5.8)	‹0.001
Neighbourhood				
SEIFA Disadvantage Index quintile		**0.85**		**0.07**
Highest disadvantage	0 (–,–)		0 (–,–)	
2nd	0.5 (–0.8, 1.8)	0.48	0.2 (–0.9, 1.4)	0.68
3rd	0.3 (–0.9, 1.5)	0.57	0.8 (–0.3, 2.0)	0.16
4th	0.5 (–0.8, 1.7)	0.45	0.5 (–0.6, 1.6)	0.40
Lowest disadvantage	0.7 (–0.6, 2.0)	0.26	1.4 (0.3, 2.4)	0.01

(a) The reference category for each characteristic is italicised.

(b) The **overall p-value** represents evidence against the null hypothesis of no differences between groups (see text). Caution is urged when interpreting individual **category versus baseline p-values** (see Box 2: Interpretation of multivariable analyses).

2.3 Discussion

Overall, the picture painted by these data is that broad characteristics of the child, mother, and family context are quite powerfully related to 4 to 5 year-old children's development as reflected in the Outcome Index. This pattern of results for the child cohort provides some support for an ecological model of child development in which the child's own attributes, along with their family and community context, exert influence on developmental trajectories (Bronfenbrenner 1979).

In contrast, these analyses suggest only minor impacts of child, family and neighbourhood characteristics on infants' outcomes. The measures of outcomes were weaker in the infant than the child cohort, so the pattern of findings may partially reflect the lower sensitivity of the Outcome Index in this cohort. It may also reflect the fact that the impact of contextual factors on children's development is a cumulative process which occurs over time. Early measures of 'outcomes' may largely reflect infants' biological predispositions, with the cumulative influences of external factors (such as disadvantage) yet to develop over time; for infants, less time has elapsed for these to impact on development. Future waves of LSAC will enable testing of this hypothesis.

- **Gender differences** were small among infants, but marked for 4 to 5 year-old children except in the physical domain. The fact that girls develop faster than boys in early childhood, especially in language and the social–emotional domain, is well established in previous research (for example, Ruble & Martin 1998). This is thought to reflect principally biological dispositions, although differential parenting practices and expectations for boys and girls also appear to have some influence (Prior et al. 1993). These latter factors may be in part responsible for the greater gender difference in outcomes in the child, as compared to infant, cohort. We can expect that overall differences will lessen as the LSAC children move towards adolescence, but with continuing male vulnerability to difficulties such as learning problems and 'acting-out' behavioural disorders (Prior et al. 2000). While such gender differences are well established in previous research, they may need more recognition in policy and service provision contexts.
- **Aboriginal and Torres Strait Islander** children were lower on average on all Outcome Index measures except the physical domain, with marked differences in the proportions above and below the 15 per cent cut-offs. This contrasts with the general lack of evidence of a difference for the infant cohort (who were lower only on the physical domain). The data suggest that factors in the children's family and neighbourhood child-rearing environment may be responsible for a decline in functioning over time (Zubrick et al. 2004).
- Children who spoke a **language other than English** were lower on average on all Outcome Index measures, while there was little evidence of a difference for infants. The slightly lower learning domain scores might reflect the fact that the PPVT and Who Am I? tests were administered in English, in which case scores would be expected to improve in subsequent waves as mastery of English develops in the school setting. However, this would not explain the lower social–emotional or physical domain scores, which might reflect reduced opportunities for the child to interact with other children, or other aspects of the circumstances of families who have a non–English speaking background.
- Children whose **mothers had more education** were higher on average on all Outcome Index measures, whereas there were no observed trends for infants. **Parental occupational status** was a clear predictor of social–emotional and learning outcomes. Both **income** and **financial stress** made independent contributions to the prediction of child outcomes, with financial stress having the stronger impact. All these variables reflect the family psychological and material capital available to the child, and suggest that by 4 to 5 years of age these each make independent contributions to the child's overall development, creating socioeconomic gradients whose impact is likely to be carried forward through the child's school life and beyond.
- **Family type** (one or two parents), while associated with more negative and fewer positive Outcome Index scores in the bivariate analyses, failed to contribute to the multivariable models. This suggests that its influence is mediated through family variables which may be associated with family type, such as income, financial stress and occupational status, as well as other factors such as social support and parent–child relationships (Sanson & Lewis 2001; Wise 2003). Future waves of LSAC will enable examination of the dynamic impact of family structure and family transitions (see also Zubrick et al. 2008).

- Bivariate analyses of **family size** indicators suggested that infant outcomes were better the smaller the family, and in the absence of **overcrowding**. Neighbourhood **liveability** also showed some association with infant outcomes. Moderate sized families appeared optimal for those in the child cohort. Effects were relatively small and often non-linear, which may explain inconsistent findings from previous research. It is likely that these effects are moderated by family factors, a hypothesis which could be examined in further research.
- **Neighbourhood disadvantage**, as indexed by SEIFA, showed only weak associations with infant outcomes, perhaps reflecting differential access to services and/or support for infants and their families in more disadvantaged areas; this hypothesis could be examined in further analyses of the Wave 1 dataset. While there were some bivariate relationships with SEIFA quintiles, they did not predict child outcomes in the multivariable analyses for the child cohort. This may reflect the fact that at 4 to 5 years, the most salient environmental influence on the child is still the family, and that neighbourhood effects are mediated through family factors. In later waves we may see these neighbourhood factors having a more direct impact on the child.

In summary, these analyses indicate that the set of sociodemographic factors examined here have little impact on infants but explain substantial variability in the child cohort. Child, family and neighbourhood factors are all associated with outcomes, supporting an ecological model of child development and the need for multifaceted approaches to supporting families of young children. While we cannot draw causal implications from the findings, they indicate that the set of variables included in the multivariable analysis are important to include as 'control' variables when examining the impact of more fine-grained aspects of the child cohort's experiences and exposures, such as prenatal and postnatal health exposures, child care experiences and educational stimulation in the home. Hence, analyses in subsequent sections control for these variables. Despite the fact that they account for a very modest amount of variance in the infant cohort, for the sake of consistency they are used as covariates in analyses for this cohort also.

3 Children's use of non-parental care

Section summary

Non-parental care is a common experience for Australian children, with one-third of infants experiencing regular formal and/or informal child care and 95 per cent of 4 to 5 year olds spending significant amounts of time in centre-based child care or early education settings. Child care/early education predictors of broad based outcomes for infants and children, after adjusting for relevant child and family demographic characteristics, were:

- Physical outcomes were poorer for infants in large group care settings, likely due to increased exposure to contagious illnesses.
- Group care was unrelated to physical outcomes at 4 to 5 years of age.
- Learning outcomes were best for children in the most educationally oriented (that is, pre-Year 1) programs.
- Child and family characteristics, particularly those related to family socioeconomic status, were stronger predictors than child care of any infant and child outcomes.

3.1 Introduction

The experience of non-parental care and its impact on children's development has been a focus of much international research over the past 20 years. With the increased participation of mothers of young children in the workforce, more and more children are experiencing non-parental care in the first few years of life and the potential impact of this care has raised both important developmental and social policy questions. The results of research to date on non-parental care have revealed a range of positive and negative findings that highlight the importance of considering the specific context in which care is provided for understanding the nature of care and its effects on children. For example, regulations governing the delivery of care which have important effects on care quality, like the minimum number of staff required to care for children of different ages, vary considerably between countries and make it difficult to generalise findings across regulatory contexts (Love et al. 2003). Data on non-parental care were included as a focus of the LSAC study for this reason.

This section begins with an overview of the characteristics of care experienced by LSAC infants and 4 to 5 year-old children and a description of how this care varies with the range of family demographic factors described in Section 2. We look specifically at four characteristics of care: type of care arrangement, number of different regular care arrangements per week, amount of time in care per week, and age of first entry into care. We then present data on the relationship between children's experience of care and their developmental competence as assessed by the LSAC Outcome Index, using regression analyses that evaluate the contribution of care, independent of key child and family characteristics. For the purpose of this report, the term non-parental care is used to refer to the range of formal centre and home-based child care settings typically provided for infants and toddlers, as well as the various informal, unregulated arrangements that include, for example, care by grandparents, friends, and nannies, but exclude care by non-resident parents. During the preschool years, formal care also includes the range of prior-to-school programs (for example, preschools) that can include a focus on the teaching of early literacy and numeracy skills. A sizeable proportion of the LSAC children (16.5 per cent) were in a pre-Year 1 school setting (for example, kindergarten, transition) at the time of the Wave 1 data collection. (The proportion of children reported as attending pre-Year 1 programs in Harrison and Ungerer (2005) was smaller (13.5 per cent), since their analyses included only children attending full-time. Also, some children were later reclassified when information on program type from teachers as well as parents was considered). These children were included in all the analyses for two reasons. First, the distinction between pre-Year 1 and preschool programs is not always clear cut, since some children attend a pre-Year 1 program part-time, and some preschool programs have strong educational components. Second, the performance of children in pre-Year 1 programs,

particularly in the learning domain, provides an important benchmark for evaluating the performance of children in other formal and informal care arrangements.

3.2 Findings

The non-parental care variables

Infant cohort

- **Type of care arrangement**: at the time of entering the study, about one-third (35 per cent) of the 5,107 LSAC infants were experiencing some form of regular non-parental care each week (see Table 8). For the majority of these infants (21 per cent) this involved care in unregulated, informal settings, typically with a grandparent. For the 11 per cent of infants in regulated, formal care settings, most (8 per cent) were cared for in long day care centres only, while the remainder were in family day care only or in a combination of either different formal, or formal and informal, arrangements.
- **Number of arrangements**: most infants in care had only a single non-parental care arrangement each week, although 8 per cent experienced two or more arrangements on a regular basis.
- **Amount of time in care**: while the majority of infants were spending less than 20 hours per week in care, infants in formal care settings were spending on average about twice as long in care as those in informal care settings only (median value 18 hours to nine hours, respectively; see Table 9). This suggests that parents who need more child care (due to longer working hours, for example) may choose to use formal care arrangements rather than relying on informal carers like grandparents.
- **Age of first entry into care**: about two-thirds of the infants in care had started their first care arrangement before they were 6 months of age (‹26 weeks), and 90 per cent were in care before 9 months of age.

Percentages of the infant cohort who were or were not in some form of non-parental care are presented in Table 10 according to child and family demographic characteristics. Fewer infants were in care if they were of Aboriginal or Torres Strait Islander origin, if their mothers had not completed high school, or if the main language spoken at home was a language other than English. In contrast, more infants were in care if they were from the most economically advantaged families, that is, families with the highest incomes, the highest SEIFA indices, the highest occupational class ratings, and those who were not financially stressed.

Table 8: Non-parental care characteristics for the infant cohort

Characteristic	n	Value
Time in non-parental care each week (%)	5,106	
None		65.1
1–20 hours		24.1
More than 20 hours		10.8
Number of hours in non-parental care each week—child is in care (median, [p25, p75])	1,820	15 [6, 24]
Number of regular non-parental care arrangements each week (%)	5,106	
None		65.0
One		26.8
Two or more		8.1
Age of entry into non-parental care (%)	1,939	
0–13 weeks		34.0
14–26 weeks		33.7
27–39 weeks		22.8
40 weeks or older		9.5
Age of entry into non-parental care in weeks—child is in care (median, [p25, p75])	1,939	22 [13, 30]
Type of non-parental care arrangements experienced by child each week (%)	5,107	
Formal care only		10.6
Long day care only		7.8
Family day care only		2.6
Long day care plus family day care		0.3
Informal care only		20.8
Grandparent only/grandparent and other informal care		15.4
Other informal (no grandparent care)		5.4
Mixed formal and informal care		3.5
Formal care plus grandparent care		2.5
Formal care plus other informal care		1.0
No care arrangements		65.1

Note: p25=25th percentile, p75=75th percentile.
Due to rounding, percentages may not add to 100 per cent (or subtotals) exactly.

Table 9: Hours spent in care by care arrangement for the infant cohort

Care arrangement	Hours spent in care: median [p25, p75]
Formal care only	18 [10, 28]
Long day care only	18 [9, 28]
Family day care only	19 [12, 29.5]
Long day care plus family day care	20 [16, 32]
Informal care only	9 [4, 20]
Grandparent only/grandparent and other informal care	9 [5, 18]
Other informal (no grandparent care)	8 [3, 20]
Mixed formal and informal care	23 [16, 32]
Formal care plus grandparent care	24 [17, 30]
Formal care plus other informal care	22 [15, 34]
No care arrangements	0 [0, 0]

Note: p25=25th percentile, p75=75th percentile.

Table 10: Care arrangements by sociodemographic variables for infant cohort (per cent)

Care category[(a)]	Formal care arrangements	Informal care arrangements	Mixed formal and informal care arrangements	No care arrangements
Sex				
Male	10.6	21.0	3.4	64.9
Female	10.7	20.5	3.6	65.3
Study child—Aboriginal/Torres Strait Islander				
No	10.8	21.0	3.6	64.7
Yes	8.2	15.8	2.3	73.8
Maternal education				
Did not complete high school	9.0	16.7	2.1	72.2
Completed high school	9.8	21.0	4.1	65.2
Tertiary	13.8	26.2	4.8	55.2
Family type				
One parent	10.2	17.9	3.8	68.1
Two parents	10.7	21.1	3.5	64.7
Main language spoken at home				
English	11.4	20.5	3.9	64.2
Not English	5.6	22.2	0.9	71.3
Combined parental income quintile				
Lowest	6.5	17.1	1.5	74.8
2nd	8.3	15.0	2.0	74.7
3rd	7.4	18.8	3.0	70.8
4th	12.6	21.7	4.3	61.4
Highest	15.7	27.4	5.5	51.4
Financially stressed household				
No	10.4	21.3	3.6	64.7
Yes	14.2	11.6	2.1	72.1
SEIFA Disadvantage Index quintile				
Highest disadvantage	8.1	19.5	3.1	69.2
2nd	12.5	18.5	3.3	65.6
3rd	10.0	19.9	2.6	67.4
4th	11.4	20.8	4.1	63.7
Lowest disadvantage	10.8	25.3	4.5	59.5

Highest occupational class				
Neither parent working	6.0	12.6	0.8	80.5
ASCO 8–9 (Unskilled labour)	8.0	12.1	3.6	76.4
ASCO 4–7 (Skilled labour & clerical)	8.7	19.2	3.0	69.0
ASCO 1–3 (Professional)	13.6	25.4	4.6	56.5

(a) Row percentages add to 100 per cent.

Interestingly, the data suggest that the specific type of care arrangements experienced by infants varied little by child characteristic or family demographic factors. Overall, twice as many infants were in informal compared to formal care arrangements, and this was the case regardless of child gender, ATSI status, maternal education, family type, or most indices of family socioeconomic status. The only exceptions were a relatively higher use of informal care arrangements by families whose main language at home was not English, and a relatively higher use of formal care arrangements by families that were not financially stressed.

Child cohort

- **Type of care arrangement**: some experience of formal centre-based child care or early education was reported for all but 5 per cent of the child cohort, with the majority of children in either a pre-Year 1 (17 per cent) or preschool (55 per cent) early education setting (see Table 11). The remaining 24 per cent of children were in long day care centres.
- **Number of arrangements**: while for 60 per cent of the children these settings were the only non-parental care settings they attended, the remaining children in care attended multiple care settings, including a variety of other formal and/or informal arrangements.
- **Amount of time in care**: similar to the infant cohort, the majority of 4 to 5 year olds (52 per cent) were in care 20 hours or less per week; however, more than 20 per cent of the children experienced much longer hours of care (›30 hours per week). On average, children in pre-Year 1 education programs and those in multiple care settings had the longest hours of care (see Table 12).
- **Age of first entry into care**: parents' retrospective reports of the age at which their children first entered care indicated that fewer children in the child cohort than in the infant cohort entered care before 9 months of age (19 per cent compared to 35 per cent, respectively), but 58 per cent of the 4 to 5 year olds were reported to have had some non-parental care experience before the age of 3 years. However, for 40 per cent of the child cohort, their first experience of regular non-parental care or early education was not until after 3 years of age. While parents can probably remember the timing of this significant event with reasonable accuracy, there is potential for some error given the retrospective nature of these reports.

Very few children were not in an early education or day care setting in the child cohort. However, the child and family demographic factors identifying those children not in care were similar to those noted for the infant cohort (see Table 13). More children were not in a care or early education arrangement if they were from an ATSI background, had mothers who had not completed high school, were from a single parent family, or spoke a language other than English at home. In contrast, more economically advantaged families had children with high participation rates in early education and care settings. Again similar to the infant cohort, the data suggest that the specific type of care arrangements experienced by children varied little by child characteristic or family demographic factors. Most 4 to 5 year-old children were in preschool settings, followed by day care and then pre-Year 1 arrangements. The few differences noted included a slightly higher participation rate in pre-Year 1 settings for girls than boys, for children from families with the lowest SEIFA index, and for children from families whose main language at home was not English.

Table 11: Non-parental care characteristics for child cohort

Characteristic[a]	n	Value
Time in non-parental care each week (%)	4,979	
None		3.7
1–20 hours		52.2
21–30 hours		22.9
31–40 hours		13.4
More than 40 hours		7.8
Number of hours in non-parental care each week—child is in care (median, [p25, p75])	4,811	18 [12, 30]
Number of regular non-parental care arrangements each week (%)	4,982	
None		3.8
One		60.4
Two		28.7
Three or more		7.0
Age of entry into non-parental care (%)	4,810	
0–52 weeks		29.8
53–104 weeks (1–2 years)		18.5
105–156 weeks (2–3 years)		11.4
157–208 weeks (3–4 years)		20.5
209 weeks or older (›4 years)		19.8
Age of entry into non-parental care in weeks—child is in care (median, [p25, p75])	4,810	109 [48, 187]
Type of non-parental care arrangements experienced by child each week (%)	4,983	
Pre-Year 1		16.5
Pre-Year 1 only		11.0
Pre-Year 1 and any other care		5.5
Preschool		54.6
Preschool only		32.0
Preschool and other formal care		7.7
Preschool and informal/mixed care		14.9
Day care		24.1
Day care only		14.9
Day care and other formal care		3.4
Day care and informal/mixed care		5.7
Informal care only		1.2
No care		3.6

(a) Care arrangements include educational care such as school and pre-school/kinder. Mixed care is a combination of formal and informal care arrangements.

Note: Due to rounding, percentages may not add to 100 per cent (or subtotals) exactly.

Table 12: Hours spent in care by care arrangement for child cohort

Care arrangement	Hours spent in care median [p25, p75]
Pre-Year 1	30 [30, 36]
Pre-Year 1 only	30 [30, 30]
Pre-Year 1 and any other care	37 [33, 43]
Preschool	15 [12, 20.5]
Preschool only	12 [10, 15]
Preschool and other formal care	20 [14, 25]
Preschool and informal/mixed care	22 [17, 30]
Day care	24 [16, 35]
Day care only	20 [14, 30]
Day care and other formal care	30 [24, 39]
Day care and informal/mixed care	30 [24, 40]
Informal care only	7.5 [2, 27]
No care	*0 [0, 0]*

Note: p25=25th percentile, p75=75th percentile.

Table 13: Care arrangements by sociodemographic variables for child cohort (per cent)

Education/care category[a]	Pre-Year 1	Preschool	Day care	Informal care only	No care
Sex					
Male	14.8	54.2	26.1	1.0	3.8
Female	18.3	55.2	21.7	1.3	3.4
Study child—Aboriginal/Torres Strait Islander					
No	16.5	54.7	24.3	1.1	3.5
Yes	17.5	55.7	17.2	2.5	7.1
Maternal education					
Did not complete high school	17.1	53.3	23.0	1.5	5.1
Completed high school	13.9	58.3	23.6	1.1	3.1
Tertiary	18.2	53.9	26.0	0.6	1.3
Family type					
1 parent	18.7	47.6	26.6	1.8	5.3
2 parents	16.1	56.0	23.5	1.1	3.3
Main language spoken at home					
English	15.0	56.7	24.3	1.1	2.9
Not English	25.5	42.7	22.1	1.8	7.8
Combined parental income quintile					
Lowest	19.6	50.2	22.0	1.2	6.9
2nd	18.4	52.7	21.4	2.1	5.4
3rd	16.5	56.2	21.3	1.0	5.1
4th	13.6	57.0	26.1	0.9	2.3
Highest	16.3	55.2	26.4	1.0	1.2
Financially stressed household					
No	16.5	55.2	24.2	1.0	3.1
Yes	15.4	49.4	22.0	2.7	10.4

SEIFA Disadvantage Index quintile					
Highest disadvantage	20.1	50.9	21.2	1.4	6.5
2nd	14.7	55.5	23.7	1.7	4.4
3rd	16.0	51.2	27.3	1.3	4.2
4th	17.0	57.8	23.3	0.4	1.5
Lowest disadvantage	15.3	58.2	24.3	0.9	1.2
Highest occupational class					
Neither parent working	19.6	47.3	21.0	1.3	10.8
ASCO 8–9 (Unskilled)	17.6	51.1	21.8	0.9	8.7
ASCO 4–7 (Skilled labour & clerical)	16.5	56.9	22.3	1.6	2.7
ASCO 1–3 (Professional)	15.5	55.8	26.3	0.9	1.6

(a) Row percentages add to 100 per cent.

Impact of non-parental care characteristics on child outcomes: multivariable analyses

In this final section we attempt to answer the question as to whether child care has an influence on child outcomes, independent of the contribution of key child and family characteristics. As noted above, children's participation in formal and informal child care and early education settings is not independent of family and child factors that are known to be important influences on children's development. For both the infant and child cohorts, fewer children were in a care/education arrangement if their families were economically disadvantaged, if they were of ATSI background, if their mothers had not completed high school, and if the main language spoken at home was other than English. These and other related indices of family socioeconomic status are all variables associated with poorer outcomes in the broader developmental literature, and so it is important to take them into account when trying to assess the relative importance for children of experience in care. We ran a series of multiple regression analyses, entering the nine key child and family demographic variables identified in Section 2, in combination with different child care variables as predictors of the children's continuous Outcome Index and domain scores. The child care variables were type of care (which included pre-Year 1 and preschool settings for the child cohort), number of hours in care each week, number of regular care arrangements each week, and age of entry into first care arrangement (see Tables 14 and 15 for the specific values of each child care variable for the infant and child cohorts).

Infant cohort

Due to the very small numbers of infants falling into some of the combinations of categories across the different child care variables (for example, very few receiving two or more types of formal care), it was not possible to separate out the independent effect of each of the four child care variables of interest upon infant outcomes. A separate regression analysis was performed for each of the four variables, so that each was adjusted for the set of child and family demographic variables, but not for the other three child care variables. This means that in assessing the effects of any child care variable we could not control for the possible confounding effects of other characteristics of the infants' care experience. We note this limitation on the interpretation of any findings. Separate models are presented for the overall Outcome Index and the three domain scores (see Table 14).

For the infant cohort, there was no evidence to suggest that any of the individual child care variables were associated with the overall Outcome Index score (all $p>0.05$).

Though the size of the apparent impacts were small, there was strong evidence to suggest that the following child care variables were associated with an increased physical domain score, independent of the nine child and family demographic variables in the model: infants not in any school or centre program ($p<0.001$); infants in 20 hours or less care per week ($p<0.001$); and infants in less than one care arrangement per week ($p=0.005$). Taken together, these variables identify children in larger group settings as most at risk for impaired general health and increased health care needs (the two components of the physical domain) in the first year.

The clearest predictor of the infant learning domain was the type of care arrangement (p=0.006), with higher scores for infants in informal care only compared to infants not in care, while infants in formal care or mixed formal/informal care were similar to those not in care after taking into account the influence of the nine child and family demographic factors.

Child cohort

Due to the small number of children not in any child care or early education arrangement in the child cohort, the analyses focused on children receiving care, comparing children's outcomes across the different care and early education settings. Four multiple regression analyses were run (one each for the overall Outcome Index and the three domains) that included all four child care variables as well as the nine key child and family demographic variables. Therefore, we were able to estimate the effect of each child care variable, independent of the effects of the other three child care variables and the nine child and family demographic variables. Table 15 presents the results of the four models.

There was strong evidence to suggest that children attending a pre-Year 1 school program had higher overall Outcome Index scores than children who were attending informal arrangements only (p‹0.001).

Unlike the infant cohort, there was no evidence of a relationship between physical domain scores and children's participation in large group care or early education settings (p=0.91).

Type of care/early education setting was relevant to children's learning domain scores (p‹0.001), with children attending a pre-Year 1 school program having higher learning domain scores than children who were attending informal arrangements only. Overall Outcome Index and learning domain scores were similar for children in preschool, day care, and informal care settings. These results were also reflected in the larger percentage of children in pre-Year 1 programs who had high Outcome Index scores (22 per cent) compared to those attending preschool (13 per cent), day care (13 per cent), or only informal care settings (14 per cent) (see Figure 8).

The higher competence of children in pre-Year 1 programs on the overall Outcome Index and the learning domain scores is likely to reflect the typically strong focus of these programs on the development of literacy and numeracy skills and that these programs require full-time attendance. Children in the pre-Year 1 programs were also likely to be slightly older than other children in the cohort who were attending preschools, long day care, or who had informal care arrangements. Across Australia, children have different access to pre-Year 1 programs according to the age eligibility criteria mandated in public education provisions in each state and territory. Additionally, children may be slightly older in pre-Year 1 programs because parents may choose to delay entry to a formal, full-time school program, even though their child is eligible by age to attend, so the child will be more mature and perhaps have a learning advantage over their on-time, younger classmates (Meisels 1992). There is no Australian evidence on how many parents make this choice. However, evidence from the United States from a large national study of children beginning school programs indicated that 6 per cent of parents made a choice to delay their child's entry even though the child was age-eligible to do so a year earlier (Malone et al. 2006). These children were more likely to be male and more likely to have more highly educated parents.

Age of entry to public pre-Year 1 programs differs across Australian states and territories. Only older children in the child cohort could have accessed a pre-Year 1 program, including those children whose parents had exercised a choice to delay their child's entry from the previous year even if the child had been age-eligible to attend. For example, in New South Wales, children are eligible to begin the pre-Year 1 program if they have their 5th birthday by 31 July, while in Victoria children are eligible to begin the pre-Year 1 program if they are 5 years old before 30 April. In most states, children with their 5th birthday early in the year were more likely to be attending a pre-Year 1 program than children with birthdays in the latter half of 2004. Additionally, in 2004, there was no universal public education pre-Year 1 program in Queensland. In that state few children, except for those in independent schools, would have been able to access a full-time pre-Year 1 program. Thus, children in the pre-Year 1 program, aside from those living in Queensland, were likely to be older than children attending preschool or child care programs. The age distribution of the child cohort for 2004 was normally distributed and the mean age was 4.7 years.

There was little or no evidence to suggest that number of hours in care each week, number of regular care arrangements each week, and age of entry into first care arrangement were independently associated with any of the child outcomes (all p›0.04).

Over and above the nine child and family demographic factors included in the analyses, the four child care/early education variables accounted for 3.8 per cent of the variability in learning domain scores for the child cohort, while accounting for 1 per cent or less of the variability in the other two domain scores and the overall Outcome Index scores. The above results suggest that the majority of the effect of the child care/early education variables on learning domain scores is accounted for by the influence of enrolment in pre-Year 1 programs. As noted above, however, these results may be influenced not only by the focus on teaching early literacy and numeracy skills typically found in these programs which are full-time formal programs in a school setting. We would expect, however, that the impact of any child factors would be mitigated by the inclusion of the nine child and family demographic variables in these analyses.

Table 14: Multivariable relationships[a] between child care variables and the Outcome Index and domain scores for the infant cohort

Characteristic[b]	Outcome Index score		Physical domain score		Social–emotional domain score		Learning domain score	
	Coefficient (95% CI)	p-value[c]	Coefficient (95% CI)	p-value[c]	Coefficient (95% CI)	p-value[c]	Coefficient (95% CI)	p-value[c]
Main type of school or centre program	n=3,591 R2=1.6%	**0.05**	n=4,800 R2=1.9%	**‹0.001**	n=4,091 R2=1.9%	**0.11**	n=4,211 R2=1.9%	**0.006**
None	0 (–,–)		0 (–,–)		0 (–,–)		0 (–,–)	
Formal care only	–1.4 (–2.5, –0.4)	0.008	–2.4 (–3.6, –1.2)	‹0.001	–0.1 (–1.1, 0.9)	0.86	–0.2 (–1.2, 0.9)	0.73
Informal care only	0.2 (–0.6, 1.1)	0.60	–0.4 (–1.3, 0.4)	0.28	–0.1 (–0.9, 0.7)	0.80	1.3 (0.5, 2.1)	0.002
Mixed formal & informal care	–0.1 (–1.7, 1.5)	0.91	–2.3 (–3.7, –0.9)	0.002	1.6 (0.3, 2.9)	0.02	1.0 (–0.6, 2.5)	0.21
Time per week in non-parental care	n=3,591 R2=1.4%	**0.64**	n=4,800 R2=1.8%	**‹0.001**	n=4,090 R2=1.8%	**0.89**	n=4,211 R2=1.7%	**0.07**
None	0 (–,–)		0 (–,–)		0 (–,–)		0 (–,–)	
1–20 hours	–0.3 (–1.0, 0.5)	0.47	–0.7 (–1.5, 0.0)	0.05	0.0 (–0.7, 0.7)	1.0	0.6 (–0.1, 1.4)	0.11
‹20 hours	–0.5 (–1.7, 0.7)	0.43	–2.4 (–3.5, –1.2)	‹0.001	0.3 (–0.8, 1.2)	0.6	1.3 (0.1, 2.4)	0.03
Number per week of regular non-parental care arrangements	n=3,591 R2=1.5%	**0.33**	n=4,800 R2=1.6%	**0.005**	n=4,090 R2=1.8%	**0.21**	n=4,211 R2=1.7%	**0.04**
None	0 (–,–)		0 (–,–)		0 (–,–)		0 (–,–)	
One	–0.6 (–1.3, 0.3)	0.20	–1.2 (–2.0, –0.4)	0.003	–0.2 (–0.9, 0.5)	0.63	0.7 (–0.1, 1.4)	0.09
≥Two	0.2 (–0.9, 1.4)	0.70	–1.2 (–2.3, –0.1)	0.04	0.9 (–0.2, 1.9)	0.11	1.3 (0.2, 2.4)	0.02
Age of entry into care	n=1,472 R2=4.2%	**0.45**	n=1,842 R2=4.1%	**0.01**	n=1,559 R2=3.2%	**0.74**	n=1,728 R2=1.9%	**0.45**
0–13 weeks	0 (–,–)		0 (–,–)		0 (–,–)		0 (–,–)	
14–26 weeks	–0.4 (–1.7, 1.1)	0.66	–0.7 (–2.0, 0.7)	0.33	–0.4 (–1.6, 0.9)	0.56	0.1 (–1.1, 1.3)	0.87
27–39 weeks	–0.8 (–2.2, 0.6)	0.25	–0.6 (–1.9, 0.7)	0.35	–0.6 (–1.8, 0.6)	0.35	–0.9 (–2.2, 0.4)	0.19
≥40 weeks	0.6 (–1.1, 2.4)	0.50	1.5 (0.1, 3.0)	0.04	–0.6 (–2.3, 1.0)	0.47	–0.4 (–2.0, 1,2)	0.61

(a) Adjusted for demographic variables, but not other child care variables.
(b) The reference category for each characteristic is italicised.
(c) The **overall p-value** represents evidence against the null hypothesis of no differences between groups (see text). Caution is urged when interpreting individual **category versus baseline p-values** (see Box 2: Interpretation of multivariable analyses).

Table 15: Multivariable relationships between child care variables and the Outcome Index and domain scores for the child cohort

	Outcome Index score n=4,382 R2=15.1%		Physical domain score n=4,389 R2=2.5%		Social–emotional domain score n=4,382 R2=11.4%		Learning domain score n=4,389 R2=16.8%	
Characteristic[a]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]
Education/care type		**‹0.001**		**0.91**		**0.89**		**‹0.001**
Informal care only	*0 (–,–)*		*0 (–,–)*		*0 (–,–)*		*0 (–,–)*	
Pre-Year 1	2.9 (0.0, 5.8)	0.05	0.4 (–3.7, 4.5)	0.86	–0.0 (–3.3, 3.3)	0.98	5.8 (2.6, 8.9)	‹0.001
Preschool	0.7 (–2.2, 3.6)	0.64	0.4 (–3.7, 4.4)	0.86	0.0 (–3.2, 3.3)	1.0	1.0 (–1.9, 4.0)	0.49
Day care	1.0 (–1.9, 3.8)	0.50	0.6 (–3.5, 4.8)	0.76	0.3 (–2.9, 3.5)	0.87	1.1 (–1.8, 4.0)	0.45
Number of care arrangements		**0.07**		**0.30**		**0.32**		**0.06**
1	*0 (–,–)*		*0 (–,–)*		*0 (–,–)*		*0 (–,–)*	
2	–0.9 (–1.6, -0.1)	0.03	–0.6 (–1.3, 0.2)	0.12	–0.6 (–1.3, 0.2)	0.16	–0.7 (–1.4, 0.0)	0.06
≥3	–0.9 (–2.2, 0.3)	0.14	–0.4 (–1.7, 0.9)	0.56	–0.6 (–1.9, 0.7)	0.34	–1.2 (–2.4, 0.0)	0.04
Time spent in care		**0.81**		**0.81**		**0.77**		**0.74**
1–20 hours	*0 (–,–)*		*0 (–,–)*		*0 (–,–)*		*0 (–,–)*	
21–30	0.0 (–0.8, 0.9)	0.95	–0.2 (–1.1, 0.6)	0.58	–0.2 (–1.0, 0.7)	0.72	0.5 (–0.4, 1.3)	0.28
31–40	0.3 (–0.8, 1.4)	0.59	0.1 (–1.1, 1.3)	0.91	0.2 (–0.9, 1.2)	0.76	0.2 (–0.9, 1.3)	0.68
40+	–0.3 (–1.7, 1.1)	0.64	–0.5 (–2.1, 1.0)	0.50	–0.5 (–2.0, 0.9)	0.47	0.3 (–0.9, 1.6)	0.57
Age of entry into care		**0.83**		**0.33**		**0.40**		**0.04**
‹1 year	*0 (–,–)*		*0 (–,–)*		*0 (–,–)*		*0 (–,–)*	
1–‹2 years	0.2 (–0.6, 1.0)	0.67	0.1 (–0.8, 1.1)	0.80	0.7 (–0.1, 1.5)	0.08	–0.5 (–1.3, 0.3)	0.25
2–‹3 years	–0.3 (–1.4, 0.8)	0.57	–0.9 (–2.0, 0.3)	0.13	0.6 (–0.5, 1.6)	0.31	–0.4 (–1.4, 0.6)	0.44
3–‹4 years	–0.3 (–1.1, 0.5)	0.40	–0.4 (–1.3, 0.5)	0.38	0.4 (–0.4, 1.2)	0.32	–0.9 (–1.7, 0.0)	0.05
4+ years	–0.1 (–1.1, 0.8)	0.77	0.4 (–0.6, 1.3)	0.46	0.7 (–0.3, 1.7)	0.15	–1.5 (–2.4, –0.6)	0.002

(a) The reference category for each characteristic is italicised.

(b) The **overall p-value** represents evidence against the null hypothesis of no differences between groups (see text). Caution is urged when interpreting individual **category versus baseline p-values** (see Box 2: Interpretation of multivariable analyses).

Figure 7: Low Outcome Index: percentage of child cohort by care characteristics

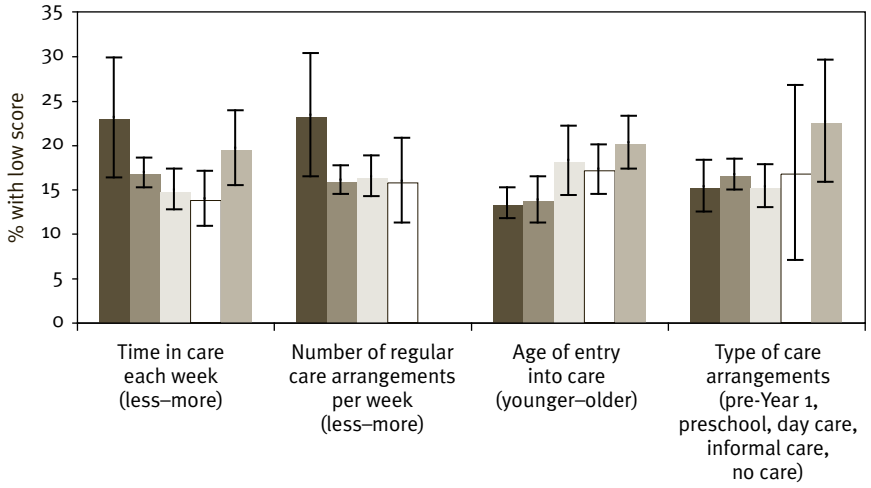
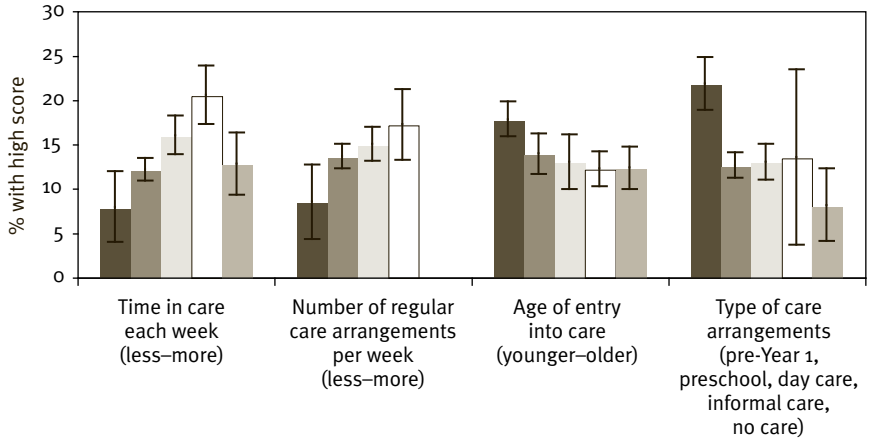


Figure 8: High Outcome Index: percentage of child cohort by care characteristics



3.3 Discussion

Participation in formal and informal non-parental child care and early education settings is a significant component of the life experience of LSAC infants and children. For the LSAC infants who are enrolled in group care settings, exposure to large numbers of children appears to be associated with lower physical domain scores (that is, poorer general health and greater health care needs). These findings are consistent with those reported by the NICHD Early Child Care Research Network (ed. 2005c), where they were attributed to the greater exposure to contagious illnesses experienced by children cared for in large groups (›6 children). The longer-term consequences of such exposures for the LSAC infants are yet to be determined. If the physical domain scores for the child cohort can be taken as a guide, we would expect this association to decrease over the pre-school years, consistent with previous literature.

Analysis of the social–emotional domain scores indicated a remarkable lack of robust effects once the influence of child and family factors was taken into account. We did not replicate North American findings of more negative social–emotional outcomes in children with longer hours of care (NICHD Early Child Care Research Network 2006). However, the cross-sectional nature of the LSAC Wave 1 data did not allow a clear test of this effect, which typically has been linked to the cumulative effect of time in care over the first four years.

Different child care or early education experiences appeared to enhance learning outcomes for the infant and child cohorts. Infants in informal care had higher learning domain scores than infants not in care. These results point to the beneficial effects of informal care, even for at-risk groups. Given that most infants in informal care only were being cared for by grandparents, it will be important to explore in further analyses the influences that extended family may have for the development of young infants. For the child cohort, educationally oriented pre-Year 1 school programs appeared effective in promoting literacy and numeracy skills to a level above that seen in children with no experience in formal care settings. However, despite the effect of these child care and early education experiences, child and family factors were still stronger determinants of learning outcomes for the infant and child cohorts.

The findings with respect to the learning domain highlight the possible beneficial effects of children's attendance at pre-Year 1 school programs and are consistent with findings of other longitudinal research. For example, the NICHD Study of Early Child Care and Youth Development (NICHD Early Child Care Research Network 2005b) reported better cognitive outcomes for children at 4 years, 6 months of age in high quality, centre-based programs, where quality of care specifically included an evaluation of the cognitive stimulation provided in the program. Similarly, the Effective Provision of Pre-School Education Project (Sylva et al. 2004) found that children with no or only minimal preschool centre experience had poorer cognitive attainment prior to school entry than children with more extended preschool experience. While the analyses conducted here did not replicate these findings of specific advantage for children in non-school centre-based programs, two points should be noted. First, only 1.2 per cent of the LSAC children attended non-centre based care only, and thus the power of the Wave 1 data to detect possible small differences in outcomes between children in centre-based care and children in other care settings is limited. Second, unadjusted analyses indicated an association between attendance at formal centre-based programs (for example, preschool, day care) and enhanced overall Outcome Index and learning domain scores, but the multivariable analyses reported above suggest that this relationship is confounded by child and family characteristics. Further analyses that attempt to disentangle these combined influences are needed.

Overall, these results are consistent with international studies that have specifically evaluated the relative effects of child care and family context variables on children's outcomes across the infant and preschool years (NICHD Early Child Care Research Network 2006). They highlight the importance of understanding the influence of child care for both infants and 4 to 5 year-old children within the broader family context that guides their development in the early years.

4 Children's health

Section summary

- Although Australian infants and children are generally in very good or excellent health, many experience substantial physical health problems—for example, low birth weight (5 per cent), preterm birth (7 per cent), special health care needs (14 per cent), overweight/obesity (21 per cent), and asthma requiring medication (15 per cent).
- Although most mothers breastfeed, relatively few meet current NHMRC recommendations for exclusive breastfeeding to at least 6 months. Most children are not meeting nutritional guidelines, and many are reported to prefer sedentary to physically active pursuits.
- Child health variables strongly influence Outcome Index scores, with indicators of current health (most notably asthma and healthful nutritional behaviours) as powerful as the perinatal influences of preterm birth. Impacts of child health are often greater in the social–emotional and/or learning domain than in the physical domain, emphasising the importance of children's health to **all** aspects of their functioning and wellbeing.
- Impacts are less evident in the first year of life and more clearly apparent by 4 to 5 years of age. This suggests that intervention in the early years (that is, between infancy and the preschool year) may have potential to prevent the impacts of poorer health developing.

4.1 Introduction

This section addresses the following questions:

- What perinatal, postnatal, and current health issues face Australian infants and 4 to 5 year-old children, and how prevalent are these issues?
- How well are Australian 4 to 5 year-old children doing with regard to healthful levels of physical activity and nutritional habits?
- How do these issues affect children's overall health and wellbeing (measured by the Outcome Index), physical health (measured by the physical domain subscale of the Outcome Index), and other areas of functioning?
- When considered relative to each other, which of these factors make the biggest contribution to children's overall and physical health?

The health data collected in Wave 1 were mainly cross-sectional, but retrospective data regarding pregnancy and the natal and postnatal periods allow us to start to appreciate the longitudinal nature of the development of good and poor child health.

4.2 Findings

Child health variables

The **child health variables** (Table 16) could broadly be classified as **prenatal** (considered in Section 5, Maternal health), **perinatal**, **postnatal**, or **current**. With the exception of height, weight and head circumference (directly measured by the LSAC interviewer), all health measures were reported by the primary care giver. Television and computer use are not considered here, as they are analysed in Section 6 (Family learning environments).

The primary **child outcomes** relevant to this section are the overall Outcome Index and physical domain scores. Some current child health variables—such as body mass index (BMI)—contributed directly to the calculation of the physical domain (and therefore overall Outcome Index) score, but we were nonetheless interested in

how these variables were related to the two other domains of child functioning. Figures 9 and 10 show the proportions of the child cohort according to each health variable scoring in the top 15 per cent (that is, above the positive cut-off) and bottom 15 per cent (below the negative cut-off) of overall Outcome Index scores. These analyses are bivariate (that is, not adjusted for sociodemographic or other variables). Comparable graphs for the infant cohort are not shown; relationships between health variables and high or low Outcome Index scores were generally either absent or weaker than (but in the same direction as) the child cohort.

Perinatal health variables

- **Birth weight**: 6 per cent of infants and 7 per cent of children were of low birth weight (‹2500g), similar to the 6.3 per cent reported for all Australian babies live-born in 2003 (AIHW 2006). Of those with low birth weight, 29 per cent of children were below the negative Outcome Index cut-off for their respective cohorts. However, the expected proportion of normal birth weight children fell above the positive cut-off, in the top 15 per cent of the Outcome Index score. (Note that no adjustment was made for gestational age in these analyses, but that future re-releases of the LSAC data may include age corrections).
- **Gestational age**: the great majority of children in both cohorts were born at term (37 to 41 weeks). Slightly more children (7 per cent) than infants (5 per cent) were born post-term (≥42 weeks), possibly indicating increasing obstetric reluctance to allow pregnancies to proceed past term. In both cohorts, 5 to 6 per cent were born preterm (33 to 36 weeks), and less than 2 per cent very preterm (32 weeks or less), slightly less than the 7.9 per cent of all Australian live births born ‹37 weeks in 2003 (AIHW 2006). Of the very preterm children, 44 per cent fell below the negative Outcome Index cut-off.

Postnatal health variables

- **Breastfeeding**: the prevalence and duration of breastfeeding were comparable across the cohorts, with 13 per cent never establishing breastfeeding, and about one-quarter feeding for between one week and three months. The majority of women who breastfed for three months or more continued beyond six months; less than 10 per cent of all LSAC mothers discontinued breastfeeding between three and six months, while just over half reported feeding for more than six months (these analyses excluded the 605 infants who were aged ‹6 months at the time of interview). The median age of ceasing breastfeeding completely for the child cohort was 6 months, with 25 per cent ceasing by 8 weeks and 75 per cent by 12 months of age. 'No breastfeeding' had a much lower proportion (9 per cent) of children above the positive Outcome Index cut-off and a much higher proportion (27 per cent) below the negative cut-off. These relationships were not evident for the infant cohort.
- For the child cohort, **milk or foods other than breast milk** were first introduced at a median age of 4 months (25 per cent by 5 weeks, 75 per cent by 5 months). Thus, only half of all mothers were meeting the national recommendations which were in place when the child cohort was born (that is, to introduce solids after the age of 4 months). This highlights the magnitude of shift in maternal practice that would be required to meet the current NHMRC recommendations that babies should be exclusively breastfed to age 6 months (NHMRC 2003b).

Current health variables

- **Health-related quality of life** (child cohort only): this was measured using the PedsQL (Pediatric Quality of Life Inventory 4.0—PedsQL 4.0) (Varni et al. 2003), a 23-item validated questionnaire for children aged 2 to 18 years that generates scores between 0 and 100 for total, physical and psychosocial health. The median total (82.1), physical (84.4) and psychosocial (80.8) scores on the PedsQL for the LSAC child cohort were very similar to the published means for the normative US sample (81.2, 83.3 and 80.2, respectively).
- **General health**: this was rated using a widely used global health single item with response options of excellent, very good, good, fair and poor (Waters, Salmon & Wake 2000). Most parents perceived their children as being healthy, with 87 per cent in both cohorts rating their child's health as excellent/very good and only 13 per cent as good/fair/poor. This contrasts with the much lower ratings mothers applied to their own health using the same rating scale (see Section 5). The mean social–emotional domain score of children rated as having good, fair or poor health was 95.1, compared to 100.7 in those with excellent or very good health—that

is, roughly half a standard deviation lower—with weaker but similar relationships seen for learning domain scores and for infants.

- Of the infants, 6 per cent were reported to have **special health care needs**, rising to 14 per cent for the children, commensurate with the US prevalence using the longer version of the same measure. The Children with Special Health Care Needs (CSHCN) Screener (Bethell et al. 2002) is widely used internationally, and probes for conditions expected to last for at least 12 months that need or use more care than a parent would consider usual for all children. Having special health care needs had impacts of similar magnitude on Outcome Index scores to the impact of poorer general health.
- The infants' **weight-for-age** standardised (z) score increased by 0.55 from birth, indicating that Australian infants gain weight more rapidly than would be expected from the normative Centers for Disease Control data (Ogden et al. 2002). This rate of growth appears plausible, as it is in line with current mean standardised (z) scores for Australian primary school children (Booth et al. 2001). This is also reflected in the rates of **'catch-up' versus 'catch-down'** change in infant weight from birth, with nearly half increasing their weight by more than two-thirds of a standard deviation, that is, moving up at least one centile band on the growth charts from birth, and only 15 per cent dropping by at least one centile band from birth. Changing weight-for-age did not appear to impact on the proportions of infants above the positive or below the negative Outcome Index cut-offs.
- Of the child cohort, 15.2 per cent were classified as overweight and 5.5 per cent as obese, using the International Obesity Task Force definitions (Cole et al. 2000). This represents a very substantial increase since the 1995 National Nutrition Survey using the same categorisation (Magarey, Daniels & Boulton 2001), and is in line with recently reported prevalence for primary school children (Magarey, Daniels & Boulton 2001). Child overweight/obesity did not appear to impact on child social–emotional and learning domain scores.
- Parents of the child cohort were asked to report on their child's **nutrition the previous day**. While 95.5 per cent met the national recommendations of at least one serve of fruit, only 43 per cent met recommendations for vegetable intake and only 26 per cent had less than two serves of high fat/high sugar foods (NHMRC 2003b). Of the child cohort, 80 per cent had at least one soft or sugar sweetened drink (including fruit juice) the previous day, while 86 per cent had two or more drinks of water the previous day; 41 per cent had displayed two or less of the five healthful behaviours the previous day, and just 24 per cent displayed four or five of these healthful behaviours. Of those with none or one healthful behaviours, only 9 per cent fell above the positive cut-off but over 26 per cent fell below the negative cut-off of the Outcome Index; of those with four or five, 18 per cent were above the positive and only 11 per cent below the negative cut-offs.
- Nearly 80 per cent of children were reported to 'very much' **enjoy physical activity**, but only 29 per cent **preferentially choose active over inactive pastimes**. Both groups were slightly overrepresented in the lowest 15 per cent of Outcome Index scores (20 per cent of the children who were reported not to enjoy physical activity and 21 per cent of those who preferentially choose inactive pastimes).
- **Asthma and wheeze**: 30 per cent of infants and children were reported to have 'ever wheezed', and 15 per cent of children were reported to have doctor diagnosed asthma for which they were taking medication at the time of the LSAC survey. These figures are in keeping with other epidemiological sources for Australian children, such as the Australian arm of the International Study of Asthma and Allergies in Childhood study (Robertson et al. 1998) and the National Health Survey 2004–05 (ABS 2006). Over a quarter of the children with currently medicated asthma had overall Outcome Index scores below the negative cut-off.

Associations with specific health outcomes comprising the physical domain

To help understand where specific health issues might exert their impacts on the child, relationships between some of the key health variables and the health measures contributing to the physical domain are tabulated in Table 17. Table 17 presents results summarising the relationship between perinatal, postnatal, and **current** variables and the health measures contributing to the physical domain of the Outcome Index.

The physical domain score for the child cohort comprises four separate measures—health-related quality of life (PedsQL), CSHCN Screener, global health, and BMI standard (z) score, with both very low and very high BMI z-scores contributing to a lower Outcome Index score. Low birth weight and prematurity showed a markedly higher prevalence of special health care needs and poorer global health ratings, a modest reduction in mean PedsQL scores, and lower rates of overweight/obesity. On average, children who breastfed longer had higher PedsQL scores, lower special health care needs, better general health and lower rates of overweight/obesity. Mean PedsQL scores and general health both rose with increasing numbers of healthful nutritional behaviour and child preferences for active pastimes.

Impact of child health variables on outcomes: multivariable analyses

Independent associations of each variable with the overall Outcome Index score for both the infant and child cohorts were examined using multivariable regression analyses controlling for all other perinatal, postnatal and current health variables as well as for the set of socioeconomic variables referred to in Section 2.

Tables 18 (infant cohort) and 19 (child cohort) show multivariable linear regression relationships between the child health variables and the continuous Outcome Index scores for the infant and child cohorts, all adjusted for the nine key sociodemographic variables identified in Section 2. For the health variables that directly contribute to calculation of the physical domain and overall Outcome Index (BMI, general health, special health care needs, PedsQL) only relationships with social–emotional and learning domain scores are shown. For all other health variables, relationships with the overall Outcome Index score and all three domain scores are shown.

Table 18 shows that the final multivariable models for the **infants** accounted for only small proportions of the total variance in scores—4 per cent of the overall Outcome Index, most strongly predicting the physical domain scores (6.5 per cent); 2.2 per cent of the variance was explained by the child health variables as a group, over and above the contribution of the sociodemographic variables.

The multivariable models for the **children** (Table 19) accounted for considerably larger proportions of the total variance—20 per cent for the overall Outcome Index, 10 per cent for the physical domain, 23 per cent for the social–emotional domain, and 16 per cent for the learning domain variances respectively. Again, much of this was related to the contribution of the sociodemographic circumstances, with the child health variables as a group accounting for 5.5 per cent of the total variance in this model over and above the contribution of the sociodemographic variables.

Perinatal health variables

- **Birth weight and gestational age**: there was strong evidence of an association between preterm birth and overall infant Outcome Index score (which fell by an average of 6 points if born ≤32 weeks gestation compared to 37 to 41 weeks, $p<0.001$), but no evidence of a relationship with low birth weight ($p=0.49$). Although low birth weight did have a borderline impact on Outcome Index for children ($p=0.04$), it continued to be outweighed by gestational age ($p=0.01$) (which fell by an average of 4 points if born ≤32 weeks gestation compared to 37 to 41 weeks). In both cohorts, this relationship appeared to be driven by the relationship between prematurity and poorer learning domain scores; impacts on physical and social–emotional domain scores were not evident. The data suggest that child outcomes tended to improve with increasing gestational age.

Postnatal health variables

- **Breastfeeding**: there was strong evidence that duration of breastfeeding was associated with improved overall Outcome Index and social–emotional domain scores for the child cohort ($p<0.001$). However, this effect was modest, with scores rising on average only 2 points for those breastfeeding ≥6 months compared to those who did not establish breastfeeding. There was no evidence that breastfeeding was associated with physical domain scores ($p=0.11$). For the infants, there was strong evidence that breastfeeding was associated with higher physical domain scores ($p<0.001$), but not with a higher overall Outcome Index score ($p=0.57$).

Current health variables

- Regarding **health-related quality of life**, there was strong evidence that physically healthy children have better mental health (p‹0.001). Mean child social–emotional domain scores increased by 0.2 points with every additional PedsQL Physical Health point. **General health** was also strongly associated with social–emotional domain scores for both cohorts (p‹0.001), with scores on average 2 points lower for children and 3 points lower for infants whose general health was not reported to be very good or excellent. There was no evidence that having **special health care needs** was associated with infant outcomes (all p›0.14), but strong evidence of an association with lower social–emotional and learning domain scores for the child cohort (p‹0.001). Scores for both domains were 3 points lower on average for children with special health care needs.
- There was some or borderline evidence of an increase in infant **weight-for-age** from birth with slightly better overall Outcome Index (p=0.002), physical (p=0.01) and social–emotional domain scores (p=0.07). Child **overweight/obesity** was not related to social–emotional or learning domain scores.
- Number of healthful nutritional behaviours was the only health characteristic that indicated strong evidence of an association with higher scores on every Outcome Index domain (p‹0.005 for all three domains). The overall Outcome Index score rose by an average of 1 point for every additional healthful behaviour, so that children who demonstrated all five healthful behaviours had scores on average 6 points higher than those demonstrating none. There was also strong evidence that **enjoyment of physical activity** was related to better total child Outcome Index, physical domain and social–emotional domain scores (all p‹0.001), although the effects were modest.
- The highly prevalent problem of **infant wheeze** showed clear evidence of an association with lower overall Outcome Index (a mean decrease of 2 points, p‹0.001) and physical domain (a mean decrease of 4 points, p‹0.001) scores, as well as showing borderline evidence of an association with social–emotional domain score (a mean increase of 1 point, p=0.03). The impact of **child asthma** was more marked—on average a 4 point drop in overall Outcome Index score (p‹0.001), mainly due to an average 6 point drop in the physical domain score (p‹0.001).

Table 16: Physical health characteristics for the infant and child cohorts

	Infants		Children	
Study child characteristic	**n**	**Value**	**n**	**Value**
Perinatal				
Weighed less than 2,500g at birth (%)	5,072	5.7	4,897	6.7
Gestational age	5,098		4,946	
42 weeks or more		4.6		7.3
37–41 weeks		88.5		85.0
33–36 weeks		5.2		6.0
32 weeks or less		1.6		1.7
Postnatal				
Duration of breastfeeding (%)[(a)]	4,747		4,952	
Never breastfed/‹1 week		13.4		13.2
1 week–‹3 months		25.0		23.8
3–‹6 months		9.8		8.1
›6 months		51.8		54.9
Age in days when breastfeeding ceased completely (median [p25, p75])	–		4,952	183 [56, 365]
Age in days when first had milk or food (other than breast milk) (median [p25, p75])	–		4,938	122 [35, 152]

Current				
PedsQL scores (median [p25, p75])	–			
Total			4,198	82.1 [75.0, 88.8]
Physical			4,198	84.4 [78.1, 90.6]
Psychosocial			4,198	80.8 [73.1, 88.5]
General health (%)	5,106		4,982	
Excellent/very good		86.8		87.0
Good/fair/poor		13.2		13.0
Special health care needs (%)	5,029	6.2	4,934	13.6
Weight-for-age z-score (mean (95% CI))	3,979	0.47 (0.43, 0.51)	–	
BMI z-score (mean (95% CI))	–		4,934	0.55 (–0.05, 1.18)
BMI status (%)	–		4,934	
Not overweight				79.3
Overweight				15.2
Obese				5.5
Change in weight-for-age z-score since birth (mean (95% CI))	3,952	0.55 (0.51, 0.60)	–	
Change in weight-for-age z-score since birth (%)	3,952		–	
Catch-up growth		46.0		
No change		38.7		
Catch-down growth		15.3		
Consumed one or more serves of fruit the previous day (%)	–		4,950	95.5
Consumed two or more serves of vegetables the previous day (%)	–		4,926	43.1
Consumed less than two serves of high-fat/ high-sugar foods the previous day (%)	–		4,930	25.9
Did not consume non-diet soft drink, cordial or fruit juice the previous day (%)	–		4,961	19.6
Had two or more drinks of water the previous day (%)	–		4,969	85.9
Number of healthful dietary behaviours displayed the previous day (%)	–		4,870	
None or one				10.7
Two				30.4
Three				35.4
Four or five				23.5
Enjoyment of physical activity	–		4,982	
Very much dislikes/somewhat dislikes/neutral				6.8
Somewhat enjoys				15.1
Very much enjoys				78.1
Choice to spend free time	–		4,976	
Inactive pastimes				25.9
Neutral				44.9
Active pastimes				29.2
Wheeze ever (infants) or in last 12 months (4–5 year olds) (%)	5,099	30.4	4,973	29.7
Doctor-diagnosed symptomatic asthma (%)	–		4,965	15.0

(a) For infants, duration of breastfeeding was only considered for those aged 6 months (183 days) or older. All children in the 4 to 5 year-old cohort had stopped breastfeeding and were included.

Note: p25=25th percentile, p75=75th percentile.
Due to rounding, percentages may not add to 100 per cent (or subtotals) exactly.

Table 17: Relationships between physical health characteristics for the child cohort

Study child characteristic	PedsQL Physical (mean (95% CI))	PedsQL Psychological (mean (95% CI))	Special health care needs (%)	Global health rating is good/fair/poor (%)	Overweight or obese (%)
Weighed less than 2,500g at birth					
No	82.8 (82.3, 83.2)	79.8 (79.3, 80.2)	12.9	12.3	21.0
Yes	80.6 (78.8, 82.4)	77.5 (75.7, 79.3)	21.7	18.6	16.0
Gestational age					
42 weeks or more	83.3 (82.0, 84.6)	79.5 (78.1, 81.0)	11.3	13.3	20.6
37–41 weeks	82.7 (82.3, 83.2)	79.8 (79.3, 80.3)	13.1	12.3	21.0
33–36 weeks	80.8 (78.9, 82.7)	76.9 (75.2, 78.7)	19.4	18.3	18.6
32 weeks or less	78.3 (74.0, 82.6)	75.7 (71.9, 79.5)	27.8	30.1	16.6
Duration of breastfeeding					
Never breastfed/‹1 week	82.4 (80.9, 83.8)	78.9 (77.5, 80.3)	16.0	17.9	26.4
1 week–‹3 months	82.0 (81.1, 83.0)	78.9 (77.9, 79.8)	15.6	13.6	23.2
3–‹6 months	82.2 (80.8, 83.6)	79.5 (78.2, 80.8)	10.8	12.2	20.8
›6 months	83.0 (82.5, 83.5)	80.0 (79.5, 80.6)	12.5	11.6	18.3
Number of healthful dietary behaviours displayed the previous day					
0–1	80.0 (79.2, 82.4)	77.2 (75.7, 78.7)	14.1	20.7	20.2
2	82.2 (81.4, 82.9)	79.4 (78.6, 80.2)	15.1	13.9	21.0
3	82.8 (82.2, 83.5)	79.8 (79.1, 80.4)	12.5	11.6	22.1
4–5	83.6 (82.8, 84.4)	80.7 (79.9, 81.4)	13.5	9.9	19.0
Choice to spend free time					
Inactive pastimes	80.4 (79.5, 81.4)	77.8 (77.9, 78.7)	13.9	16.4	22.1
Neutral	82.9 (82.4, 83.5)	79.9 (79.3, 80.5)	12.3	12.0	20.0
Active pastimes	84.1 (83.3, 84.8)	80.6 (79.9, 81.4)	15.0	11.5	20.6

Figure 9: Low Outcome Index: percentage of child cohort by health characteristics

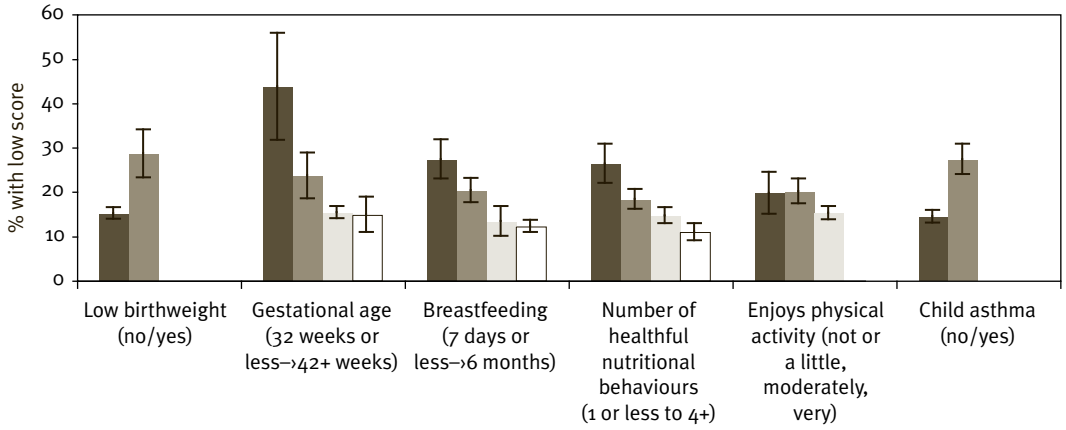


Figure 10: High Outcome Index: percentage of child cohort by health characteristics

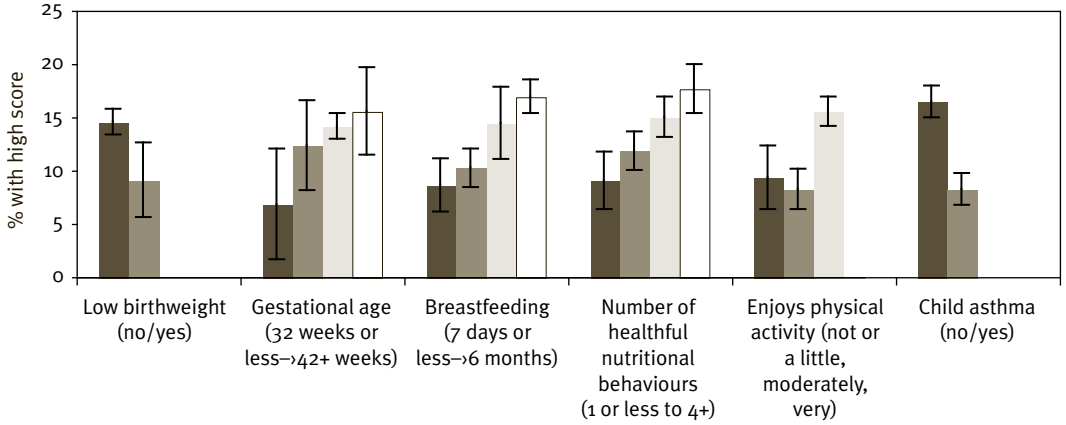


Table 18: Multivariable relationships between child health characteristics and Outcome Index and domain scores for the infant cohort

	Outcome Index score n=2,769 R2=3.8%		Physical domain score n=3,283 R2=6.5%		Social–emotional domain score n=2,756 R2=4.5%		Learning domain score n=3,196 R2=3.8%	
Study child characteristic[a]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]
Perinatal								
‹2,500g at birth	−0.7 (−2.8, 1.3)	**0.49**	0.0 (−2.3, 2.2)	**0.97**	−0.3 (−2.2, 1.5)	**0.71**	−1.0 (−2.9, 0.9)	**0.29**
Gestational age		**‹0.001**		**0.12**		**0.85**		**‹0.001**
42 weeks or more	1.8 (0.1, 3.6)	0.04	0.3 (−1.3, 2.0)	0.67	0.6 (−1.0, 2.2)	0.44	2.6 (1.0, 4.3)	0.002
37–41 weeks	*0 (–,–)*		*0 (–,–)*		*0 (–,–)*		*0 (–,–)*	
33–36 weeks	−2.9 (−5.2, −0.6)	0.02	−1.7 (−4.2, 0.8)	0.18	−0.1 (−1.9, 1.6)	0.87	−2.7 (−4.5, −0.8)	0.005
32 weeks or less	−5.8 (−9.0, −2.6)	‹0.001	−4.8 (−9.0, −0.7)	0.02	0.7 (−2.6, 3.9)	0.69	−6.3 (−9.6, −3.1)	‹0.001
Postnatal								
Duration of breastfeeding		**0.57**		**‹0.001**		**0.01**		**0.14**
Never/‹1 week	*0 (–,–)*		*0 (–,–)*		*0 (–,–)*		*0 (–,–)*	
1 week–‹3 months	0.8 (−0.7, 2.4)	0.30	0.8 (−0.6, 2.1)	0.27	−0.8 (−2.2, 0.6)	0.29	1.4 (0.2, 2.6)	0.03
3–‹6 months	1.3 (−0.5, 3.2)	0.17	0.3 (−1.4, 2.1)	0.72	0.3 (−1.5, 2.1)	0.71	1.4 (−0.1, 3.0)	0.07
›6 months	0.8 (−0.6, 2.2)	0.26	2.1 (0.8, 3.4)	0.001	−1.6 (−2.9, −0.3)	0.02	1.1 (−0.2, 2.4)	0.09
Current								
General health good/fair/poor	–		–		−3.1 (−4.4, −1.8)	**‹0.001**	−2.2 (−3.3, −1.0)	**‹0.001**
Special health care needs	–		–		−1.4 (−3.3, 0.5)	**0.14**	0.0 (−1.5, 1.5)	**1.00**
Change in weight-for-age since birth		**0.002**		**0.01**		**0.07**		**0.49**
Catch-up growth	1.4 (0.6, 2.2)	0.001	1.0 (0.2, 1.8)	0.01	1.1 (0.2, 1.9)	0.02	0.5 (−0.3, 1.3)	0.26
No change	*0 (–,–)*		*0 (–,–)*		*0 (–,–)*		*0 (–,–)*	
Catch-down growth	0.1 (−1.1, 1.2)	0.91	−0.3 (−1.4, 0.7)	0.52	0.4 (−0.9, 1.6)	0.58	0.0 (−1.0, 1.0)	0.95
Wheezing in the past 12 months	−2.0 (−3.0, −1.0)	**‹0.001**	−4.2 (−5.1, −3.3)	**‹0.001**	1.0 (0.1, 1.8)	**0.03**	0.7 (−0.1, 1.5)	**0.09**

(a) The reference category for each characteristic is italicised.

(b) The **overall p-value** represents evidence against the null hypothesis of no differences between groups (see text). Caution is urged when interpreting individual **category versus baseline p-values** (see Box 2: Interpretation of multivariable analyses).

Table 19: Multivariable relationships between child health characteristics and the Outcome Index and domain scores for the child cohort

	Outcome Index score n=4,373 R2=19.8%		Physical domain score n=4,378 R2=9.6%		Social–emotional domain score n=3,686 R2=23.4%		Learning domain score n=3,688 R2=15.5%	
Study child characteristic[a]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]
Perinatal								
‹2,500g at birth	−1.7 (−3.4, −0.1)	**0.04**	−1.4 (−3.2, 0.3)	**0.11**	0.5 (−1.2, 2.2)	**0.57**	−1.9 (−3.6, −0.2)	**0.03**
Gestational age		**0.01**		**0.51**		**0.21**		**0.008**
42 weeks or more	0.8 (−0.2, 1.8)	0.14	0.4 (−0.7, 1.4)	0.49	−0.3 (−1.5, 0.9)	0.58	1.5 (0.3, 2.8)	0.02
37–41 weeks	*0 (–,–)*		*0 (–,–)*		*0 (–,–)*		*0 (–,–)*	
33–36 weeks	−0.3 (−1.9, 1.3)	0.72	−0.4 (−2.2, 1.3)	0.63	−0.6 (−2.4, 1.1)	0.47	0.4 (−1.3, 2.0)	0.67
32 weeks or less	−4.1 (−7.1, −1.2)	0.006	−1.8 (−4.4, 0.8)	0.18	−3.1 (−6.0, −0.2)	0.04	−3.4 (−6.7, −0.1)	0.04
Postnatal								
Duration of breastfeeding		**‹0.001**		**0.11**		**‹0.001**		**0.02**
Never/‹1 week	*0 (–,–)*		*0 (–,–)*		*0 (–,–)*		*0 (–,–)*	
1 week–‹3 months	0.0 (−1.2, 1.3)	0.94	−0.6 (−1.9, 0.6)	0.32	0.3 (−1.0, 1.7)	0.61	0.2 (−1.0, 1.3)	0.76
3–‹6 months	1.9 (0.5, 3.3)	0.009	0.4 (−0.9, 1.8)	0.53	1.4 (−0.1, 2.9)	0.06	1.9 (0.4, 3.4)	0.02
›6 months	1.8 (0.7, 2.9)	0.002	0.4 (−0.6, 1.5)	0.42	2.4 (1.2, 3.5)	‹0.001	1.0 (0.0, 2.1)	0.05
Current								
General health – good/fair/poor	–		–		−2.2 (−3.4, −1.1)	**‹0.001**	0.1 (−0.9, 1.1)	**0.84**
Special health care needs	–		–		−3.6 (−4.8, −2.3)	**‹0.001**	−3.2 (−4.3, −2.1)	**‹0.001**
BMI status	–		–			**0.34**		**0.71**
Not overweight					*0 (–,–)*		*0 (–,–)*	
Overweight					0.5 (−0.3, 1.4)	0.23	−0.3 (−1.2, 0.6)	0.54
Obese					0.7 (−0.6, 2.1)	0.31	0.4 (−1.1, 1.9)	0.60
Change for each extra point on PEDS Physical(c)	–		–		0.2 (0.2, 0.2)	**‹0.001**	0.0 (0.0, 0.1)	**0.04**
Change for each extra healthful behaviour(c)	1.0 (0.7, 1.2)	‹0.001	0.7 (0.4, 1.0)	‹0.001	0.5 (0.2, 0.7)	**0.001**	0.5 (0.2, 0.8)	**0.004**
Enjoyment of physical activity		‹0.001		‹0.001		**‹0.001**		**0.57**
Dislikes or neutral	*0 (–,–)*		*0 (–,–)*		*0 (–,–)*		*0 (–,–)*	
Somewhat enjoys	−0.8 (−2.1, 0.5)	0.25	−1.2 (−2.6, 0.2)	0.08	−0.6 (−2.1, 0.9)	0.42	0.2 (−1.3, 1.7)	0.80
Very much enjoys	2.1 (0.9, 3.3)	‹0.001	1.9 (0.8, 3.1)	0.001	0.9 (−0.5, 2.3)	0.21	0.5 (−0.9, 1.9)	0.45
Doctor diagnosed and medicated asthma	−3.5 (−4.2, −2.7)	**‹0.001**	−6.0 (−7.0, −5.0)	**‹0.001**	−0.1 (−1.1, 0.9)	**0.81**	1.3 (0.2, 2.3)	**0.02**

(a) The reference category for each characteristic is italicised.
(b) The **overall p-value** represents evidence against the null hypothesis of no differences between groups (see text). Caution is urged when interpreting individual **category versus baseline p-values** (see Box 2: Interpretation of multivariable analyses).
(c) These two variables are continuous, not categorical.

4.3 Discussion

Although the Australian infants and children in the LSAC cohorts are generally considered by their parents to be in very good or excellent health, many children experience substantial health problems, including low birth weight (5 per cent), preterm birth (7 per cent), special health care needs (14 per cent), overweight/obesity (21 per cent), and asthma requiring medication (15 per cent). The prevalence of chronic childhood conditions such as asthma and obesity has been reported to have increased in recent decades, both in Australia and overseas (Asher et al. 2006; Booth et al. 2003; Perrin, Bloom & Gortmaker 2007; Ross Anderson et al. 2007; Shamssain 2007). The high prevalence of these problems is in line with other comparable national and international studies, supporting confidence in the generalisability of the subsequent multivariable associations.

The findings reported above suggest that many of these problems are already influencing the broad outcomes of Australian children as young as preschool age. There was strong evidence for many of the child health variables being associated with Outcome Index scores, with indicators of current health (most notably asthma and healthful nutritional behaviours) having as powerful an influence as perinatal influences (preterm birth). Given that the burden of poorer outcomes is likely to worsen over time for children with these problems, and that most of them are known to be at least partly preventable, these data lay down a very robust challenge to deliver health care and health promotion that can more effectively improve outcomes for Australian children.

Associations with health problems were often greater in the social–emotional and/or learning domain than in the physical domain, emphasising the importance of children's health to all aspects of children's functioning and wellbeing. This was further borne out by the strong relationships between the measures directly contributing to the physical domain (children's general health and the physical score of the PedsQL) and social–emotional domain scores for the child cohort.

The high prevalence of overweight and obesity (21 per cent) in the preschoolers is of particular concern, because of the rapidity with which its prevalence is rising. In the last national survey, the 1995 National Nutrition Survey involving 532 children aged 4 to 6 years (Magarey, Daniels & Boulton 2001), 13 per cent of boys and 19 per cent of girls were overweight or obese using the same cut-off points utilised in LSAC. Because BMI is incorporated into the Outcome Index, it was not possible in this report to study in depth its predictors or correlates with physical domain and overall Outcome Index score. However, at this young age, overweight and obesity were not strongly associated with poorer scores on the other two domains (social–emotional and learning). This is in keeping with limited international data regarding this age group, but contrasts with mounting evidence of poorer health and wellbeing in older children and adolescents and an unprecedented health burden in adults with obesity. LSAC should offer rich opportunities to study longitudinal relationships between physical and psychosocial health and BMI trajectories over time. Rapid early growth may be important in the early genesis of overweight and obesity (Stettler 2007), and will be an important variable to study in the infant cohort in future waves. The findings reported here (high prevalence, but as yet little morbidity) suggest that the preschool and school entry periods may be an optimal time to address excess adiposity, **before** health impacts develop.

However, it was possible to examine the impacts of healthful and less healthful nutritional and physical activity behaviours. Many preschoolers are not meeting nutritional guidelines for fruit and (particularly) vegetables, 75 to 80 per cent were reported to have consumed sweet drinks and foods likely to be high fat and/or high sugar the previous day, and close to 20 per cent were reported not to enjoy physical activity. All these factors were already implicated in children's health and overall outcomes, even after adjusting for sociodemographic circumstances. This was most striking for children who demonstrated no healthful nutritional behaviours the previous day, whose overall Outcome Index scores were approximately half a standard deviation lower than those with all five healthful behaviours.

With the exception of child height, weight and girth, direct child health measurements were not taken in the first wave of LSAC. Therefore, it is not possible to assess relationships between the multiple sociodemographic, non-parental care, health (both child and maternal) exposures and family learning environments on 'harder' health outcomes such as respiratory function and antecedents of diabetes and cardiovascular disease.

As seen in Sections 2, 3 and 5, associations with outcomes in the infants were less apparent than in the children, reinforcing the notion that the early years offer great potential for population interventions designed to prevent the emergence of disparities due to child health problems by the preschool year.

5 Mothers' health

Section summary

- LSAC mothers were broadly representative of all Australian mothers on parameters such as smoking and alcohol in pregnancy, mental health status, and prevalence of overweight and obesity.
- Serious maternal psychological distress was associated with a very substantial worsening of child outcomes. Better maternal general health and enjoyment of physical activity predicted better child Outcome Index scores, driven mainly by their impacts on the physical and social–emotional (rather than learning) domains.
- Prenatal health, smoking and alcohol use, and meeting nutritional and physical activity guidelines contributed relatively little to children's outcomes.

5.1 Introduction

This section addresses the following questions:

- What prenatal, postnatal, and current maternal health issues face Australian infants and 4 to 5 year-old children, and how strongly are these associated with child outcomes?
- What associations do maternal choices regarding healthful levels of physical activity, nutritional habits and substance use (smoking, alcohol) have with their children's overall functioning?
- When considered relative to each other, which factors appear to make the strongest contribution to children's overall wellbeing?

Like the child health data, maternal health data collected in Wave 1 were mainly cross-sectional. However, retrospective data regarding maternal health during pregnancy and the postnatal period allow us to start to appreciate the longitudinal nature of the development of good and poor child outcomes in the early years.

5.2 Findings

Maternal health variables

The **maternal health variables** (Table 20) could broadly be classified as **prenatal, postnatal, current health**, and **current lifestyle**. In the bivariate and multivariable analyses, we examined whether maternal health variables predicted Outcome Index scores, while noting the caveats regarding causal inferences above. All maternal health measures were self-reported.

The **child outcomes** examined for this section were the overall Outcome Index and the three domain scores. We examined the association between each maternal health variable with the continuous Outcome Index score and the proportion of study children with an Outcome Index score in the top 15 per cent and bottom 15 per cent of their cohort.

Figures 11 to 12 show the proportions of the child cohort according to the maternal health variables scoring in the top 15 per cent (that is, above the positive cut-off) and bottom 15 per cent (that is, below the negative cut-off) of total Outcome Index scores. Independent associations of each variable with the overall Outcome Index score for both the infant and child cohorts were examined using multivariable regression analyses controlling for all other prenatal, postnatal, current health and current lifestyle variables as well as for the set of socioeconomic variables referred to in Section 2. These results are presented in Tables 21 and 22.

The proportions of the child cohort according to each maternal health variable scoring in the top and bottom 15 per cent of overall Outcome Index scores show that some of the relationships are striking, while

others are marginal or absent (see Figures 9 and 10). These analyses are bivariate, that is, not adjusted for sociodemographic or other variables. Comparable graphs for the infant cohort are not shown; relationships between health variables and high or low Outcome Index scores were generally either absent or weaker than (but in the same direction as) the child cohort.

Prenatal maternal health variables

- **Physical health problems during pregnancy**: close to 6 per cent of mothers reported having diabetes in both cohorts. The prevalence of diabetes in pregnancy (mainly gestational diabetes) is uncertain because of its rapidly changing epidemiology and the multiple sets of criteria in use internationally for its diagnosis (Agarwal et al. 2005). However, the LSAC prevalence appears to be at the lower end of recently-quoted rates of ≥8 per cent, suggesting either that the LSAC cohorts had lower rates of gestational diabetes (that is, were healthier than average) or that not all cases had been detected. Of children whose mothers reported having gestational diabetes, 21 per cent fell into the lowest 15 per cent of Outcome Index scores, compared to less than 15 per cent of children whose mothers did not report this condition.
- About 8 per cent in both cohorts reported **hypertension**, comparable to the 9.8 per cent prevalence (0.6 per cent chronic hypertension, 4.2 per cent pre-eclampsia, 0.3 per cent chronic hypertension with pre-eclampsia, and 4.3 per cent gestational hypertension) reported in a recent large New South Wales study of women delivering babies in 2000–2002 (Roberts et al. 2005). Children whose mothers reported hypertension during pregnancy were slightly overrepresented in the lowest 15 per cent of Outcome Index scores compared to children whose mothers did not report this condition (18 per cent versus 15 per cent).
- **Smoking**: close to 20 per cent of mothers in both cohorts reported smoking during pregnancy, a figure which is comparable to the 17 per cent reported in five states and territories in 2003 (Laws & Sullivan 2005); heavy smoking was, however, rarely reported (see Table 20). Of infants whose mothers reported smoking more than two packs of cigarettes per day during pregnancy, 30 per cent fell in the lowest 15 per cent of Outcome Index scores, compared to 15 per cent of infants whose mothers did not smoke during pregnancy. The percentage of the child cohort scoring in the top 15 per cent of Outcome Index scores fell from no smoking (17 per cent), through occasional smoking (11 per cent), to daily smoking (5 per cent), while the percentage scoring in the bottom 15 per cent of Outcome Index scores rose in a stepwise fashion from 13 per cent for no smoking to over 27 per cent for smoking most days.
- **Alcohol consumption** during pregnancy was reported more often for the infant cohort (38 per cent) than the child cohort (28 per cent). Reported rates from other studies vary greatly (from 22 to 76 per cent) depending on the sampling strategy, but the rates for both LSAC cohorts appear somewhat higher than reported in the 2005 Alcohol Awareness Survey, in which 23 per cent of Australian women aged 25 to 49 years reported continuing to drink during pregnancy (Roy Morgan Research 2005). Less than 1 per cent of mothers in both cohorts reported consumption 'most days' during pregnancy. The percentage of children scoring in the lowest and highest 15 per cent of Outcome Index scores showed little variation according to the frequency of alcohol consumption during pregnancy (did not drink, drank occasionally, drank most days), with the perhaps surprising exception that a high percentage of children whose mothers reported drinking most days during pregnancy (29 per cent) scored above the positive cut-off for the Outcome Index.

Postnatal maternal health variables

- **Postnatal depression**: 15 per cent of child cohort mothers reported that they experienced postnatal depression during the first year after the study child was born, in keeping with Australian epidemiologic studies using community measures (such as the Edinburgh Postnatal Depression Scale) during the first postnatal year (Boyce & Stubbs 1994; Brown & Lumley 1998). This question was not asked of mothers of the infant cohort, since in most cases a full year had not elapsed since birth at that time so that, for most of the infants, the current maternal health and lifestyle variables could equally well be considered to be 'postnatal'. Of children whose mothers reported postnatal depression, 20 per cent fell below the negative cut-off for the Outcome Index compared to 13 per cent of children whose mothers reported not having this condition.

Current maternal health variables

- **General health**: this was rated using the same widely used five point global health item (derived from the SF-6, see Ware et al. 1992) as for the children, with response options of excellent, very good, good, fair and poor. Only 61 per cent of mothers of the infant cohort and 58 per cent of mothers of the child cohort rated their own health as excellent/very good, with the remainder (39 per cent and 42 per cent respectively) reporting their own health to be good, fair or poor. This contrasts with how mothers see the general health of their children (Section 4), with 87 per cent of infants and children rated as being in excellent/very good health. Children whose mothers reported good/fair/poor health were overrepresented in the lowest 15 per cent of Outcome Index scores (23 per cent compared to 10 per cent of children whose mothers reported excellent or very good health).

- **Serious psychological distress**: the Kessler six-item screen of adult mental health (K-6) (Kessler et al. 2003) probes symptoms of anxiety and depression, is well validated and is widely used in large Australian surveys. Possible scores range from 6 to 30; these scores were dichotomised using the standard recommended cut points for the K-6. Serious maternal psychological distress (a score ≤18) was reported by 4 per cent of mothers of the infant cohort and 6 per cent of the child cohort.

- The percentage of children scoring in the lowest and 15 per cent of Outcome Index scores differed strikingly according to maternal mental health status. Only 3 per cent of children of distressed mothers had Outcome Index scores above the positive cut-off, while more than 40 per cent had scores below the negative cut-off.

- The **BMI status** of mothers in both cohorts was nearly identical, with 55 per cent classified as not overweight, 26 per cent overweight (BMI›25 up to 30 kg/m^2), and 18 to 19 per cent obese (BMI›30kgm^2), in keeping with other recent surveys. Only 10 per cent of children of obese mothers were above the Outcome Index positive cut-off, while 22 per cent were below the negative cut-off (compared to 17 per cent and 13 per cent of children of non-overweight mothers, respectively).

Current maternal lifestyle variables

- **Current alcohol consumption**: reported daily intake was low, with the median number of alcoholic drinks per day being 0.14 for the infant cohort and 0.20 for the child cohort, and only 2 per cent and 3 per cent of mothers respectively averaging more than two standard drinks daily—the current NHMRC definition of 'risky drinking' (NHMRC 2001). Forty-five per cent of mothers in the child cohort, and 48 per cent in the infant cohort, reported either never drinking or drinking less than one drink per month. Surprisingly, children whose mothers averaged more than two standard drinks daily were underrepresented in the bottom 15 per cent of Outcome Index scores (8 per cent compared to 16 per cent of children whose mothers who drank less than two standard drinks daily).

- Regarding **binge drinking**, although the NHMRC considers more than five standard drinks in a session to be 'a binge' for women, it does not stipulate how often this must occur to constitute 'binge drinking' (NHMRC 2001). If defined as five or more standard drinks in a sitting twice a month or more, 7 per cent of mothers in the infant cohort and 12 per cent of mothers in the child cohort could be classified as binge drinkers. The percentage of children scoring in the lowest 15 per cent of Outcome Index scores showed little variation according to maternal binge drinking.

- **Current smoking**: 20 per cent of mothers in both cohorts were smokers, nearly identical to 2001 Australian national figures of 20.8 per cent of women over 14 years of age reported to smoke at least occasionally (AIHW 2001). Of those who smoked, 60 per cent reported smoking up to half a packet per day, 6 to 7 per cent up to a full pack per day, and 1 to 2 per cent more than a pack a day. The majority of parents (86 to 88 per cent) reported that no one smoked inside the house; 8 to 10 per cent of households had one person and 4 per cent had two or more people who smoked inside.

- The percentage of children scoring in the highest and lowest 15 per cent varied considerably by current maternal smoking and the number of people smoking inside the study child's household (Figure 12). Only 3 per cent of children whose mothers smoked more than two packets of cigarettes daily scored above the

positive Outcome Index cut-off (compared to 17 per cent of children whose mothers did not smoke), while 35 per cent scored below the negative cut-off (compared to 14 per cent of children whose mothers did not smoke). Similarly, 28 per cent of children living with two or more reported indoor smokers scored below the negative cut-off (compared to 14 per cent of children not living with indoor smokers), and just 3 per cent scored above the positive cut-off (compared to 16 per cent of children not living with indoor smokers).

- Mothers reported on their own **nutrition**, by estimating the number of serves of fruit and of vegetables per day using standardised questions developed for Australia. Only 3.5 per cent of mothers across both cohorts reported meeting current recommendations (five or more serves of vegetables and two or more serves of fruit per day) (NHMRC 2003a). Children whose mothers met these recommendations were overrepresented in the top 15 per cent of Outcome Index scores (20 per cent compared to 15 per cent of children whose mothers did not meet the recommendations).
- Mothers also reported on their own **physical activity** levels. Close to 30 per cent in both cohorts reported that they found physical activity to be not enjoyable/a little enjoyable, around 30 per cent reported it as very enjoyable, with the remaining 40 per cent finding it moderately enjoyable. The percentage of the child cohort scoring in the top 15 per cent of Outcome Index scores rose in a stepwise fashion from 'not enjoyable/a little enjoyable' (12 per cent) to 'very enjoyable' (20 per cent), while the percentage scoring in the bottom 15 per cent of Outcome Index scores fell from 'not enjoyable/a little enjoyable' (21 per cent) through to 'very enjoyable' (10 per cent). According to their reports, 17 to 18 per cent of mothers meet the current recommendation of at least 30 minutes of moderate to vigorous physical activity (MVPA) five or more times per week, with the median frequency of 30 minutes daily MVPA being two days per week for both cohorts (Department of Health and Ageing 1999). The percentage of children scoring in the highest or lowest 15 per cent of Outcome Index scores showed little variation according to MVPA status.

Impact of maternal health variables on child outcomes: multivariable analyses

Tables 21 (infant cohort) and 22 (child cohort) show multivariable linear regression relationships between the maternal health variables and the continuous Outcome Index and domain scores, all adjusted for the nine key sociodemographic variables identified in Section 2. Table 21 shows that the final multivariable models for the **infant cohort** accounted for only small proportions of the total variance in scores (5.5 per cent of the overall Outcome Index and 5 per cent or less for each domain score). Over and above the contribution of the sociodemographic variables, the maternal health variables as a group accounted for 3.6 per cent of the variability in overall Outcome Index score.

There was no evidence that diabetes, hypertension, or cigarette smoking during pregnancy were associated with overall Outcome Index or domain scores (all $p>0.10$), suggesting that the observed correlation between heavy prenatal smoking and infant Outcome Index scores may be largely explicable by sociodemographic gradients. There was strong evidence ($p<0.001$) that maternal general health (but not serious psychological distress) affected infant overall and physical and social–emotional scores, all of which were on average 2 to 3 points lower if the mother reported only good, fair or poor (as opposed to excellent or very good) general health. There was no evidence that daily alcohol consumption, maternal smoking, number of residents smoking indoors, or maternal fruit and vegetable intake were associated with Outcome Index scores (all $p>0.30$). There was strong evidence ($p<0.001$) that increasing maternal enjoyment of physical activity was associated with increasing overall Outcome Index, social–emotional and learning domain scores, but not physical domain scores. Regarding maternal BMI status, the single finding that overweight and obesity were associated with slightly higher social–emotional domain scores is of uncertain importance.

Table 22 shows that the final multivariable models for the **child cohort** accounted for considerably larger proportions of the total variance in scores (20 per cent for the overall Outcome Index, 7 per cent for the physical domain, 17 per cent for the social–emotional domain, and 14 per cent for the learning domain respectively). Over and above the contribution of the nine sociodemographic variables, the maternal health variables as a group accounted for 6.4 per cent of variability in Outcome Index scores. Regarding maternal health impacts on the LSAC children, Table 22 shows the following strong associations:

- Poorer **maternal general health** was associated with lowered overall Outcome Index, physical and social–emotional domain scores, even more than in the infant cohort (with scores falling by 3 to 4 points on average, p<0.001).
- **Serious psychological distress** was associated with lower scores on all Outcome Index measures, with the largest effect size being for overall Outcome Index and social–emotional domain scores (with scores falling by 5 and 6 points on average—more than half a standard deviation—respectively, both p<0.001).
- Maternal **enjoyment of physical activity** was associated with higher overall Outcome Index (p=0.002) and social–emotional domain (p<0.001) scores (with scores falling by 2 points on average).

For all other maternal health variables, there was either no evidence of association with Outcome Index or domain scores (diabetes and hypertension in pregnancy; current alcohol and smoking; and fruit and vegetable intake) or the associations were weak and/or inconsistent in direction (cigarette smoking during pregnancy, number of residents who smoke indoors, BMI status).

Substantial amounts of data were missing for both the postnatal depression and maternal BMI status variables. Because postnatal depression had the highest number of missing cases and showed little relationship to overall Outcome Index or domain scores, it was excluded from the multivariable analyses reported above (which increased the available child sample by around 250 individuals). Maternal BMI status was missing for a further 224 infants and 217 children, and made a borderline contribution to the learning domain score (p=0.02) in the child cohort. Data on BMI status were more likely to be missing when a language other then English was spoken at home, with lower maternal education and low family income (both infants and children); lower occupational class (infants only); and being an Aboriginal or Torres Strait Islander (child cohort only) (all p<0.05). Therefore, the multivariable analysis was repeated without the inclusion of maternal BMI status as a potential predictor. Total variance explained was nearly identical with and without maternal BMI status and no conclusion changed as a result.

Table 20: Physical health characteristics of mothers of the infant and child cohorts

Maternal characteristic	Infants		Children	
	n	Value	n	Value
Prenatal				
Had diabetes during pregnancy (%)	4,223	5.9	4,043	5.7
Had high blood pressure during pregnancy (%)	4,238	8.3	4,069	8.0
Drank alcohol during pregnancy (%)	4,227	37.6	4,075	27.7
Frequency of alcohol consumption during pregnancy (%)	4,054		4,075	
Did not drink at all		62.7		72.4
Drank occasionally		36.5		27.1
Drank most days		0.7		0.5
Smoked cigarettes during pregnancy (%)	4,239	18.3	4,074	20.0
Frequency of maternal cigarette smoking during pregnancy (%)	–		4,074	
Did not smoke at all				80.0
Smoked occasionally				9.7
Smoked most days				10.3
Number of cigarettes smoked daily during pregnancy (%)	4,284		–	
None		83.7		
1–12		12.1		
13–24		3.5		
25 or more		0.7		

Postnatal				
Suffered from postnatal depression (%)	–		3,738	15.4
Current health				
General health (%)	4,300		4,160	
Excellent/very good		61.0		58.0
Good/fair/poor		39.0		42.0
Suffers from serious psychological distress (%)	4,307	4.1	4,164	6.0
BMI status of mother (%)	3,957		3,843	
Not overweight		55.4		55.6
Overweight		25.9		26.1
Obese		18.7		18.3
Current lifestyle				
Average daily alcohol consumption (median [p25, p75])	4,152	0.14 [0.05, 0.57]	3,977	0.20 [0.05, 0.57]
Average daily alcohol consumption is greater than two standard drinks (%)	4,152	2.1	3,977	3.4
Has five or more standard drinks in a sitting two times per month or more often (%)	4,213	7.4	4,050	11.6
Number of cigarettes smoked daily (%)	4,284		4,119	
None		80.6		78.9
1–12		12.4		12.2
13–24		5.7		7.0
25 or more		1.3		2.0
Number of residents who smoke inside household (%)	4,301		4,175	
None		87.8		85.7
One		8.0		10.4
Two or more		4.2		3.9
Has five or more serves of vegetables and two or more serves of fruit per day (%)	4,299	3.5	4,152	3.6
Level of enjoyment of physical activity (%)	4,300		4,157	
Not enjoyable/a little enjoyable		30.9		28.2
Moderately enjoyable		42.8		42.0
Very enjoyable		26.3		29.8
Days per week that mother does 30 minutes of MVPA (median [p25, p75])	4,307	2 [1, 4]	4,152	2 [1, 4]
Does 30 minutes of MVPA 5 or more times per week (%)	4,307	16.5	4,152	17.8

Note: p25=25th percentile, p75=75th percentile.
Due to rounding, percentages may not add to 100 per cent (or subtotals) exactly.

Figure 11: Low Outcome Index: percentage of child cohort

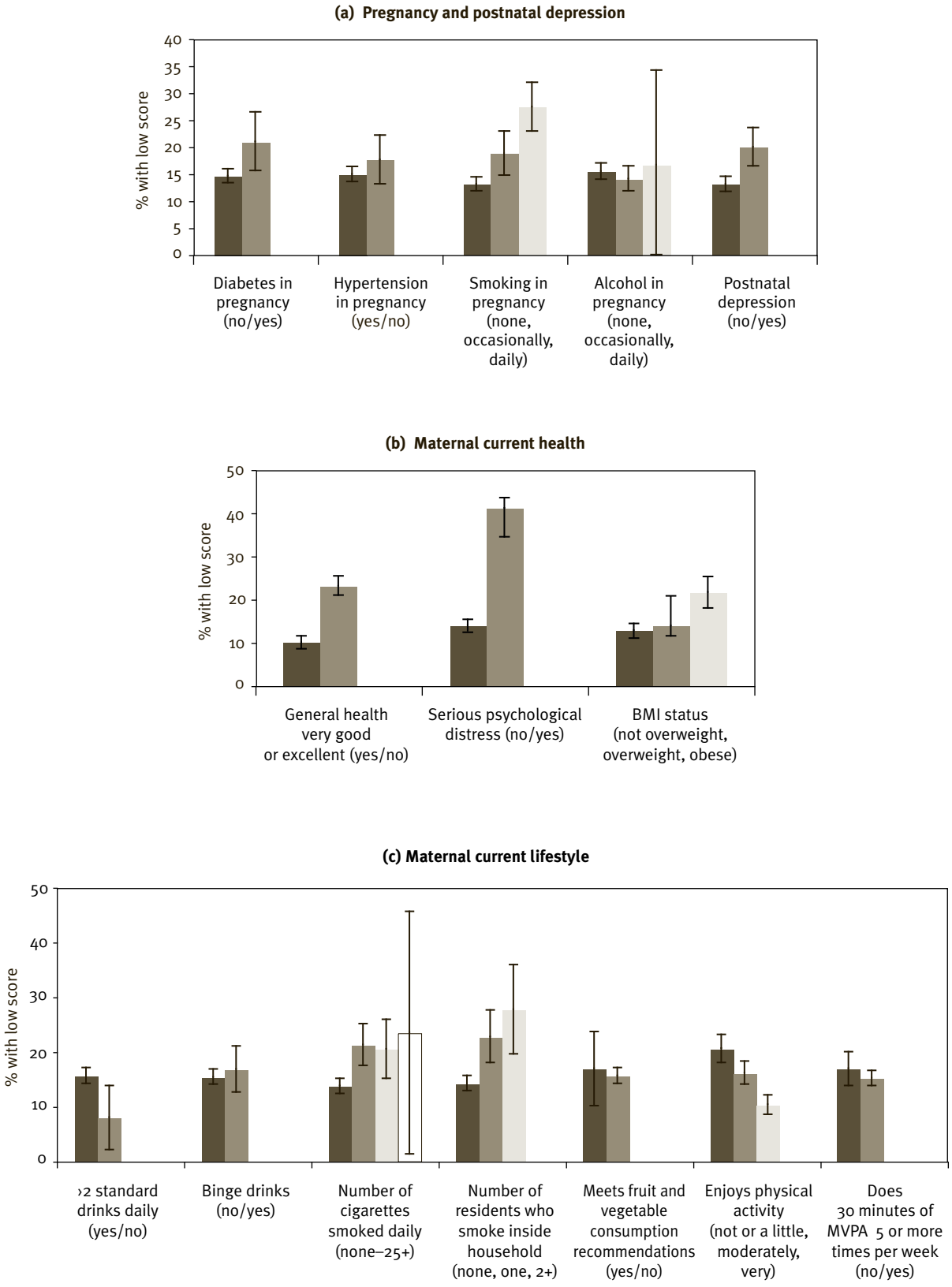


Figure 12: High Outcome Index: percentage of child cohort

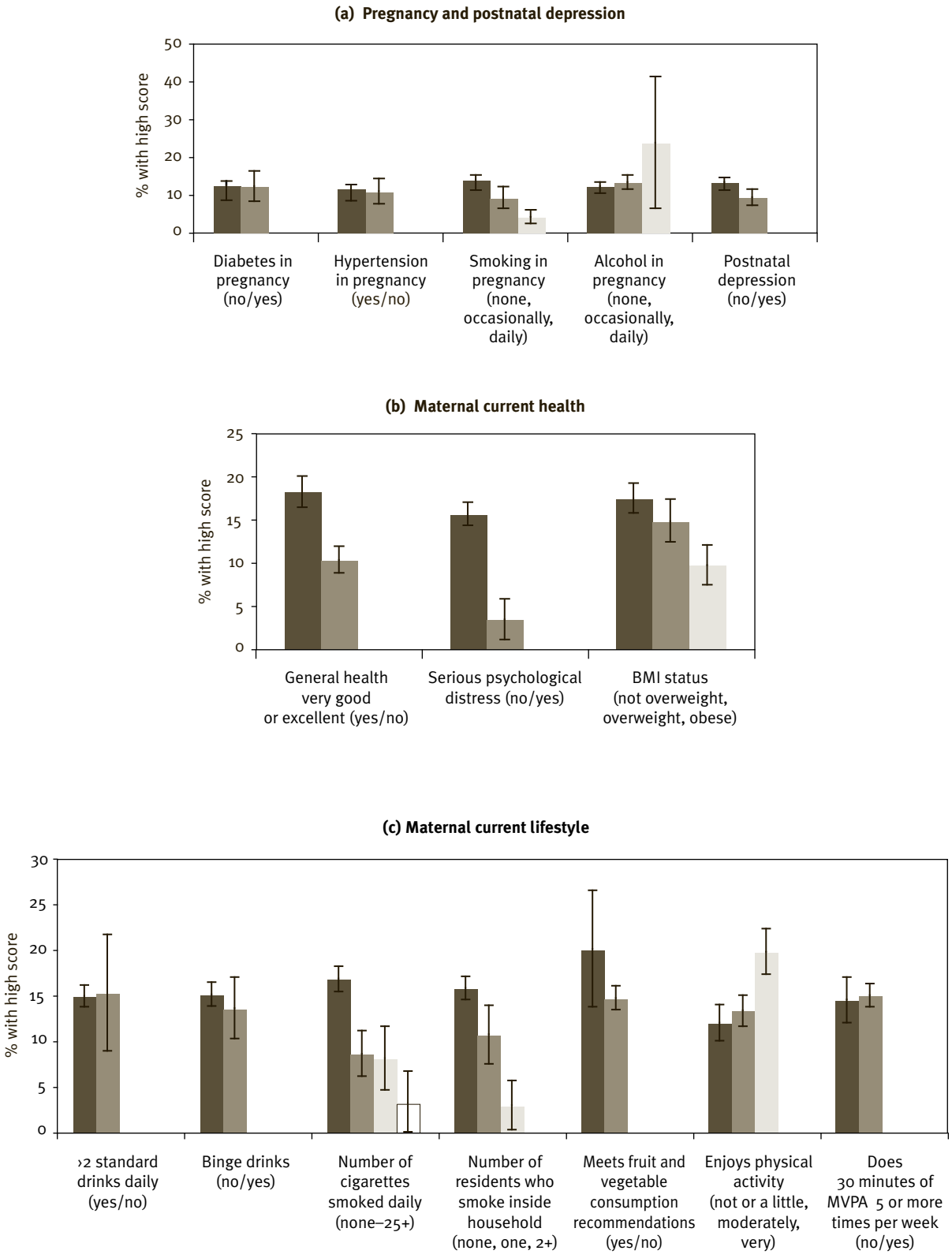


Table 21: Multivariable relationships between maternal health characteristic and the Outcome Index and domain scores for the infant cohort

	Outcome Index score n=2,909 R2=5.5%		Physical domain score n=3,310 R2=5.0%		Social–emotional domain score n=3,304 R2=4.5%		Learning domain score n=2,916 R2=3.9%	
Maternal characteristic[a]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]
Prenatal								
Diabetes	−0.4 (−2.1, 1.3)	**0.62**	−0.7 (−2.5, 1.0)	**0.40**	0.2 (−1.4, 1.7)	**0.84**	−0.6 (−2.4, 1.1)	**0.47**
Hypertension	0.9 (−0.6, 2.5)	**0.24**	−0.2 (−1.7, 1.4)	**0.83**	−0.1 (−1.4, 1.3)	**0.93**	1.2 (−0.3, 2.6)	**0.11**
No. of cigarettes smoked daily		**0.42**		**0.80**		**0.92**		**0.09**
None	*0 (–,–)*		*0 (–,–)*		*0 (–,–)*		*0 (–,–)*	
1–12	−0.6 (−2.4, 1.3)	0.53	−0.3 (−2.1, 1.5)	0.73	0.1 (−1.4, 1.6)	0.91	−0.1 (−1.6, 1.5)	0.94
13–24	1.0 (−1.9, 3.9)	0.49	−0.7 (−3.6, 2.2)	0.64	1.0 (−1.9, 4.0)	0.49	1.0 (−1.7, 3.6)	0.47
25 or more	−4.0 (−11.6, 3.5)	0.29	−4.2 (−12.8, 4.3)	0.33	0.3 (−7.3, 8.0)	0.93	−6.6 (−12.2, −1.0)	0.02
Current health								
General health good/fair/poor	−2.7 (−3.6, −1.9)	**‹0.001**	−3.1 (−3.9, −2.3)	**‹0.001**	−2.3 (−3.1, −1.5)	**‹0.001**	−0.1 (−0.8, 0.7)	**0.85**
Psychological distress (serious)	0.2 (−2.0, 2.5)	**0.86**	−0.2 (−2.6, 2.1)	**0.85**	0.1 (−2.4, 2.6)	**0.96**	1.0 (−0.8, 2.8)	**0.29**
BMI status		**0.07**		**0.76**		**‹0.001**		**0.37**
Not overweight	0 (–,–)		0 (–,–)		0 (–,–)		0 (–,–)	
Overweight	1.0 (0.2, 1.9)	0.02	−0.1 (−1.0, 0.7)	0.72	1.6 (0.7, 2.4)	‹0.001	0.5 (−0.4, 1.3)	0.30
Obese	0.1 (−0.9, 1.2)	0.79	−0.4 (−1.4, 0.6)	0.48	1.4 (0.4, 2.3)	0.007	−0.3 (−1.4, 0.8)	0.56
Current lifestyle								
Daily alcohol consumption ›2 standard drinks	−1.2 (−3.9, 1.5)	**0.39**	0.3 (−2.2, 2.9)	**0.80**	−0.3 (−2.5, 1.9)	**0.80**	−2.1 (−4.6, 0.3)	**0.09**
No. of cigarettes smoked daily		0.38		0.84		0.50		0.18
None	*0 (–,–)*		*0 (–,–)*		*0 (–,–)*		*0 (–,–)*	
1–12	1.6 (−0.2, 3.3)	0.09	−0.5 (−2.3, 1.3)	0.58	1.0 (−0.5, 2.6)	0.18	2.0 (0.2, 3.7)	0.03
13–24	1.2 (−1.2, 3.6)	0.32	−1.0 (−3.7, 1.7)	0.47	1.4 (−0.8, 3.5)	0.22	1.2 (−1.1, 3.6)	0.29
≥25	0.0 (−4.9, 4.9)	1.0	−1.4 (−5.8, 2.9)	0.52	1.8 (−2.7, 6.3)	0.43	1.8 (−2.5, 6.1)	0.42
No. of residents who smoke inside		**0.74**		**0.57**		**0.30**		**0.005**
None	*0 (–,–)*		*0 (–,–)*		*0 (–,–)*		*0 (–,–)*	
One	0.2 (−1.4, 1.8)	0.80	−0.8 (−2.4, 0.8)	0.34	−1.1 (−2.7, 0.5)	0.16	2.2 (0.7, 3.6)	0.003
Two or more	−0.9 (−3.1, 1.4)	0.46	0.4 (−2.0, 2.8)	0.73	−0.8 (−2.7, 1.2)	0.45	−1.1 (−3.1, 1.0)	0.32
≥5 serves of vegetables and ≥2 serves of fruit/day	−1.0 (−3.2, 1.3)	**0.40**	0.8 (−1.7, 3.2)	**0.54**	−0.3 (−2.2, 1.6)	**0.75**	−1.9 (−4.2, 0.4)	**0.10**
Enjoyment of physical activity		**‹0.001**		**0.24**		**‹0.001**		**‹0.001**
Dislikes/neutral	*0 (–,–)*		*0 (–,–)*		*0 (–,–)*		*0 (–,–)*	
Somewhat enjoys	1.7 (0.8, 2.6)	‹0.001	0.4 (−0.4, 1.2)	0.34	1.4 (0.5, 2.2)	0.002	1.7 (0.8, 2.6)	‹0.001
Very much enjoys	2.8 (1.8, 3.8)	‹0.001	0.8 (−0.1, 1.8)	0.09	2.3 (1.4, 3.2)	‹0.001	2.2 (1.1, 3.3)	‹0.001

(a) The reference category for each characteristic is italicised.
(b) The **overall p-value** represents evidence against the null hypothesis of no differences between groups (see text). Caution is urged when interpreting individual **category versus baseline p-values** (see Box 2: Interpretation of multivariable analyses).

Table 22: Multivariable relationships between maternal health characteristic and the Outcome Index and domain scores for the child cohort

	Outcome Index score n=3,332 R2=19.5%		Physical domain score n=3,325 R2=7.1%		Social–emotional domain score n=3,332 R2=16.9%		Learning domain score n=3,325 R2=14.2%	
Maternal characteristic[a]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]	**Coefficient (95% CI)**	**p-value**[b]
Prenatal								
Diabetes	−0.2 (−1.6, 1.3)	**0.81**	−1.6 (−3.3, 0.1)	**0.07**	0.5 (−1.0, 2.0)	**0.49**	0.8 (−0.9, 2.5)	**0.35**
Hypertension	0.1 (−1.0, 1.3)	**0.82**	−0.3 (−1.6, 1.1)	**0.69**	0.2 (−1.0, 1.4)	**0.75**	0.0 (−1.3, 1.3)	**0.98**
Cigarette smoking		**0.05**		**0.68**		**0.02**		**0.02**
Did not smoke	*0 (–,–)*		*0 (–,–)*		*0 (–,–)*		*0 (–,–)*	
Occasionally	−0.7 (−2.0, 0.7)	0.33	0.4 (−1.0, 1.8)	0.59	−1.0 (−2.4, 0.4)	0.16	−0.8 (−2.2, 0.6)	0.28
Most days	−1.8 (−3.2, −0.3)	0.02	0.7 (−0.9, 2.2)	0.41	−2.2 (−3.7, −0.6)	0.005	−2.3 (−3.8, −0.7)	0.004
Current health								
General health good/fair/poor	−3.3 (−4.0, −2.7)	**‹0.001**	−4.1 (−4.8, −3.4)	**‹0.001**	−2.6 (−3.3, −2.0)	**‹0.001**	−0.4 (−1.1, 0.3)	**0.31**
Psychological distress (serious)	−5.1 (−6.9, −3.4)	**‹0.001**	−2.0 (−3.8, −0.2)	**0.03**	−6.4 (−8.3, −4.6)	**‹0.001**	−2.3 (−4.1, −0.5)	**0.01**
BMI status		**0.04**		**0.33**		**0.43**		**0.02**
Not overweight	0 (–,–)		0 (–,–)		0 (–,–)		0 (–,–)	
Overweight	−0.1 (−0.8, 0.7)	0.88	0.0 (−0.7, 0.8)	0.94	0.0 (−0.7, 0.8)	0.93	−0.2 (−1.0, 0.6)	0.65
Obese	−1.2 (−2.2, −0.2)	0.02	−0.8 (−2.0, 0.3)	0.16	−0.6 (−1.7, 0.4)	0.23	−1.3 (−2.2, −0.4)	0.005
Current lifestyle								
Daily alcohol consumption ›2 standard drinks	0.8 (−0.6, 2.3)	**0.26**	0.5 (−1.2, 2.2)	**0.57**	0.8 (−0.7, 2.4)	**0.28**	0.4 (−1.3, 2.2)	**0.63**
No. of cigarettes smoked daily		0.48		0.44		**0.24**		**0.22**
None	*0 (–,–)*		*0 (–,–)*		*0 (–,–)*		*0 (–,–)*	
1–12	0.0 (−1.2, 1.3)	0.95	0.1 (−1.3, 1.6)	0.86	0.1 (−1.1, 1.4)	0.81	−0.2 (−1.5, 1.1)	0.76
13–24	1.0 (−0.7, 2.8)	0.23	0.1 (−1.7, 1.9)	0.91	0.6 (−1.3, 2.5)	0.51	1.5 (−0.4, 3.3)	0.13
25 or more	−0.7 (−3.1, 1.7)	0.56	2.0 (−0.5, 4.5)	0.11	−2.5 (−5.4, 0.4)	0.09	−1.0 (−3.7, 1.8)	0.48
No. of residents who smoke inside		**0.23**		**0.43**		**0.56**		**0.006**
None	*0 (–,–)*		*0 (–,–)*		*0 (–,–)*		*0 (–,–)*	
One	−1.1 (−2.4, 0.3)	0.12	0.4 (−1.0, 1.8)	0.55	−0.7 (−1.9, 0.6)	0.30	−2.0 (−3.2, −0.8)	0.001
Two or more	−1.1 (−3.3, 1.2)	0.36	−1.2 (−3.7, 1.3)	0.33	−0.5 (−2.6, 1.6)	0.64	−0.5 (−2.9, 1.9)	0.69
≥5 serves of vegetables and ≥2 serves of fruit/day	1.2 (−0.5, 2.9)	**0.17**	1.4 (−0.8, 3.6)	**0.22**	0.8 (−0.9, 2.4)	**0.37**	−0.4 (−2.2, 1.3)	**0.64**
Enjoyment of physical activity		**0.002**		**0.91**		**‹0.001**		
Dislikes/neutral	*0 (–,–)*		*0 (–,–)*		*0 (–,–)*		*0 (–,–)*	**0.38**
Somewhat enjoys	0.4 (−0.5, 1.2)	0.38	−0.2 (−1.1, 0.7)	0.73	0.9 (0.0, 1.7)	0.05	0.0 (−0.8, 0.8)	1.0
Very much enjoys	1.4 (0.6, 2.2)	0.001	0.0 (−0.9, 0.9)	0.99	2.4 (1.5, 3.3)	‹0.001	0.5 (−0.4, 1.4)	0.29

(a) The reference category for each characteristic is italicised.

(b) The **overall p-value** represents evidence against the null hypothesis of no differences between groups (see text). Caution is urged when interpreting individual **category versus baseline p-values** (see Box 2: Interpretation of multivariable analyses).

5.3 Discussion

These findings confirm the major role of mothers' own health in their children's outcomes. LSAC mothers were broadly representative of all Australian mothers on parameters such as smoking and alcohol in pregnancy, mental health status, and prevalence of overweight and obesity. This gives confidence that the associations between maternal health and children's outcomes revealed in the multivariable analyses are likely to be generalisable to the broader population of Australian children.

Of all the child and maternal health variables studied, serious maternal psychological distress predicted the greatest fall in children's outcomes (by half a standard deviation or more). Rates of serious maternal psychological distress were 1.5 times higher in mothers of preschoolers (6 per cent) than mothers of infants (4 per cent). This is not an isolated finding—Queensland's Longitudinal Mater Study (Najman et al. 2000) also reported that maternal depression was more common prenatally and at age 4 than in the postnatal year. There appears to be a need for services and supports directed at improving maternal mental health throughout the entire preschool period, and perhaps beyond.

Maternal general health and enjoyment of physical activity were other powerful predictors of child Outcome Index scores, driven mainly by their impacts on the physical and social–emotional (rather than learning) domains, though their impacts were less sizeable than that of maternal mental health. However, prenatal health, smoking and alcohol use, and meeting nutritional and physical activity guidelines contributed relatively little to children's outcomes in these analyses. These are interesting findings, given that children's own nutritional habits appeared to make a significant and substantial contribution to their outcomes, and that the prenatal maternal health variables studied (hypertension, diabetes, smoking, and alcohol intake) would be expected to contribute to conditions such as intrauterine growth restriction and preterm birth—which did show strong relationships with children's outcomes. It is recognised that separating 'child' and 'maternal' variables is artificial, since they are so closely intertwined particularly during pregnancy. Therefore, analyses combining child and maternal health variables might alter somewhat the relationships depicted in Sections 4 and 5, but were beyond the scope of this report. It is also likely that sociodemographic gradients 'explain' why some of the associations seen in the bivariate were not evident in the multivariable analyses.

The high prevalence of maternal overweight and obesity is of great concern, since maternal BMI status typically exceeds all other risk factors for current and future obesity in their offspring. Though beyond the scope of this report, this relationship has been demonstrated to hold for the LSAC children (Wake et al. 2007). However, it is not surprising that maternal BMI contributed little to children's outcomes, since child overweight/obesity itself had little impact on outcomes. Over time, it is likely that relationships between maternal BMI status, child BMI status, and child outcomes will emerge and intensify.

Taken together, the data in Sections 4 and 5 strongly suggest that children's physical health, mothers' psychological health, and the healthful behaviours of both children and mothers make major contributions to Australian children's outcomes throughout the early years.

6 Family learning environments and child outcomes

Section summary

The family environment plays a central role in young children's socialisation and learning. To a large extent, young children learn by interacting with family members in a variety of activities at home and in the community. Important family environment predictors for a higher Outcome Index for 4 to 5 year-old children, after controlling for child and family characteristics, included:

- a family member read to the child on three or more days per week
- there were 10 or more children's books in the family home
- the child enjoyed being read to by a family member for more than 10 minutes at a time
- the child had access to a computer at home
- the child had medium or high engagement in out-of-home activities with family members.

Children who watched more hours of television during the week or on the weekend had lower Outcome Index scores. This effect was apparent for children who averaged three or more hours of television on weekdays and five or more hours of television on weekend days.

6.1 Introduction

Children begin school with different levels of preparation for learning which are strongly determined by learning opportunities afforded to them in the family. The nature and frequency of shared activities between adults and children constitute important variations in children's early learning experiences and competence in the early years of school (Bradley et al. 2001; Tudge et al. 2003). Children's exposure to literacy materials in the home and their engagement with adults in a range of family activities provide cognitive stimulation and promote skill development. The communication that occurs between adults and children during such shared engagement in activities is particularly important. Martini and Mistry (1993) found that children who did better in their early schooling had parents who consistently responded to children's communicative initiations, read to them frequently, and engaged in shared activities. Bennett, Weigel and Martin (2002) reported that family values and practices that reflected an orientation of 'family as educator' were most predictive of children's higher achievement in the early years of school.

In this section the following research questions are addressed in relation to the Wave 1 LSAC data for the child cohort only:

- What is the nature of the early literacy environment in the home for these children?
- What home and out-of-home learning activities do family members share with children?
- How much television do children view at home?
- What access do children have to computers and how much do they use them?
- Do these learning experiences and opportunities in the family relate to children's outcomes?

In this section, children's early literacy experiences in the home are described as well as the nature of home and out-of-home learning activities between children and family members. The information is presented in Table 23. The nature of children's experiences is then related to their positive and negative overall Outcome Index scores

(comprising the top and bottom 15 per cent of the distribution). Results for these are given in Figures 13 and 14. Finally, regression models evaluating the impact of the various home learning opportunities and experiences on the Outcome Index and learning domain scores are presented in Table 24.

6.2 Findings

The family learning environment variables

Early literacy experiences

Individual differences in children's early literacy skills emerge before they begin formal schooling and are reasonably stable across the early school years (eds Shonkoff & Phillips 2000). Children who begin formal schooling with adequate language skills are more likely to become fluent readers by Year 3 of school (de Jong & Leseman 2001; Senechal & LeFevre 2002). In the home, parents' beliefs and practices about reading influence both the extent to which literacy experiences and activities are available to the child and the manner in which they occur. Young children whose parents read to them regularly develop stronger literacy-related skills before starting school (Bus, van Ijzendoorn & Pellegrini 1995; Molfese, Modglin & Molfese 2003; Senechal et al. 2001). The number of children's books in the home and visits to the library are also indicators of the opportunities afforded to children to access reading materials and to learn the value of reading as an activity. Aside from the literacy resources and opportunities afforded to children at home, child characteristics, such as a child's level of interest and capacity to listen when adults read to them, also play a part.

Four questions on the LSAC questionnaire measured children's early experiences of literacy in the family: In the past week, on how many days have you or someone in your family read to [child's name] from a book?; About how many children's books does [child's name] have in your home now?; For about how many minutes does [child's name] enjoy being read to at a sitting?; In the past month, has [child's name] visited a library with you or another family member?

Overall, a positive picture emerges of children's early literacy experiences in the family (see Table 23):

- 75 per cent of children were read to by a family member on three or more days per week
- 89 per cent of children had 10 or more children's books in the family home
- 50 per cent of children had visited a library in the last month with a family member
- 68 per cent of children enjoyed being read to by a family member for more than 10 minutes at a sitting.

Features of the early literacy family environment were also examined according to the percentages of children who had a positive and negative Outcome Index and are shown in Figures 13 and 14. In summary:

- Outcome Index scores (that is, fell in the top 15 per cent of the distribution on the overall Outcome Index) and 25 per cent had negative Outcome Index scores (that is, in the lowest 15 per cent).
- For children who had less than 10 children's books in the home, 5 per cent had a positive Outcome Index and 35 per cent had a negative Outcome Index.
- For children who had not visited a library in the last month, 11 per cent had a positive Outcome Index and 18 per cent had a negative Outcome Index.

For children who did not like being read to for more than 10 minutes at a time, 7 per cent had a positive Outcome Index and 28 per cent had a negative Outcome Index.

Shared home activities

Shared activities in the home, aside from specific literacy-related practices, also constitute important variations in children's early learning experiences that impact on communicative and academic competence in the first years of school (Bradley et al. 2001; McClelland, Kessenich & Morrison 2003; Morrison & Cooney 2002; Tudge et al. 2003). The amount of verbal interaction with young children and the extent of their exposure to age appropriate experiences influence children's communicative competence. In their interactions with children, engaged parents use language in ways that resemble literacy discourses (Martini 1995). In such exchanges, expressive language is more elaborated (for example, events and actions are described and explained); more complex language forms are used which are grammatically and syntactically complex; and accounts of events are structured as narratives (unfold in specific stages). All children, regardless of participation in early childhood programs prior to school, benefit from home literacy environments that foster their language and literacy skill development (Bennett, Weigel & Martin 2002).

The LSAC questionnaire asked about the frequency of participation, across a week, by their child and family members in six home activities which were rated on a scale of 'no participation' in such activities to 'everyday participation'. The activities were: told child a story (not from a book); drew pictures or worked on art or craft activities; engaged in musical activities; played with toys or games indoors; involved children in everyday activities, such as cooking or caring for pets; played games outdoors or exercised together (see Table 23).

On three or more days per week:

- 28 per cent of children were told a story (not read from a book)
- 57 per cent of children engaged with a family member in drawing or other art/craft activities
- 60 per cent of children engaged with a family member in music, singing, or other musical activities
- 52 per cent of children played with toys or games indoors with a family member
- 67 per cent of children engaged with family members in everyday activities
- 59 per cent of children engaged in games or other physical activities outdoors with a family member.

The ratings for the six home activities were summed and a mean item score was obtained, which was then divided into approximate tertiles for frequency of participation in shared home activities. There was low engagement in shared home activities for 27 per cent of the children, medium engagement for 41 per cent of the children, and high engagement for 33 per cent of the children. Figures 13 and 14 show the percentages of children with a positive (top 15 per cent) and negative (bottom 15 per cent) overall Outcome Index for each level of engagement of children with family members in shared home activities. In summary:

- 11 per cent of children who had low engagement with family members in shared home activities had a positive Outcome Index (compared to 13 per cent who had medium engagement and 17 per cent who had high engagement); and 20 per cent of children who had low engagement in shared home activities had a negative Outcome Index (compared to 16 per cent of children who had medium engagement and 14 per cent who had high engagement in shared home activities).

Television viewing and use of computers

Beside opportunities for developing print-based literacy, children's exposure to television and computers at home can also serve to stimulate learning. However, watching television can take time away from reading and other learning activities. A body of evidence from the United States indicates that while educational television programs can teach academic and prosocial skills, viewing extensive general entertainment is associated with lower levels of school readiness and academic performance (Anderson et al. 2001; Zill, Davies & Daly 1994).

Parents rated the hours of television (and video) viewing by children for a typical weekday and a typical day on the weekend. The categorised ratings for the number of hours of television (and video) that children watched each week are presented in Table 23. In summary:

- 20 per cent of children watched television (or videos) at home for three or more hours each week day
- 22 per cent of children watched television (or videos) at home for three or more hours each day on a weekend.

Comparisons of positive (top 15 per cent) and negative (bottom 15 per cent) values for the overall Outcome Index against the categories for the number of hours of television that children watch on weekdays or on weekends are shown in Figures 13 and 14. In summary:

- 10 per cent of children who watched three to five hours and 5 per cent who watched five or more hours of television on a typical week day had a positive Outcome Index; and 23 per cent of children who watched three to five hours and 39 per cent who watched five or more hours of television on a typical week day had a negative Outcome Index.
- 11 per cent of children who watched three to five hours and 6 per cent who watched five or more hours of television on a typical day on the weekend had a positive Outcome Index; and 22 per cent of children who watched three to five hours and 36 per cent who watched five or more hours of television on a typical day on the weekend had a negative Outcome Index.

Parents were asked whether the child had access to a computer at home and to rate the number of hours children used the computer on a typical day during the week and on any day on the weekend. The responses on access to a computer and number of hours of use are shown in Table 23. In summary:

- 75 per cent of children had access to a computer at home
- 10 per cent of children who had access to a computer used it for one or more hours each day during the week
- 14 per cent who had access to a computer at home used it for one or more hours each day on a weekend.

While a high proportion of children had access to computer, the proportion of children using it on a regular basis for more than an hour per week was small. Consequently, only the variable of access (or not) to a computer is subsequently discussed. Comparisons of the overall Outcome Index (positive and negative bands) for children who did, or did not, have access to a computer are shown in Figures 13 and 14. In summary:

- 8 per cent of children who did not have access to a computer had a high Outcome Index (compared to 16 per cent of children who had access to a computer); and 26 per cent of children who did not have access to computer had a low Outcome Index (compared to 13 per cent of children who had access to a computer).

Out-of-home activities

The family learning environment includes activities in the home, as well as activities outside the home in which children engage with family members (Payne, Whitehurst & Angell 1994). Foster et al. (2005) found that enrichment activities in the community, taken with family members, contribute to children's emergent literacy skills and social development. Family outings provide cognitive and language stimulation that enhance children's knowledge and experience of the world. Parental time spent with the child in such activities is a measure of parental involvement and is a significant predictor of later educational achievement (Flouri & Buchanan 2004).

Parents were asked whether the child had engaged in any of seven activities with a family member in the previous month. The findings on the number and nature of the activities which children shared with family members outside the home are presented in Table 23. In summary:

- 38 per cent went to a movie
- 93 per cent went to a playground or swimming pool
- 42 per cent went to a sporting event in which the child was not a player
- 24 per cent went to a live performance for children
- 51 per cent attended a school, cultural or community event

- 34 per cent attended a religious service
- 15 per cent visited a museum or art gallery.

Affirmative responses to the items on the various out-of-home activities were totalled to obtain a participation summary score. A categorisation of low, medium and high engagement of children with family members in out-of-home activities was made using approximate tertile cut-offs. Engagement by family members with children in out-of-home activities was low for 14 per cent, medium for 52 per cent, and high for 34 per cent of the children. Comparisons of positive and negative values on the overall Outcome Index by level of engagement in out-of-home activities are shown in Figures 13 and 14. In summary:

- 8 per cent of children who had low engagement in out-of-home activities in the previous month had a positive Outcome Index (compared to 13 per cent who had medium engagement and 17 per cent who had high engagement); and 26 per cent of children who had low engagement had a negative Outcome Index (compared to 16 per cent who had medium and 12 per cent who had high engagement).

Table 23: Family learning experiences for the child cohort

Family learning environment variables	n	Distribution (%)
Early literacy experiences		
Length of time child enjoys being read to by others (minutes)	4,979	
0–10		22.1
11–20		37.0
20 or more		40.9
Number of children's books in the home	4,981	
0–9		11.5
10–29		8.8
30 or more		79.7
Child has visited library with family member in the last month	4,981	50.2
Days in the past week someone in the family read to child	4,980	
0–2		24.8
3–5		30.3
6–7		44.9
Shared home activities		
Number of days in past week that some one in family engaged in home learning activities with the child		
Told child a story	4,979	
0–2		71.9
3–5		16.7
6–7		11.5
Drawn pictures or other art/craft activities	4,976	
0–2		43.4
3–5		35.4
6–7		21.3
Played with music, sang or other musical activities	4,976	
0–2		40.3
3–5		32.5
6–7		27.7
Played with toys or games indoors	4,979	
0–2		48.8
3–5		30.1
6–7		21.5

Involved child in everyday activities	4,978	
0–2		32.6
3–5		26.5
6–7		40.9
Played games outdoors or other physical outdoor activities	4,977	
0–2		40.7
3–5		36.6
6–7		22.7
Overall family engagement in shared home activities	4,970	
Low		26.8
Medium		40.5
High		32.7
Television viewing		
Number of hours child spends watching television or video on a typical week day	4,980	
‹1		16.2
1–‹3		64.0
3–‹5		15.8
5 or more		4.0
Number of hours that child spends watching television or video on a typical day on the weekend	4,969	
‹1		21.1
1–‹3		56.8
3–‹5		17.5
5 or more		4.6
Computer access and usage		
Child has access to a computer at home	4,982	74.8
Number of hours that child spends using a computer on a typical weekday	4,975	
‹1		89.7
1–‹3		9.8
3 or more		0.5
Number of hours that child spends using a computer on a typical weekend day	4,974	
‹1		86.4
1–‹3		12.9
3 or more		0.8
Out-of-home activities		
Child has done the following activities in the past month accompanied by someone in the family		
Gone to a movie	4,981	38.1
Gone to a playground or swimming pool	4,981	92.9
Gone to a sporting event where the child was not a player	4,980	42.0
Gone to a live performance for children	4,978	23.7
Attended a school, cultural or community event	4,981	51.0
Attended a religious service	4,981	33.6
Visited a museum or art gallery	4,981	14.8
Overall level of family engagement in out-of-home activities	4,977	
Low		13.8
Medium		52.1
High		34.1

Note: Due to rounding, percentages may not add to 100 per cent (or subtotals) exactly.

Figure 13: Low Outcome Index: percentage of child cohort

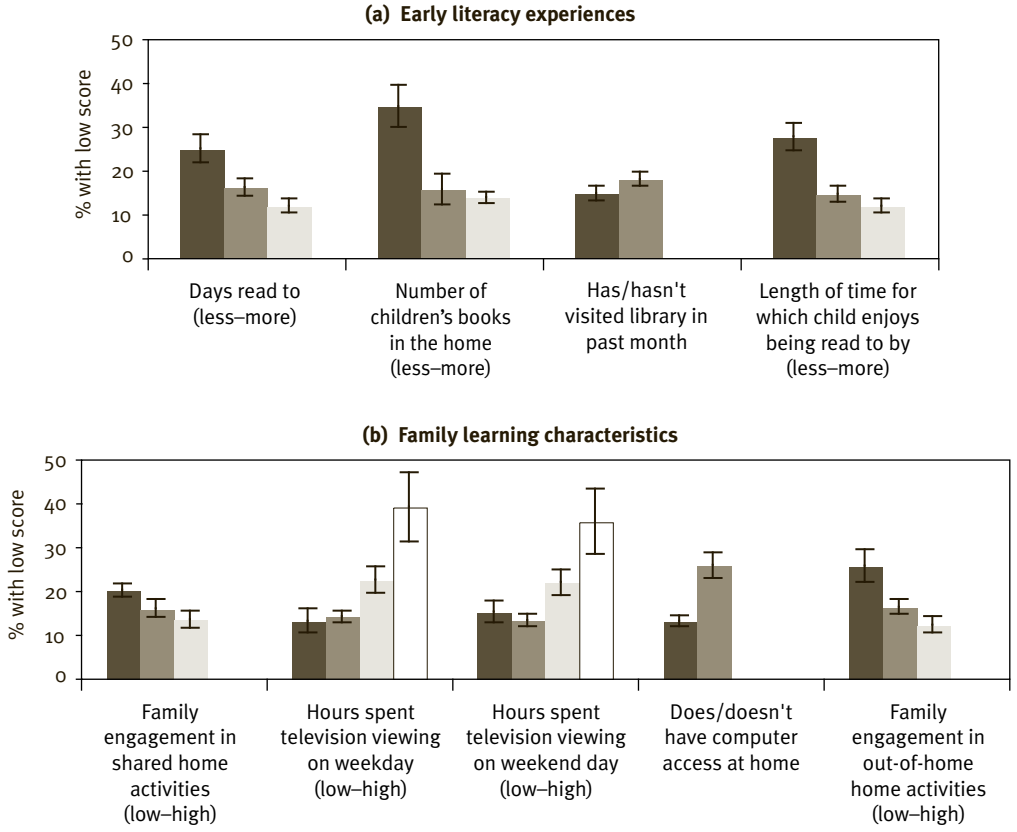
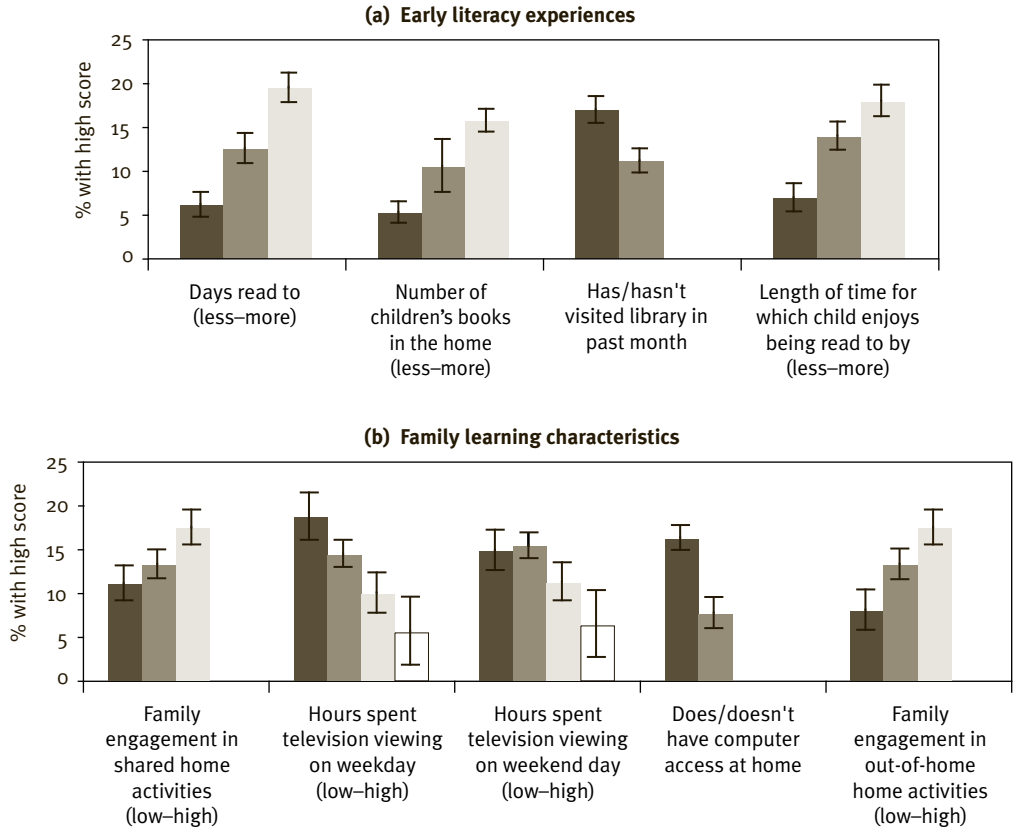


Figure 14: High Outcome Index: percentage of child cohort



Summary of descriptive analyses

On the above comparisons, children with less supportive early literacy environments were less likely to have positive Outcome Index scores and more had negative Outcome Index scores. These findings have implications for promoting children's emergent literacy at home through drawing attention, in particular, to reading to children regularly and providing reading resources for children to access. Overall, children were engaged with family members in a range of shared home activities; children with low engagement in shared home activities had less positive Outcome Index scores and more negative Outcome Index scores than children with medium and high engagement.

In line with previous research, the data from these analyses suggest strong negative associations between high levels of television viewing and a negative Outcome Index score. Children without access to a computer at home also had less positive Overall Index scores and learning domain scores. Differences in child outcomes related to access to a computer may relate to family resources. Children with lower engagement in out-of-home activities were less likely to have Outcome Index scores in the top 15 per cent and these children were also more likely to have scores below the 'low' Outcome Index cut-off point, suggesting that child outcomes are enhanced by shared participation of children with family members in a range of activities outside the home.

Impact of family learning environment on child outcomes: multivariable analyses

Family socioeconomic circumstances are known to affect the quality of the family learning environment (Brooks-Gunn & Duncan 1997; Hoddinott, Lethbridge, & Phipps 2002; Yeung, Linver & Brooks-Gunn 2002). Children benefit from the human capital available within the family when parents have higher levels of income which may be invested in material goods for the child, such as books and toys, and through the influence of higher levels of parental education. Gershoff (2003) reported that 20 per cent of children from low-income families were lagging in the development of cognitive skills on standardised measures and teacher ratings when they began kindergarten, while 31 per cent had delays in social and emotional adjustment. Parents of these children had lower levels of education, and children with significant delays tended to live in single-parent families. However, research findings do not exclusively support this position that social disadvantage leads to poorer outcomes. Christian, Morrison and Bryant (1998) found that children at 4 to 5 years whose mothers had lower levels of education but who provided richer family learning literacy environments had higher levels of learning competencies at entrance to kindergarten than children of mothers with more formal education who focused less on literacy in the home. Denton, Reaney and West (2001) also reported that children who lived in families with income above the poverty threshold were more likely to have richer home literacy environments than children whose family income was below the poverty line. However, children with richer home literacy environments, regardless of whether family income was above or below the poverty threshold, demonstrated higher levels of reading knowledge and skills at the beginning of school.

Multivariable regression analyses were used to assess the extent to which family learning environments predicted child outcomes. The analysis adjusted for the set of nine demographic characteristics known to affect the learning outcomes of young children which are described in Section 2 (Foster et al. 2005; Hoddinott, Lethbridge & Phipps 2002; McClelland, Kessenich & Morrison 2003).

A range of family learning environment variables was incorporated into each of two models to assess their effect on the continuous Outcome Index and learning domain scores, respectively. All family learning environment variables were entered into each model together, so that the contribution of each variable to children's learning outcomes could be assessed independently of the contribution of all other variables in the model. The findings of these regression analyses are presented in Table 24.

The first model, investigating relationships between family environment variables and the overall Outcome Index accounted for 21 per cent of the variability in the outcome. Over and above the contribution of the child and family factors, 7 per cent of the variability in Outcome Index score was accounted for by the set of family learning environment variables. There was very strong evidence ($p \leq 0.001$) that the following characteristics were positively associated with higher Outcome Index scores: child is read to by a family member on six to seven days per week; there are 10 or more children's books in the home; child enjoys being read to for more than 10 minutes at a time;

child has access to a computer at home; and child's family shows a medium or high level of engagement in out-of-home activities. There was also strong evidence for an association between overall Outcome Index scores and hours spent television viewing on weekdays, with Outcome Index scores tending to decrease as time spent viewing television increased (p=0.002). There was weaker evidence for a similar trend with weekend television viewing (p=0.03). There was little evidence that two variables (child visited a library in the last month, and the categorised scale score for shared home activities) were associated with the overall Outcome Index.

In the second model, relationships between family learning environment variables and the learning domain score were analysed. This model accounted for 19.5 per cent of variability in learning domain scores, with 5.8 per cent of the variability in learning domain score accounted for by the set of family learning environment variables. There was strong evidence that the following characteristics were positively associated with child learning outcomes: child is read to by a family member on three or more days per week (p‹0.001); there are 10 or more children's books in the home (p=0.04); child has visited a library with a family member in the last month (p‹0.001); child enjoys being read to for more than 10 minutes at a time (p‹0.001); child has access to a computer at home (p‹0.001); and child has a medium or high level of engagement in out-of-home activities (p‹0.005). Surprisingly, there is evidence to suggest that children who had medium or high engagement in shared home activities had **lower** learning domain scores (p=0.02). This may reflect the diverse and discrete activities that comprise this scale, which may not, therefore, be a truly useful predictor of child learning outcomes. There was no evidence that television viewing on weekdays or on weekends were associated with the learning domain, despite their strong contribution to the overall Outcome Index. This suggests that excessive television viewing may more strongly predict physical and social–emotional outcomes than learning outcomes.

Table 24: Multivariable relationships between family learning environment and the Outcome Index and learning domain scores for the child cohort

	Outcome Index score n=4,565, R2=21.4%		**Learning domain score** n=4,572, R2=19.5%	
Family learning environment variables	**Coefficient (95% CI)**	**p-value**[(a)]	**Coefficient (95% CI)**	**p-value**[(a)]
Early literacy experiences				
Days in past week family member read to child from book (relative to 0–2 days)		**0.002**		**‹0.001**
3–5	1.1 (0.2, 1.9)	0.02	1.4 (0.5, 2.2)	0.002
6–7	1.5 (0.7, 2.4)	‹0.001	2.4 (1.6, 3.3)	‹0.001
Number of children's books in home (relative to 0–9)		**‹0.001**		**0.04**
10–29	2.9 (1.5, 4.3)	‹0.001	1.4 (0.0, 2.9)	0.05
30 or more	2.7 (1.4, 3.9)	‹0.001	1.7 (0.4, 3.0)	0.01
Child has visited a library with a family member in the past month	0.1 (-0.4, 0.6)	**0.76**	1.3 (0.7, 1.8)	**‹0.001**
Length of time which child enjoys being read to (relative to 0–10 minutes)		**‹0.001**		**‹0.001**
11–20	2.8 (2.0, 3.7)	‹0.001	2.3 (1.5, 3.1)	‹0.001
20 or more	3.5 (2.7, 4.4)	‹0.001	3.3 (2.5, 4.1)	‹0.001
Shared home activities				
Overall level of family engagement in shared home activities (relative to low)		**0.17**		**0.02**
Medium	–0.3 (–0.9, 0.4)	0.46	–1.0 (–1.7, –0.3)	0.005
High	0.4 (–0.4, 1.2)	0.33	–0.9 (–1.7, –0.1)	0.03
Television viewing				
Number of hours watching television on typical week day (relative to ‹1 hour)		**0.002**		**0.19**
1–‹3	–0.5 (–1.3, 0.3)	0.20	–0.5 (–1.3, 0.3)	0.21

3–‹5	–1.8 (–3.0, –0.7)	0.002	–1.0 (–2.1, 0.2)	0.10
5 or more	–3.1 (–5.1, –1.1)	0.002	–1.6 (–3.4, 0.1)	0.06
Number of hours watching television on typical weekend day (relative to ‹1 hour)		**0.03**		**0.26**
1–‹3	0.4 (–0.3, 1.2)	0.26	0.6 (–0.1, 1.3)	0.10
3–‹5	–0.3 (–1.4, 0.8)	0.55	0.1 (–0.8, 1.1)	0.80
5 or more	–1.7 (–3.6, 0.3)	0.09	0.0 (–1.7, 1.7)	0.97
Computer access and usage				
Study child has computer access at home	1.9 (1.2, 2.6)	**‹0.001**	2.2 (1.4, 2.9)	**‹0.001**
Out-of-home activities				
Overall level of family engagement in out-of-home activities (relative to low)		**‹0.001**		**0.005**
Medium	1.7 (0.8, 2.7)	0.001	1.1 (0.2, 2.0)	0.02
High	2.7 (1.7, 3.7)	‹0.001	1.6 (0.7, 2.6)	0.001

(a) The **overall p-value** represents evidence against the null hypothesis of no differences between groups (see text). Caution is urged when interpreting individual **category versus baseline p-values** (see Box 2: Interpretation of multivariable analyses).

6.3 Discussion

The purposes of analyses in this section were to explore the nature of the early home literacy environments for 4 to 5 year-old Australian children, as well as the nature of activities these children share with family members at home and out of home. Analyses also considered the extent of children's television viewing and access to a computer at home. Features of family learning environments that showed strong evidence of being positively associated with higher learning outcomes on the overall Outcome Index and the learning domain were: child is read to on three or more days per week; there are more than 10 children's books in the home; child enjoys being read to for more than 10 minutes at a time; child has access to a computer in the home; and child has medium to high engagement in out-of-home learning activities with family members. The analyses suggest that access to a computer in the home may be a proxy for an educational home environment that leads to improved learning outcomes. While a computer in the home may be related to adults' own requirements for work-related or information needs, nevertheless there was evidence of a 'digital divide' in its effects on child outcomes. The findings indicate different effects in each model for the impact of television viewing on child outcomes. In particular, children who watched three or more hours of television on week days or five hours or more on the weekend were more likely to have a lower Outcome Index score (encompassing physical, social–emotional and learning domains), while these effects were not evident in the model that used the learning domain as the outcome variable.

The multivariable findings attest to the importance of these family environment features to child outcomes. While much of the diversity in knowledge and skills which children bring to school has been linked to social background, these findings indicate that the differences in learning and developmental outcomes related to the family learning environment are apparent irrespective of the social and economic circumstances of the family. Implications of the findings from this research for social policy should be to ensure greater awareness of the impact of the quality of the family learning environments on child outcomes. The effects of quality family learning environments, prior to school, on children's achievement in the early years of school is well established (Bennett, Weigel & Martin 2002; Bradley et al. 2001; Martini & Mistry 1993; Tudge et al. 2003). Thus, attention to children's learning environment in the family warrants significant attention.

7 Discussion

There is consensus that the early years of life are particularly important to children's ongoing physical health, social–emotional development and early learning (McCain, Mustard & Shanker 2007; eds Shonkoff & Phillips 2000). The experiences of children during the early years are considered important because they affect biological pathways as well as providing the basis for subsequent learning. Development is a cumulative process and attainment at any age can have important consequences for later competencies and capacities (see, for example, McCain & Mustard 1999; Heckman 2000; and the National Scientific Council on the Developing Child 2007). The processes by which early experiences affect later patterns of development are inherently complex. However, research findings from LSAC, as a nationally representative sample of children, can help researchers, practitioners and policy makers understand some of these complexities about the nature of Australian children's experiences and their potential impact on later development.

This section provides a review of the findings from LSAC Wave 1 data presented in the previous sections. Its main focus is the relationships between key independent variables and the overall Outcome Index of children's development, as well as outcomes in the physical, social–emotional and learning domains. The implications of these findings for policy are discussed and the complexities in using information from the Outcome Index to inform policy are also considered.

Perspectives from several disciplines were encompassed in the design and measurement of LSAC, and thus shape the interpretation of findings in this report. As discussed in Section 1, ecological systems theory is proposed as a theoretical model to explain how children's development is influenced by the experiences available to them in society (Bronfenbrenner 1989, 1993). Bronfenbrenner argues that development occurs throughout life and is influenced by events and experiences across time, in various contexts, that directly and indirectly impact on the developing child (for example, interactions between children and parents in the home; the quality of parental work experiences; the quality of early education programs). Further, interactions across these contexts have important effects (for example, parents' relationships with school; the impact of work on family life). Whereas psychological and sociological perspectives emphasise intrinsic, environmental and cultural factors, economic theories place more emphasis on how societies and families make choices on the use of resources that affect outcomes for children. For example, Haveman and Wolfe (1995) proposed that three factors affect children's wellbeing: social investment determines the nature of options available to children or their parents in a society; parental investment is about the choices parents make about the quality and quantity of resources they devote to their children; and children's investment reflects the choices children will make themselves, a factor that begins to exert greater influence over time as children are able to make personal decisions. Thus, different theories may inform interpretations of the data analyses in understanding the experiences of young children and their families in Australia.

7.1 The LSAC Outcome Index and children's developmental competencies

As discussed in Section 1, reports using social indicators provide an efficient way for policy makers to understand trends and present information about subgroup differences within the larger population (for example, by gender, race/ethnicity, and income status), as well as the influence of particular life experiences and opportunities available to groups within the population. The use of aggregated measures to reflect children's developmental competencies and wellbeing has evolved internationally during the last 25 years (Ben-Arieh 2006). However, there is still much to be learned about the substantive issues in the use of such measures (Land et al. 2007; Moore, Brown & Scarupa 2003). The LSAC Outcome Index is unusual in that it is a composite measure that reflects not national trends, but individual children's competencies across three domains: physical, social–emotional, and learning. The Outcome Index enables representation of developmental strengths as well as vulnerabilities.

The analyses in this report utilised Wave 1 data for the LSAC infant and child cohorts. As noted in Section 1, not all of the outcomes that were measured for the child cohort were measured for the infant cohort. This reflects the reality of development, with some skills either not observable at such a young age or not measurable within the LSAC design. Hence, the meaning of the Outcome Index in these analyses varies to some degree across cohorts and limits the comparisons that can be made between cohorts.

In Section 1, we reported the number of domains on which a child's score was in the top 15 per cent, and in the bottom 15 per cent, of the range of scores on any specific domain. The findings revealed that, as expected, development does not occur uniformly across all domains at these ages. Approximately two-thirds of children in both cohorts (infant and child) did not score below the negative cut-off (bottom 15 per cent) on any of the three domains. A similar pattern was revealed in relation to the positive cut-off (top 15 per cent). For infants, it was not possible to define a positive cut-off in the physical domain, so no infant could score above the cut-off on all three domains. These summary findings of the percentage of children who are identified with developmental strengths or difficulties need to be interpreted with caution. The selection of 15 per cent to indicate the percentage of children who are doing well or who are having difficulties, overall or in any domain, is essentially an arbitrary decision, but relates to the statistical concept of one standard deviation below the mean and is also in line with prevalence estimates from population surveys such as the National Mental Health Survey of Children and Youth (Sawyer et al. 2000).

7.2 Families, children and social demography

Families have experienced rapid change over the last few decades. Understanding the nature of families and the complexities in their social demography imparts important information to researchers and policy makers. It can no longer be assumed that children live in a household with two biological parents. Households are complex structures and relationships of members of households are likely to vary considerably over time. Increased maternal employment, varying levels of unemployment, and changing work characteristics, as well as the changes in the racial and ethnic composition of Australian society, make it important to understand how such social variations, defined by demographic characteristics of families, impact on the lives of children (Sanson & Lewis 2001). Bronfenbrenner (1979) drew attention to the limitations of relying on a 'social address' to understand the experiences of children in families because demographic variables are distal representations of more proximal family processes that directly impact on the lives of children. However, sociodemographic characteristics remain important variables in research to inform policy about how different groups in society are faring, the nature of family diversity, and how vulnerable families with young children might be supported.

An emphasis in the analyses in this report was on multivariable associations between various sociodemographic characteristics on children's outcomes. Across the analyses in this report, nine sociodemographic variables were selected for inclusion because of their theoretical and policy interest and use in comparable research reports (for example, Hoddinott, Lethbridge & Phipps 2002; Jones et al. 2002; Lugaila 2003). This set of sociodemographic variables, as well as being analysed to explore their specific associations with infant and child outcomes (see Section 2), were also included in subsequent sections of this report as important variables in the analyses that investigated the influences of non-parental care, child health, maternal health, and family learning environment (child cohort only) on outcomes.

The selected sociodemographic variables represented four tiers of influence (child, mother, family and neighbourhood) as proposed by ecological models of development (Bronfenbrenner, 1979, 1989, 1993). **Child level variables** were gender, Aboriginal and Torres Strait Islander status, and speaking a language other than English. **Maternal education** was included because it is known from other research that it is an important influence on children's outcomes across domains of health, social–emotional development, and learning (see, for example, Hoddinott, Lethbridge & Phipps 2002). **Family level variables** included were family type, family income, financial stress and parental occupational status. Low family income and poverty, in particular, have been strongly associated with poorer outcomes for children internationally (see, for example, Logan et al. 2007; Daly 2006). However, a simple finding that children in low-income households, or those with any other specific

sociodemographic characteristic, experience fewer opportunities and less optimal developmental experiences does not make it possible to establish whether such a characteristic is a causal factor, or if other factors are also operating that affect outcomes at the same time. For example, less well educated parents may have lower than average income and hence be less able to support optimal opportunities for their children. These reciprocal and indirect influences need to be considered in the interpretation of findings, requiring a multivariable analytical approach as used here.

Within the set of demographic variables used in the analyses, a measure of **neighbourhood quality** was also included because there is increasing evidence that neighbourhood variables are important to children's developmental outcomes (see, for example, Tremblay et al. 2001). The variables included measured social advantage/disadvantage of the neighbourhood in which a family lived, that is, the Socio-Economic Indexes for Areas [SEIFA] quintiles (ABS 2003b).

7.3 The infant cohort

Although few contemporary experts in child development would view the first two years of life as a 'critical' period during which the path of future development is fully determined, this stage of development is still regarded by many as being a 'sensitive' period during which developmental pathways are first established (Halfon & McLearn 2002; National Scientific Council on the Developing Child 2007). Because early developmental pathways have the potential to impact on subsequent development in important ways, the influences that shape early development need to be considered. However, for the infant cohort of LSAC (mean age of 9.5 months), overall there were relatively few predictors that exerted influence on outcomes from the cross-sectional analyses. These findings are discussed below within the various areas of the data analyses.

Sociodemographic characteristics and outcomes

For the infant cohort, the analyses of relationships between child, family and neighbourhood factors and the Outcome Index measures suggested they had only minor impact. This may reflect weaknesses in the measurement of the Outcome Index itself for this age group, since it is difficult to collect very sensitive outcome measures for infants using the methodology employed in LSAC. It may also reflect the fact that the impact of contextual factors on children's development is a cumulative process which occurs over time. Early measures of 'outcomes' may largely reflect infants' biological predispositions and the effects of environmental influences may only be seen at later stages. This hypothesis can be tested when data from future waves of LSAC become available.

Non-parental care experiences and outcomes

The impact on development of children's participation in formal and informal child care and early education settings is not independent of other family and child factors. For the infant cohort, fewer children were in a non-parental care/education arrangement if their families were economically disadvantaged, if they were of Aboriginal or Torres Strait Islander background, if their mothers had not completed high school, and if the main language spoken at home was other than English. These and other related indices of family socioeconomic status are all variables associated with poorer outcomes in the broader developmental literature, and it is important to take these factors into account when trying to assess the relative importance for children of their experience in care settings.

No child care variables were strong predictors of the overall Outcome Index score for the infant cohort. However, child care variables contributed to the prediction of the physical and learning domain scores. Infants not in care had better physical domain scores than infants in formal or mixed formal/informal care, infants in more than 20 hours of care per week, and infants in one or more care arrangements per week. These findings indicate that children in larger group settings are at most risk for perceived poorer general health and additional health care needs in the first year. These findings are consistent with those reported by the NICHD Study of Early Child Care and Youth Development (NICHD Early Child Care Research Network 2005a) in the United States. For the learning domain, there was evidence of higher scores for infants who experienced only informal care compared to infants

not in care, while the outcomes for infants in formal care or mixed formal/informal care did not differ from those of infants not in care. Because most infants in informal care only were being cared for by grandparents, this finding should be explored in further analyses about the influences that extended family as care givers may have on infants' development.

Infant health and outcomes

Most of the children in the infant cohort were reported to be in very good or excellent health. However, there were significant numbers with physical health problems including low birth weight or preterm birth, special health care needs, rapid weight gain since birth, and a very high prevalence of infant wheeze. Additionally, while most mothers had breastfed their children, only half of all mothers had met the current NHMRC recommendations for exclusive breastfeeding for at least six months. Almost all mothers who had not breastfed for at least six months had either never established breastfeeding or breastfed for less than three months.

For the infant cohort, using a multivariable model, it appeared much of the influence of these early risk factors was yet to become apparent. Of strong policy relevance, however, was evidence that very preterm birth was strongly associated with poorer Outcome Index scores; prolonged breastfeeding was strongly associated with better physical and social–emotional outcomes; and infant wheeze was strongly associated with poorer physical and social–emotional outcomes. Given that preterm birth, breastfeeding and infant wheeze are potentially modifiable through social, welfare and health policies, these are important findings. Paradoxically, given its emerging associations with later overweight and obesity (Stettler 2007), rapid weight gain since birth was associated with **better** outcome scores in this cohort. This finding could prompt a re-evaluation of growth trajectories perceived as 'healthy' by parents and promoted by early-years health professionals.

Maternal health and outcomes

Across both cohorts, the LSAC mothers were broadly representative of all Australian mothers on parameters such as smoking and alcohol in pregnancy, mental health status, and a high prevalence (45 per cent) of overweight and obesity. In the multivariable analyses, there was no evidence that diabetes, hypertension, or cigarette smoking during pregnancy were associated with overall Outcome Index or domain scores for the infants, suggesting that the correlations in the bivariate analyses between heavy prenatal smoking and infant Outcome Index scores may be explained by sociodemographic factors. Two factors stood out as being strongly associated with better infant outcomes: good maternal general health (especially the physical and social–emotional domains) and greater maternal enjoyment of physical activity (especially the social–emotional and learning domains).

The findings confirmed just how strongly maternal health and lifestyle are intertwined with child outcomes even at this young age, and support the need for holistic health care and policies targeting both these areas. An important corollary is to consider **fathers'** health and lifestyle in future analyses. Unlike many other studies, LSAC is collecting the data to address the influence of not just mothers but fathers on their children's health and other outcomes.

7.4 The child cohort

While the family remains the key influence on children's experiences and outcomes throughout childhood, children at age 4 to 5 years are also more likely to spend more time in contexts outside the immediate family and participating in early education programs, including child care programs. By 4 years old, children are developing the skills and competencies that will hold them in good stead for a successful transition to school. Features of children's home environment, such as reading to children and participation in educational activities, can have substantial effects on children's future language and literacy skills, as can participation in early education programs. Family characteristics, such as household income and mothers' level of education, are also related to these competencies. At this age, social and emotional competencies, including self-regulation of behaviour, also become important. Variations in these competencies have been found to be influenced by parental mental health problems, and associated with family socioeconomic status (Tremblay et al. 2001). For the child cohort of LSAC (mean age of 4.7 years) there were a number of findings comparable to previous research conducted in other national contexts.

Sociodemographic characteristics and outcomes

In contrast to the infant cohort, sociodemographic factors accounted for substantial variation in the Outcome Index measures for the child cohort, indicating a role for child, maternal and family characteristics. Girls consistently showed more positive outcomes than boys. Aboriginal and Torres Strait Islander children had poorer outcomes in all but the physical domain. Similarly, children in families where a language other than English was spoken tended to have poorer outcomes. There was strong evidence for more positive outcomes with higher maternal education, with higher family income, and in the absence of financial stress. Children whose parents had a skilled or professional occupation also had more positive outcomes. Family type (two parents versus single-parent family) and neighbourhood disadvantage, while showing some bivariate relationships with outcomes, did not make a unique contribution to overall child outcomes, suggesting that their influence may be mediated through family variables such as income, financial stress and family occupational status.

Non-parental care experiences and child outcomes

As noted for the infant cohort, children's participation in formal and informal child care and early education settings is not independent of family and child factors that influence children's development. For the child cohort, fewer children were in a non-parental care/education arrangement if their families were economically disadvantaged, if they were of Aboriginal or Torres Strait Islander background, if their mothers had not completed high school, and if the main language spoken at home was something other than English. These and other related indices of family socioeconomic status are all variables associated with poorer outcomes in the broader developmental literature and, as noted above, were also shown here to be related to Outcome Index scores. Hence it is important to take these factors into account when trying to assess the relative importance for children of their experiences in formal (or informal) early education and care programs.

In the multivariable analyses for the child cohort, children who were attending a pre-Year 1 program had higher overall Outcome Index and learning domain scores than children who were attending informal care arrangements only. There were no significant differences between children attending a pre-Year 1 program and children who attended other group programs such as preschool or day care, although a higher proportion of children attending pre-Year 1 programs had higher Outcome Index scores than children in preschool or day care. This relative advantage for children attending pre-Year 1 programs may be explained by the nature of the program (for example, full-time with a strong focus on the development of academic skills). These children were also likely to be slightly older than the children with other care arrangements because age eligibility criteria for participation in pre-Year 1 programs varies across states and territories, so that only children whose birth date was later in the year were able to be enrolled. Additionally, children in pre-Year 1 programs also may have been older because of parental choices to delay entry even if the child was age eligible in the previous year, so the child was more mature and able to cope with the demands of a full-time school program.

Child health and outcomes

Most of the children in the child cohort were reported to be in very good or excellent health, but many also experienced physical health problems. Such problems included a high prevalence of each of special health care needs, overweight/obesity, and asthma requiring medication. As for the infant cohort, while most mothers had breastfed their children, few mothers had met the NHMRC recommendations for exclusive breastfeeding for at least six months. Less than one-quarter of children had diets that adequately met nutritional guidelines and many preferred less physical activities.

In a multivariable model, relationships were more evident than for the infant cohort, suggesting that impacts may be cumulative and that adverse outcomes may take time to become apparent. Low birth weight, preterm birth, and asthma were all strongly predictive of poorer outcomes, while longer breastfeeding, enjoyment of physical activity and healthful nutritional behaviours were all strongly associated with better outcomes.

Maternal health and outcomes

As noted for the infant cohort findings, the LSAC mothers were broadly representative of all Australian mothers on parameters such as smoking and alcohol in pregnancy, mental health status, and a high prevalence of overweight and obesity.

More and stronger associations were seen between maternal factors and child outcomes in the child than in the infant cohort multivariable analyses. Prenatal factors (diabetes, hypertension and cigarette smoking) were far outweighed by the current issues of poor maternal health, psychological distress, and mothers' own enjoyment of physical activity. These effects were often greater in the social–emotional and/or learning domains than in the physical domain, emphasising the relevance of mothers' health to all aspects of their children's functioning and wellbeing. Overall, these findings underscore the importance of policy initiatives targeting maternal (and therefore, probably, paternal) health and lifestyle. These perhaps surprising findings raise challenging policy issues, since healthy lifestyles are often considered the province of individual responsibility. Lack of perceived impacts on their children may be another reason for little motivation for individual behaviour and lifestyle change in young parents. This may well require substantial policy as well as research realignment, since neither maternal nor paternal factors figured prominently in a recent Australian study of stakeholder priorities for population child health and wellbeing (Davis et al. 2005). However, 'lifestyle' indicators such as heavy current alcohol intake, smoking, mother's own weight status, and maternal fruit and vegetable consumption were not predictive of children's outcomes at this young age.

Family learning environments and child outcomes

There was strong evidence that a number of opportunities and resources available in the family contributed to higher overall Outcome Index scores. These findings were in line with those from research in other national contexts (for example, Foster et al. 2005). These opportunities and experiences included that the child was read to by a family member on three or more days per week; there were 10 or more children's books in the home; the child enjoyed being read to for more than 10 minutes at a time; and the child had access to a computer at home. Positive child outcomes were also associated with a medium or high level of engagement by the child in out-of-home activities with family members.

Evidence was also strong for an association between the overall Outcome Index and hours spent television viewing on weekdays, with the Outcome Index score tending to decrease as time spent watching television increased. There was weaker evidence for a similar trend for weekend television viewing. Similar results were found when using the learning domain score as the outcome rather than the Overall Index, except there was no evidence of an association between the numbers of hours that children spent watching television on weekdays or on the weekend and learning outcomes. This suggests that the impact of time spent watching television upon child outcomes is attributable to either or both of the physical and social–emotional domains.

7.5 Implications for policy

The Wave 1 data provide a wealth of information on children's physical, social–emotional and learning competencies. The lives of the two cohorts are being assessed across multiple contexts, including home, school and community. The pattern of results for the child cohort supports an ecological model of child development in which the child's own attributes, along with their family and community context, exert influence on developmental trajectories. While the effects were weaker for the infant cohort, this could be interpreted in terms of the likelihood that there is a greater impact from cumulative external influences (for example, disadvantage) over time. For infants, less time had elapsed for such influences to impact on development. The findings underscore the importance of using a broad conceptual framework when trying to understand the complex nature of children's development. It also draws attention to the importance of longitudinal analyses. Limitations of the analyses provided in this report include the fact that the findings are based only on the first wave of data collection of LSAC and are, therefore, cross-sectional in nature. However, these findings do provide an initial basis for understanding a range of influences on developmental outcomes. Information on important influences on outcomes will be enhanced through the addition of subsequent waves of data.

The results of these analyses of the LSAC Wave 1 data showed a number of strong relationships between child and family factors and child outcomes. Important influences on outcomes were suggested within every one of the five areas studied (sociodemographic circumstances, non-parental care, child health, maternal health, and family learning environments). However, it is necessary to qualify these findings; since all the analyses reported are cross-sectional, cause and effect relationships cannot be identified and, for some of the associations, the effects on outcomes were modest in size. Given the current understanding of the importance of early child development for later development (eds Shonkoff & Phillips 2000), it will be important to continue to explore how the data from this stage of LSAC predict later child outcomes across childhood.

The persistent public and policy attention to indicators of negative outcomes for children has led to comment that there is an unbalanced depiction of children and families. Many of the findings reported in these analyses indicate that most children are doing well. Such positive findings deserve more attention. However, a considerable number of children do show decreased competence for overall outcomes and outcomes in specific domains. These children were not evenly represented across the Australian population in terms of the sociodemographic characteristics of children and families. While there was evidence that outcomes for significant numbers of children could be improved right across the socioeconomic spectrum, it was clear that there was also a socioeconomic gradient with poorer outcomes in the context of greater family disadvantage. Policy initiatives should ensure that there are effective systems to support the development of social and psychological capital within families through parenting programs and family support services in communities. Given the wide range of environmental risk factors that can influence family functioning and therefore children's development, a multi-service and whole-of-government approach to policy, crossing the health, education and community sectors, remains important. Universal and primary care services across the health, education and community sectors need to be coordinated to address multiple environmental risk factors and respond to the needs of families with complex needs. This direction has been important in current policy initiatives in the Stronger Families and Communities Strategy (Department of Families and Community Services 2004a) and the *National Agenda for Early Childhood* (Department of Families and Community Services 2004b). It is important that services for families are flexible so that they can respond to the emerging needs and problems of children and families rather than waiting until problems become established.

Intervening early in the life course has the greatest potential to prevent or significantly ameliorate some of the health and wellbeing problems seen in adult life (National Scientific Council on the Developing Child 2007). From an economic perspective, responsible investments in services for young children and their families focus on benefits relative to cost (Heckman 2000). Because risk factors frequently cluster together and are cumulative, interventions that focus on single issues are unlikely to lead to lasting effective change. The central issue is that a myriad of influences (individual characteristics, family circumstances and social and community resources) are likely to influence children's developmental pathways through childhood and into adulthood, and the relative importance of various influences may vary over time. Addressing inequalities for children and families is a critical social investment. A direct way to improving outcomes in childhood is to provide support to ensure that family environments in the early years meet the health and developmental needs of young children. Interventions need to focus on supporting efforts to provide healthy, nurturing and stimulating family environments for children.

Appendix A: Summary of variables included in the Outcome Index

Infant cohort

Physical

- **Overall health rating**: single parent rated item of infants' health, from 1 (excellent) to 5 (poor).
- **Special health care needs**: single derived yes or no item based on six component items indicating whether child needed medication or more health care than the average child due to a condition that has lasted or was expected to last 12 months or more.

Social–emotional

- **STSI Approach**: mean of a four item parent rated subscale from abbreviated Short Temperament Scale for Infants (STSI) (Sanson et al. 1987; Prior et al. 2000) on 1 to 6 frequency scale; low scores indicate withdrawing/shy, and high scores indicate approaching/sociable; response rate 84 per cent; adequate reliability (alpha=0.72).
- **STSI Irritability**: mean of a four item parent rated subscale from abbreviated STSI, on 1 to 6 frequency scale; low scores indicate calm/not irritable, and high scores indicate irritable/volatile; response rate 84 per cent; fair reliability (alpha=0.57).
- **STSI Cooperativeness**: mean of a four item parent rated scale from abbreviated STSI, on 1 to 6 frequency scale; low scores indicate uncooperative, unadaptable, and high scores indicate adaptable, cooperative; response rate 84 per cent; adequate reliability (alpha=0.65).

Learning

- **CSBS Total**: normed standardised score based on 24 items in the parent report Communication and Symbolic Behaviour Scale (Wetherby & Prizant 2001); items reflect the child's exhibition of various behaviours demonstrating emerging communication skills; good reliability (alpha=0.89).

Child cohort

Physical

Health

- **Overall health rating**: single parent rated item of child's health, from 1 (excellent) to 5 (poor).
- **Special health care needs**: single derived yes or no item based on six component items indicating whether child needed medication or more health care than the average child due to a condition that has lasted or was expected to last 12 months or more.
- **Body Mass Index (BMI)**: calculated from directly assessed variables of child's height and weight.

Motor

- **PedsQL Physical Health Summary score**: eight item parent report scale from the PedsQL (Varni, Seid & Rode 1999), assessing the physical functioning dimension of the broader health related quality of life construct. Essentially, it assesses a child's level of functioning in daily activities that rely on good physical health. Scaled to range from 0 (poor) to 100 (good).

Social–emotional

Social competence

- **SDQ Prosocial**: mean of five parent rated items in the Prosocial subscale of the Strengths and Difficulties Questionnaire (SDQ) (Goodman 1997), assessing the child's propensity to behave in a way that is considerate and helpful to others, with items scored from 1 (not true) to 3 (certainly true); adequate reliability (alpha=0.66).
- **SDQ Peer problems**: mean of five parent rated items in the Peer subscale of the SDQ, assessing problems in the child's ability to form positive relationships with other children, with items scored from 1 (not true) to 3 (certainly true); fair reliability (alpha=0.50).

Internalising

- **SDQ Emotional symptoms**: mean of five parent rated items in the Emotional Symptoms subscale of the SDQ, assessing a child's frequency of display of negative emotional states (for example, nervousness, worry) with items scored from 1 (not true) to 3 (certainly true); fair reliability (alpha=0.58).

Externalising

- **SDQ Hyperactivity**: mean of five parent rated items in the Hyperactivity subscale of the SDQ, assessing child's fidgetiness, concentration span and impulsiveness with items scored from 1 (not true) to 3 (certainly true); good reliability (alpha=0.74).
- **SDQ Conduct**: mean of five parent rated items in the Conduct subscale of the SDQ, assessing child's tendency to display problem behaviours when interacting with others, with items scored from 1 (not true) to 3 (certainly true); good reliability (alpha=0.69).

Learning

Language

- **PPVT**: A standardised Rasch modelled score based on interviewer administration of an abbreviated form of the Peabody Picture Vocabulary Test (PPVT-III Form IIA) (Dunn & Dunn 1997), a measure of receptive language.

Literacy

- **Parent rating of reading skills**: parent rating on three yes/no items assessing whether a child has obtained reading skills at different levels of complexity, summed to give scores from 0 (good) to 3 (poor).
- **Teacher rating of reading skills**: teacher yes/no ratings on five items; 0 (poor skills) to 5 (strong skills); available for 64 per cent of sample. Items assess the level of complexity a child is capable of reading as well as the child's interest in reading.
- **Teacher rating of writing skills**: teacher yes/no ratings on six items; 0 (poor skills) to 6 (strong skills); available for 65 per cent of sample. Items assess the level of complexity of the child's writing skills as well as the child's interest in writing.

Numeracy

- **Teacher rating of numeracy skills**: teacher yes/no ratings on five items; 0 (poor skills) to 5 (strong skills); available on about 64 per cent of sample. Items assess the child's ability to perform numeric tasks such as counting, classifying, and simple addition, along with the ability to recognise numbers.

Approach to learning

- **Who Am I? (WAI)**: standardised score based on interviewer administration of the *Who Am I?* (ACER 1999), an Australian measure which assesses a child's ability to perform a range of tasks such as reading, writing, copying, and symbol recognition as a measure of school readiness.

Appendix B

LSAC Research Consortium

Members of the LSAC Research Consortium are:

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List of shortened forms

Child cohort	4 to 5 year-old LSAC children
Infant cohort	3 to 19 month-old LSAC children

ABS	Australian Bureau of Statistics
AIHW	Australian Institute of Health and Welfare
ASCO	Australian Standard Classification of Occupations
ATSI	Aboriginal or Torres Strait Islander
BMI	Body Mass Index
CSHCN	Children with Special Health Care Needs Screener
CI	Confidence interval
LOTE	Language other than English
LSAC	Longitudinal Study of Australian Children
NHMRC	National Health and Medical Research Council
PedsQL	Pediatric Quality of Life Inventory 4.0
OR	Odds ratio
SEIFA	Socio-Economic Indexes for Areas
SDQ	Strengths and Difficulties Questionnaire

Endnotes

1. The item on whether the child had greater health care needs than the average child (Special Health Care Needs Screener) was a dichotomous variable, but was standardised along with all other variables. No other dichotomous variables contributed to the Outcome Index.

2. Corrected gestational age was not taken into account during the calculation of the Outcome Index.

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