

The effects of childcare on child development

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Executive Summary

Using Australian data, this report provides information about the characteristics that affect child development and the role which early childhood non-parental care plays in child development. We assess whether the effect of non-parental care, such as formal and informal childcare, on child development differs by key characteristics of childcare providers and by children's characteristics. The research links in with the national early childhood development strategy developed and endorsed by the Council of Australian Governments' (COAG) in July 2009.

The data and descriptive analysis

Data from the Longitudinal Survey of Australian Children (LSAC) are used to produce a range of descriptive statistics and to carry out a multivariate analysis. The latter is described in the next two subsections of this summary. The LSAC data are longitudinal, tracking families over time, with parents being interviewed every second year commencing from 2004. Currently, three waves of data are available. We use the birth cohort only, which follows families where the child was in their first year of life in Wave 1. As a result, all children included in the analysis are around the same age: 0-1 in Wave 1, 2-3 in Wave 2, and 4-5 in Wave 3.

The report includes summary statistics for a wide range of characteristics observed in the data across the three waves (Tables 1 to 6). First, we report on a range of children's characteristics, such as gender and exact age. This is followed by a description of the circumstances at birth of the study child and the mother's smoking and alcohol drinking behaviour during the three trimesters at birth. Although, a substantial proportion of the mothers drank alcohol (nearly 40%) or smoked (just over 18%), the amount consumed was relatively small in most cases. The third group of characteristics are related to the household environment, the parents' characteristics, labour market status and the activities undertaken with their children. In accordance with expectation, the proportion of mothers working full time or part time increases from Wave 1 to Wave 3 as their child grows older. For couples, the most popular employment combination in Wave 2 and Wave 3 is one partner working full time (typically the father) while the other works part time.

The LSAC distinguishes a number of different childcare types, which for the main descriptive analyses we have grouped in five categories.¹ First, we categorise childcare into two types: informal and formal childcare. Informal childcare includes care provided by grandparents, other relatives, and other persons such as friends or neighbours. In our descriptive tables (Tables 7 and 8), formal childcare is further subdivided into four different types of childcare: day care centre, other regular formal care, irregular formal care and education. The label day care centre indicates the use of a long day care centre. Other regular formal care includes the use of family day care, before and after school care, or a nanny. Irregular formal care includes the use of occasional care, gym/leisure/community centre and mobile care unit. The latter two types of formal care include both regulated and unregulated care services. This means that some types of care included in this category need to participate in the Quality Improvement and Accreditation System (QIAS) for approved childcare whereas other types of care in this category do not need to participate. All types of formal care may employ qualified or unqualified staff, where the level of qualification may vary as well. The fourth category, education includes preschool, kindergarten/ reception/ preparatory and Year 1. We observe a clear move from informal care in the first wave (children are aged 0-1), to day care centre use in wave 2 (children are aged 2-3) and education-related care in wave 3 (children are aged 4-5). A similar move in the average proportion of time spent in the different types of childcare is observed over the three waves. That is, in Wave 1 informal care is used for the largest proportion of time; in Wave 2, day care centre time is greatest; and in Wave 3, time in education is highest. This change occurs at the same time as the overall increase in non-parental childcare use. Not surprisingly, when parents are more involved in the labour market, more non-parental childcare is used for their children. Compared to couple families, single-parent families use more childcare at a comparable intensity of labour market involvement (Table 9).

Comparing the raw data of children's outcomes on learning, and physical and socio-emotional development by childcare use, a few small differences are observed (Tables 10 and 11). Children in childcare, excluding those in informal childcare only, appear slightly worse off physically, possibly due to the spreading of colds and other infections for which children still need to build their immunity. However, they are slightly better off in socio-emotional development and in learning. Children attending informal childcare only are slightly better off

¹ Some detailed information on childcare types is available in Appendix B. However, many of these types contain too few observations to allow separate inclusion in the analyses.

physically but attendance in at least some formal childcare is associated with slightly better learning (except in the first wave) and better socio-emotional outcomes.

The methodology

This report uses an Education Production Function (EPF) which leads us to estimate a “value-added” model. The theory on which the EPF is based makes the assumption that current child outcomes depend on child outcomes in the previous period and on a range of inputs between the previous and the current period. We propose that one of the appropriate inputs is childcare attendance. In the multivariate analyses, we only distinguish the effects of day care, other formal care and informal care separately. We use outcomes observed in Wave 2 of the LSAC (when children are aged 2 to 3) as our dependent variables. That is, Wave 2 is the current period in our model and Wave 1 is the previous period. Outcomes in the previous period are outcomes observed in Wave 1 which are comparable to those in Wave 2. All outcomes are as reported by the main carer. A simple regression approach is used to estimate the contribution of these different factors to children’s outcomes.

As control variables in addition to childcare attendance we use:

- Child characteristics: age, gender, birth weight, aboriginal/Torres Strait Islander descent, has a medical condition, and whether the child has sleeping problems.
- Parental and family characteristics: number of parents, parents’ medical conditions, the highest education level of the main carer, number of siblings, whether English is the main language spoken at home, eligibility for welfare payments as an indicator for low-income families, and whether the study child’s house is cluttered.
- Parental inputs: number of children’s books at home, told a story to the child, read to the child, played with the child outdoors, took the child out to a concert/museum/library, took child out to movies/sports, average time spent by child watching TV/video on weekdays, and hostile parenting.
- Neighbourhood: a disadvantage measure and whether residence is located in a remote or very remote area.

The results from the multivariate analysis

Including this wide range of control variables, we find that childcare use remains a statistically significant factor in the children’s outcome models. As expected the statistical significance and size of the effect reduce when more control variables are included in the

regressions since many of the characteristics listed above are also affecting the probability of childcare use (confounding its effect).

Exploring the effect of childcare use further, we find that a combination of formal and informal childcare has the largest effect on learning and socio-emotional outcomes, and that informal care only, and any other formal have larger effects on socio-emotional outcomes compared to using a day care centre (although using a day care centre has a substantial positive effect as well compared to not using any care) (see Table 13). This seems to indicate that informal care could be equally important to a child's development as formal care. This pattern remains after inclusion of the control variables, but the effects are smaller and less statistically significant (Table 13-b). Meanwhile, after controlling for a wide range of variables, only children that use any day care experience a significant positive effect on learning outcomes (Table 13-a). The effects on learning outcomes of using informal care only and any other formal are no longer statistically significant after we control for a range of other factors.

Distinguishing the amount of childcare used shows that low and medium use (up to 28 hours per week) of any childcare, particularly low and medium use (up to 24 hours per week) of any formal care, low use (up to 9 hours per week) of day care, and medium use (between 6 and 18 hours per week) of informal care are associated with better children's outcomes compared to other levels of usage (Table 14 a-b) . However, there are no significant negative effects from using any level of childcare compared to not using childcare. The estimated effects are either positive or zero. High use of more than 18 hours of informal care appears associated with higher socio-emotional outcomes when controlling for a range of factors.

We developed a variable to proxy quality of care by constructing a ratio of the number of children per staff member. This variable was then interacted with childcare use. Only the interaction with day care in the socio-emotional model was negatively (and significantly) associated with outcomes. This indicates that a higher number of children per staff member reduced the beneficial effect of day care on socio-emotional outcomes of children (see Table 16). However, the number of staff and number of children is imprecisely measured so the variable is likely to be a rough proxy for the quality of care.

Although we cannot claim that any of the above associations are causal effects arising from childcare, we have controlled for as many other potential factors determining children's outcomes as was possible. As expected, this reduces the size and statistical significance of the

estimated coefficients, but it does not eliminate the effect of childcare on children's outcomes completely and they remain positive.

Finally, to assess the likelihood of differences in the associations of childcare with children's outcomes, we estimated a basic model which included the lagged outcome variable and the different childcare variables for subgroups of the population (see Appendix E). Note that there were too few observations in these subgroups to allow sensible interactions with the childcare variables in addition to including all the control variables. The subgroups of interest were children living with a single parent, children whose main carer did not complete high school, and children living in a home where English is not the main language.

The effects of childcare for the children of single parents appear to be larger than for the general population. The effects of formal childcare (both day care and other formal) appear to have a larger positive association with learning and socio-emotional outcomes, whereas informal childcare has a smaller positive association for this group compared to the general population. Compared to children of single parents, the associations between childcare and outcomes are smaller for children of low-educated main carers. However, compared to the general population, formal childcare still appears to have a stronger positive association with child outcomes for children of low-educated main carers, whereas informal childcare has a weaker positive association. Children living in households where the main language is not English were observed to have a larger positive correlation of their learning outcomes with childcare use than children of low-educated main carers but lower than children of single parents and these effects were only significant if formal care was used. With regard to socio-emotional outcomes all types of childcare appeared to have similarly large effects for this group, indicating they benefit considerably from childcare, and all effects are much larger than for children in the general population, or children of single parents or low-educated main carers.

1. Introduction

The main aim of the research in this report is to provide information on whether the effect of non-parental care on child development differs by key characteristics of childcare providers and by children's characteristics. This project is a first step towards providing insight into what factors are important when examining children's outcomes in terms of their development. In addition, this report provides an overview of childcare use among children with a range of different characteristics, and summarises the types of childcare used and the characteristics of the childcare providers.

The role of childcare programs in children's development has become a topic of interest with an increasing number of children attending such programs. This increase in childcare usage has resulted at least partly from higher female labour force participation rates which seem likely to continue for the next few years. However, more recently, childcare (and for older children preschool as well) has also been suggested as a way of helping children from disadvantaged backgrounds catch up with regard to important skills or preventing them from falling behind children from more advantaged backgrounds in the first place.

The research links in well with the national early childhood development strategy developed and endorsed by the Council of Australian Governments' (COAG) in July 2009 as described in COAG (2009). The research aims to provide information about potential characteristics that affect child development and the role which early childhood non-parental care, such as formal and informal childcare, play in child development using Australian data. Combined with a literature review on this topic, these empirical results can be compared to results from similar analyses internationally.

In addition to examining the broad, overall effect of childcare, the international literature has provided some evidence that different types of childcare may affect children differently, and that children from different backgrounds may be affected differently by the mode of childcare they experience. We briefly review this literature, and then use the LSAC to carry out an analysis for Australia. The central research question is: how do different childcare types (e.g., formal centre-based care, registered family care, parental care, grandparents or relatives) affect child development? The childcare types that can be distinguished in the multivariate analyses are limited to informal care and formal care, where the latter can be further separated into long day care and other formal care. A specific focus is on whether centre-based care (long day care) is better than other care types, which appears to be a result arising from the international literature. In addition, we intend to investigate whether children from different

backgrounds (low – high SES, as measured by low – high parental education, and low – high income families) respond differently to the different types of childcare. A second specific focus is on children living in single parent households on income support, although this is a relatively small group within our data. Welfare policies tend to encourage single parents to increase labour market participation and working hours in order to improve the financial situation of the family. However, if the single parent works more hours, their children will need to spend more time in non-parental care. The effect of childcare use on child development in single-parent families, while allowing for employment status of the single parent and available income in the household, is particularly relevant in view of developing policies for single parents that are beneficial for both the parent and the children.

Section 2 in this report contains the international literature review discussing the effects of attending childcare on child development, but with a special focus on Australian results. After a brief description in Section 3 of waves 1, 2 and 3 of the Longitudinal Survey of Australian Children (LSAC), which are used in the empirical analyses, we provide a descriptive overview of childcare attendance, and of the characteristics of the childcare used by the children in Section 4. Part of the descriptive analysis is done separately for children of single parents and couples.

After discussing the methodology to be used in Section 5, Section 6 reports the results from multivariate analyses of child development. In order to answer the main question of this study, a multivariate regression accounting for a wide range of characteristics of the family – including the parents’ labour force status, education and income–, the child and the childcare provider is used to identify the factors that explain child development with regard to cognitive and non-cognitive aspects, paying particular attention to childcare attendance.

Child development can be measured with regard to cognitive skills, such as the ability to understand and communicate. These skills are assessed by parents, workers at the childcare facility or, at a later stage, teachers (at primary school or preschool). In addition, a range of questions are asked of both parents and teachers regarding the child’s behaviour and interaction with others, indicating the level of non-cognitive skills.

Special attention will be given to indigenous children for as far as this is possible given the relatively small size of the group. For example, in our modelling we will allow the effect of childcare to differ for indigenous children, so that we can examine whether these effects are different.

2. Previous Research on the Effects of Childcare on Child Development

There is a substantial amount of international literature in the area of child development discussing the issue from an economic perspective aiming to quantify the effects of childhood circumstances on the child's development. Childhood circumstances that have been investigated include families' socioeconomic backgrounds as well as the extent of childcare use, while measures of child development have recently been considered in terms of cognitive and non-cognitive skills (Heckman and Rubinstein, 2001; Heckman, Stixrud and Urzua, 2006).

A large proportion of the literature is based on US and UK data although there have been some recent studies based on data from Canada and a range of European countries as well. To deal with the large volume of literature on this topic systematically, we have summarised a large number of papers in Table A1 in the Appendix by topic and by country. The topics that we distinguish are effects of childcare/kindergarten, mother's employment/father's care, child development more generally and LSAC more generally. We discuss these in turn in the following subsections.

2.1 Effects of Childcare/Kindergarten

The research evidence on childcare use has been somewhat mixed with several papers finding negative behavioural effects arising from childcare use but also research finding positive academic effects (Harrison, 2008; Gormley *et al.*, 2005). As a consequence, generalisations of the impact of childcare on child development have not been readily forthcoming. Several papers (Hill, Waldfogel and Brooks-Gunn, 2002; NICHD and Duncan, 2003) have identified childcare quality as playing an important role in child development, thus making general statements about the benefits/dangers of childcare unhelpful. In addition, the effects are often found to be different for children with different characteristics: for example, girls versus boys (Bernal and Keane, 2009; Havnes and Mogstad, 2009b), ethnicity (Currie and Duncan, 1995), education of the mother (Bernal and Keane, 2009; Havnes and Mogstad, 2009b), or disadvantaged versus more advantaged children (Sylva *et al.*, 2004).

Regarding Australian research, a number of papers have described childcare use and preschool attendance in the LSAC (e.g., Harrison and Ungerer, 2005), and a few papers have investigated the relationship between childcare use and child development (e.g., Harrison, 2008; and Leigh and Yamauchi, 2009) or other factors affecting child development (e.g., the effect of financial factors: Bradbury, 2007).

In Australia, Harrison (2008) reported that children attending regular childcare were rated by their parents as more socially competent and having fewer behavioural problems than children not attending childcare by a small but statistically significant amount. Within the different types of childcare, relative to children receiving mixed and informal childcare, children attending formal childcare had higher behavioural problems.

Hill, Waldfogel and Brooks-Gunn (2002) find that high quality centre-based care would confer persistent positive benefits to children who would otherwise have no non-maternal care or have home-based non-maternal care. Contrary to this US evidence, studies investigating data from Australia (Leigh and Yamauchi 2009), Canada (Baker, Gruber and Milligan, 2008) and the UK (Magnuson, Ruhm and Waldfogel, 2007) have found worse behavioural outcomes arising from childcare use.

Baker, Gruber and Milligan (2008) present evidence from 1997 to 2000 in Quebec showing that an introduction of universally accessible childcare was detrimental to children in outcomes ranging from aggression, motor and social skills to illness as well as resulting in more hostile parenting and lower quality parental relationships. The authors note the possibility their findings are short-term rather than long-term effects.

Magnuson, Ruhm and Waldfogel (2007) analysed longitudinal UK data from 1998 and 2000. They found that pre-kindergarten was associated with behavioural problems but also with academic gains. However, the gains in academic skills dissipated towards the end of first grade although these gains were larger and more persistent for disadvantaged children.

Similar to Baker, Gruber and Milligan (2008) and Magnuson, Ruhm and Waldfogel (2007), Leigh and Yamauchi (2009) using LSAC found an association between non-parental care and worse behavioural outcomes in Australia as well, particularly for families from higher socio-economic backgrounds and for children in day care centres with larger group sizes.

In relation to childcare quality, carer and parent's ratings of the child's social competence were found to be higher when children were cared for in smaller groups and spend more time in active engagement (Harrison 2008). NICHD and Duncan (2003) found that higher childcare quality predicted improved cognitive outcomes for both infant and preschool ages. Childcare settings that employ staff with higher qualifications are rated higher on quality and result in better outcomes with regard to intellectual and social-behavioural development (Sylva *et al.*, 2004).

2.2 Mother's Employment/Father's Care

The mother's employment and childcare are often closely related. Results indicate that the effect of a mother's entry into the labour market (and thereby non-maternal care) on the cognitive and emotional competence of the child depends on the age of the child. Negative consequences are often found for cognitive ability when mothers enter market work while the child is still an infant, whereas results for older children (between one and two years of age) of working mothers are mixed (Averett *et al.*, 2005). A UK study by Gregg *et al.* (2005) into the effect of a mother's employment on the cognitive outcomes of her children in early to mid childhood finds that only full-time employment in the first 18 months of her child's life has a negative effect. This is more so for higher educated women and less so for single women. The effect also depends on the type of non-parental childcare used. The negative effect is only evident when care consists largely of unpaid care by a relative, friend or neighbour. Furthermore, the results indicate that employment in combination with using centre-based childcare may even have a positive effect on child development. These results are in line with evidence reported by Gregg *et al.* from US studies, where a return to full-time employment in the first year is also found to have some negative effect, but later returns to employment or part-time employment appear to have no effect. For instance, Berger *et al.* (2005) found, using US data, that a return to work within 12 weeks of giving birth (which is relatively common in the US but not in other developed countries) negatively affects child development and health, particularly if the return is full-time.

Bernal and Keane (2010) estimate the effect of all childcare use (formal and informal together) on the child's cognitive development. Their model accounts for the selection into work of the mother and her childcare decisions. They do this by forming approximations to the decision rules for work and childcare implied by a structural model, and estimate these jointly with a cognitive ability production function and a wage equation. They call this a "quasi-structural" approach. It is important to account for the work and childcare decision, since factors affecting these two decisions are also likely to affect the child's outcome. That is, families who use childcare are different from families who do not use childcare. Using this approach Bernal and Keane find robust negative effects of childcare use on the cognitive development of children in single-parent families.

Similarly, Del Boca, Flinn and Wisswal (2010) examine the effect of childcare in a broader context. Their theoretical model allows the household to make seven choices in each period: hours of work for each parent; time spent in "active" childcare for each parent; time spent in

“passive” child care by each parent; and expenditures on “child” goods. The aim of the household is to maximise household utility. In period t , utility is a function of each parent's hours of leisure, the level of a consumption good produced by the household, and the level of their child's quality. After estimating this model they were able to analyse the issue of the impact of mother's employment on their children's development. They found essentially no effect of employment on child quality at the end of the developmental stage they analysed.

Related research for Denmark by Datta Gupta and Simonsen (2010) found that, on average, participation in non-parental care has no effect compared to home care. However, the results diverge by type of non-parental care. Preschool, which employs highly qualified staff and more male staff, is found to be as good as home care. Family day care, however, seems to reduce non-cognitive skills for boys born to mothers with low levels of education. Furthermore, all results suggest that preschool outperforms family day care for the overall population. This is largely driven by the group of boys born to mothers with a vocational degree. The intensity of non-parental care use is also important with increases in hours of use above the mean of 30 hours deteriorating child outcomes.

2.3 Child Development More Generally

Child development in terms of developing good cognitive and non-cognitive skills is shown to be important in a range of labour market and behavioural outcomes in later life (Heckman, Stixrud and Urzua, 2006). They show that the same low-dimensional vector of abilities that explains schooling choices, wages, employment, work experience, and choice of occupation also explains a wide variety of risky behaviours. They use five measures of cognitive skills including: arithmetic reasoning, word knowledge, paragraph comprehension, mathematical knowledge, and coding speed. They use two non-cognitive measures. First, the Rotter Locus of Control Scale which measures the degree of control individuals feel they possess over their life, and second, the Rosenberg Self-Esteem Scale which measures perceptions of self-worth. The authors conclude that both cognitive and non-cognitive abilities determine social and economic success. In addition, they mention that for many dimensions of behaviour, they deem non-cognitive ability to be as important, if not more important, than cognitive ability.

Given the relevance of these skills in later life, ensuring development of cognitive and non-cognitive skills in early life is important. A review paper by Almond and Currie (2010) discusses the literature on child development in general quite extensively (although there is a focus on US-based studies). They discuss the literature associated with a range of factors that may affect early child development such as prenatal environment (including maternal health,

economic shocks, air pollution) and early childhood environment (including infections, health status, home environment, toxic exposures). They find the potential for long-term effects arising from some of these influences, particularly in the prenatal environment. The paper also explores the effectiveness of public policies to remediate some of these disadvantages. They subdivide policies in a number of categories: income-enhancing policies; near-cash programs (such as Food Stamps); and early intervention programs through home visits, food supplementation for mothers, infants and children, childcare and health insurance. Several of the papers that they review seem to indicate a difference in the effects of shocks and remediation by gender. They conclude that there are a range of opportunities to remediate shortcomings caused by factors earlier in life. However, they emphasise that the prenatal period seems particularly important for later development. In their opinion, the least costly approach to intervene is still an open question and evidence on this keeps changing.

2.4 LSAC more generally

Many of the Australian studies discussed in the previous subsections made use of the LSAC. In addition, LSAC has been used for other more descriptive studies. In this subsection, we discuss a few of these papers.

A good introduction to the type of childcare information that is available in the LSAC is provided by Harrison and Ungerer (2005). They give an extensive overview of the childcare use of children in the Birth Cohort (children followed from birth) and the Child Cohort (children followed from the age of 4 to 5) broken down by a number of characteristics such as State of residency and households' income level. At the time only one wave was available.

The data have also been used by medical researchers. For example, Hiscock *et al.* (2007) used the Child Cohort to investigate the relationship between sleep problems and behavioural and health outcomes. They show that there is a strong negative relationship between sleep problems and these outcomes, and that this problem is very common among 4 to 5 year olds. They note the value of a study like the LSAC in representing the general population and focussing on a diverse number of issues reduces the reporting bias that might occur when a study into a specific issue is undertaken amongst a select group of children.

Finally, the data have also been used to make comparisons to similar data collected at a different time so changes over time in child cohorts can be examined. Smart and Sanson (2005) compare child temperament results from LSAC with those from the Australian Temperament Project (ATP) which started in 1983 amongst children in Victoria and is still

ongoing. They found that, overall, there were no marked changes in children's temperaments and its effect on behavioural and socio-emotional functioning. There were a few smaller differences, such as the 2004 cohort being slightly more sociable and outgoing, for example. The authors suggest this may have something to do with more widespread childcare use, although they cannot verify this with the data and other explanations are possible. When new data sets become available, the LSAC will remain a useful resource that can be used in comparisons for many years to come.

3. Data

The empirical analyses in this report are based on data from *Growing Up in Australia*, the Longitudinal Study of Australian Children (LSAC). LSAC is a nationally representative longitudinal study on children in Australia jointly conducted by three Australian government organisations.³ The sample was drawn in two stages: first a number of postcodes was randomly selected, before randomly selecting children within the relevant postcodes. A few remote areas were excluded from the first stage of the sampling design. The representativeness of the resulting sample of children was assessed by comparing the distribution of a number of key characteristics with those reported in the 2001 Census. Table 11 in Australian Institute of Family Studies (AIFS) (2009) shows that the LSAC parents are somewhat better educated than the general population, but are similar with regard to parents' age and the percentage that are of indigenous background or non-English speaking background. More detailed information on the sample is available in AIFS (2009).

The LSAC is a biannual cohort-based panel dataset, which started in 2004. Information is collected for two birth cohorts: the Birth Cohort (B cohort) children who were born in a 12-month period, March 2003- February 2004, so all children are aged 0 to 1 in the first wave, and the Child Cohort (K cohort) children who were born between March 1999-February 2000, so they were 4 to 5 years old in the first wave. Families with children of the appropriate ages were selected from the Medicare enrolment database held by the Health Insurance Commission and invited to participate in the study. Only one child per family is observed. Although surveys are only conducted once every two years, secondary information is gathered via mail-out questionnaires in the years in which the primary surveys are not conducted.

The observation unit in LSAC is the study child, and information is collected from multiple sources: parents, childcare centres/home-based carers, pre-school/school teachers and the study children themselves. LSAC collects data through various methods: parent's face-to-face interview, parent's self-completion questionnaires, time-use diaries, home/centre-based carer's questionnaires, teacher's questionnaire, child assessments, and child self-report interview once they are 4-5 years old.

As we seek to assess the effects of childcare on child development, our sample comprises families from the infant cohort only. We use three waves of the B cohort data collected at the

³ These are the Department of Families, Housing, Community Services and Indigenous Affairs (FaHCSIA), the Australian Institute of Family Studies (AIFS), and the Australian Bureau of Statistics (ABS).

children's age of 0-1 (Wave 1), at the age of 2-3 (Wave 2) and, most recently, at the age of 4-5 (Wave 3). There are 5,107 infants in Wave 1. Due to survey attrition the sample falls to 4,606 2-3 year olds in Wave 2 and to 4,386 4-5 year olds in Wave 3.

LSAC is the first-ever comprehensive, national Australian dataset on children as they grow up. B cohort data provides information on various children's characteristics including characteristics that can be traced back to pregnancy and childbirth; children's physical, social, cognitive and emotional development; parents' demographic and labour market characteristics; and other information such as childcare use, time use and home environment. The descriptive analysis in the next section describes a number of these children's and parents' characteristics. Detailed information on the data can be found in the data user guide (Australian Institute of Family Studies, 2009).

In Sections 5 and 6, we examine the effect of childcare use on children's cognitive and non-cognitive skill development more closely using multivariate analysis. In measuring child development, LSAC draws from a range of existing child development survey instruments created by researchers, other survey studies and organisations in areas such as education, paediatrics, psychology and psychiatry (see Sanson *et al.*, 2005 for more information). The complexity in quantitatively assessing child development lies partly in determining which measures to use, as they span several domains and vary with the child's age. For example, the Communication Symbiotic Behaviour Scale (CSBS) identifies development in infants and toddlers between the ages of 6 and 24 months while the MacArthur Scale of Communicative Development Inventory (MCDI-III) instrument was developed for 2-3 year olds to measure the ability of the children to form sentences and the extent of their vocabulary. The measures are constructed from aggregate child development scores which are made up of responses to a range of questions in the survey.

4. Descriptive analysis

The descriptive analysis primarily involves presenting a range of summary statistics from the perspective of the children observed in the LSAC over a period of 4 years. A large number of children's, parents' and household characteristics are reported in the LSAC and a selection of these is presented in Sections 4.1 and 4.2. In Section 4.3, the usage of different types of childcare are described for children from different backgrounds in Australia, while children's outcomes by childcare use are reported in Section 4.4.

4.1 Children's characteristics

LSAC collects information on a range of current characteristics of the study children in each of the waves. Using population weights, Table 1 presents these characteristics of children in Waves 1, 2 and 3.⁴ Consistent with population proportions, the birth cohort sample contains about 2 percentage points more boys than girls in Wave 1. Attrition from Wave 1 to Wave 2 and then to Wave 3, does not change the proportion of boys.

About 41% of children are the first child in the family, followed by around 36% who are the second child. This indicates the higher prevalence of families with two children compared to families with three or more children. With attrition, the proportion of observations on first and second children increases slightly, indicating a slightly higher probability of smaller families continuing to participate.

Most children are breastfed at some stage, with the average age at which the mother stops breastfeeding at about 7 months. Sleeping problems are most prevalent when children are between 2 and 3 years old. The majority of children are healthy and have no medical conditions. The proportion of children that have medical conditions increases from just under 6% between ages 0 and 1 to just over 10% between ages 4 and 5. In particular, sensory conditions increase substantially over this time. It is likely that several of these conditions were already present at birth but are only discovered at a later age, for example, because the child's development lags behind that of other children.

⁴ All tables in this section use population weights.

Table 1. Children's characteristics (in % unless otherwise indicated)

Variables	Child is aged 0-1 (Wave 1)	Child is aged 2-3 (Wave 2)	Child is aged 4-5 (Wave 3)
Sex			
Female	48.8	48.9	48.9
Male	51.2	51.1	51.1
	(5,107)	(4,606)	(4,386)
Exact age (years)	0.8	2.9	4.9
	(5,107)	(4,606)	(4,386)
Current weight (kg)	9.3	15.1	19.5
	(3,979)	(4,559)	(4,329)
Current head circumference (cm)	45.6		
	(5,034)		
Ever breastfed			
Yes	90.8		
No	9.2		
	(5,105)		
Age stopped breastfeeding (months)	3.2	7.0	7.6
	(3,089)	(4,524)	(4,380)
Birth order			
1st child	40.8	40.9	41.6
2nd child	35.7	36.3	36.0
3rd child	15.8	15.5	15.2
4th or later child	7.6	7.3	7.2
	(5,107)	(4,606)	(4,386)
Birth order (relative to siblings)			
Only child	39.1	19.9	11.4
Multiple - eldest child	1.7	21.0	30.2
Multiple - middle child	1.7	13.0	19.7
Multiple - youngest child	57.5	46.1	38.7
	(5,107)	(4,606)	(4,386)
Medical conditions present			
No medical condition	94.2	91.7	89.9
Sensory	0.7	3.2	5.1
Physical	0.9	1.6	1.8
Intellectual	0.0	0.2	0.4
Other	4.1	2.1	0.4
Multiple	0.2	1.3	2.5
	(5,107)	(4,606)	(4,386)
Child has sleeping problems			
No	89.7	84.5	88.3
Yes	10.3	15.5	11.7
	(5,098)	(4,606)	(4,385)
Child is fearful to interviewer			
Constantly fearful	1.0		
Typically fearful	4.3		
Half and half	85.5		
Typically trusting	9.2		
	(5,048)		

Note: Authors' own computations based on LSAC 2003-08. Population-weighted results are presented. The total number of observations (children) for each variable is shown in parentheses.

Table 2 describes the circumstances of their birth and the mother's behaviour during the three trimesters of pregnancy, and it presents the characteristics of children at birth. Table 2 shows that nearly 7% of children are born prematurely, and about 6% of children are born underweight. Nearly 30% of all children were born by caesarean and a further 10% required other assistance at birth.

Examining the mother's behaviour during the three trimesters of her pregnancy, about 18% of mothers reported that they smoked and about 38% of mothers drank some alcohol. The non-response on this question is relatively high (about 17% of all respondents) compared to other questions.

The amount of smoking and drinking undertaken by these mothers across the three trimesters of the pregnancy is relatively moderate. The majority of mothers who drank during the pregnancy only did so occasionally, with the second-largest group being mothers who drank one standard drink per week on average. The proportion of mothers drinking some alcohol increased toward the end of the pregnancy from 25% to 34%, but most of these additional women would only drink occasionally as well.

The proportion of women who smoked during their pregnancy was somewhat lower, but smoking being a more addictive habit, these women were more likely to smoke everyday rather than occasionally. However, most of the women smoking everyday managed to limit their smoking to ten cigarettes or less. Slightly fewer women smoked towards the end of their pregnancy (just over 15% compared to just under 18% at the start). This increase in non-smokers reduced the proportion of women smoking between 1 and 20 cigarettes.

Table 2. Child birth and pregnancy characteristics (in % unless otherwise indicated)

Variables	At birth or during pregnancy		
Type of birth			
Normal	61.7		
Caesarean	28.6		
Other difficulties/use of forceps etc.	9.7		
	(5,103)		
Timing of birth			
On time	88.5		
Late	4.6		
Early	5.2		
Very early	1.6		
	(5,098)		
Birth weight (gm)	3395.3		
	(5,072)		
Birth weight categories			
Less than 2.5 kg	5.7		
Between 2.5 and 4.5 kg	92.3		
Over 4.5 kg	2.1		
	(5,072)		
Birth length (cm)	50.3		
	(4,842)		
Head's circumference at birth (cm)	45.6		
	(5,034)		
Mother smoked while pregnant			
Yes	18.3		
No	81.7		
	(4,239)		
Average no. of cigarettes if smoking	1 st trimester	2 nd trimester	3 rd trimester
None	82.4	84.0	84.6
Less than 10	10.0	9.2	8.3
11-20	4.6	3.8	3.8
21-30	0.7	0.7	0.8
31-40	0.1	0.1	0.1
41-50	0.0	0.0	0.0
51 or more	0.0	0.1	0.1
Occasional - not every day	2.3	2.2	2.2
	(4,238)	(4,239)	(4,238)
Mother drank alcohol while pregnant			
Yes	37.6		
No	62.4		
	(4,227)		
Average no. of standard drinks if drinking	1 st trimester	2 nd trimester	3 rd trimester
None	75.0	67.7	66.1
1	3.3	4.7	4.4
2	2.0	2.7	3.1
3+	1.5	1.9	2.3
Occasional - not every week	18.1	22.9	24.1
	(4,230)	(4,231)	(4,228)

Note: Authors' own computations based on LSAC 2003-08. Population-weighted results are presented. The total number of observations (children) for each variable is shown in parentheses.

4.2 Parents' and household characteristics

Table 3 describes the type of household in which the LSAC children live. Nearly 90% of the children live with both biological parents at the age of 0-1. The proportion of children residing with a lone parent increases from 10% at the age of 0-1 to 14% at the age of 4-5. In addition, the proportion that lives with one biological and one non-biological parent increases to 3.3% by the age of 4-5 (from 0.4% at age 0-1). The numbers indicate that about 7.5% of the relationships from the first wave have broken up in the four years from Wave 1 to Wave 3.

Over 70% of parents are legally married, and this increases by just over 2 percentage points from Wave 1 to Wave 3. The proportion of de facto parents decreases substantially from Wave 1 to Wave 3, from just under 19% to 12% (either marrying their partners or breaking up).

About 40% of children were an only child at the age of 0-1, but by the time they are 4-5 years old, 89% of all children have at least one sibling. The majority of children have one sibling, reflecting the prevalence of two-child families, followed by a group of nearly 30% of children who have two siblings.

For 87% of the households, English is the main language at home. This proportion drops slightly in the second wave but is back up to the original level in Wave 3. Just under (over in Wave 2) 5% of children is from a household with parents from an Aboriginal/ Torres Strait islander background. This proportion is fairly constant over the three waves, indicating similar attrition rates for children from an Aboriginal/ Torres Strait islander background as from another background.

The survey also collects information on the home environment. In the first wave, just over 9% of the children live in a house which is cluttered (based on the interviewer's observation). This decreases to 6.8% in the third wave. This reduction could be either due to attrition of families who live in more cluttered houses or the reason for the larger proportion of cluttered houses could be the higher time pressure on parents with newborn children, leaving less time for clearing the house of clutter and cleaning up. In Waves 2 and 3, information is asked on the number of children's books in the house. The majority (over two thirds) of households has more than 30 books, and this proportion increases with the age of the study child in Wave 3 to close to 80%.

Table 3. Household characteristics (in %)

Variables	Child is aged 0-1 (Wave 1)	Child is aged 2-3 (Wave 2)	Child is aged 4-5 (Wave 3)
Categories indicating number and type of parents			
2 biological parents	88.9	85.7	82.3
1 biol parent and 1 non-biol parent	0.4	0.9	3.3
1 biological parent (no P2)	10.4	13.1	14.0
2 non-biological parents	0.2	0.2	0.2
1 non-biological parent (no P2)	0.1	0.1	0.3
	(5,107)	(4,606)	(4,386)
Marital status of parents			
De facto	18.8	14.4	12.0
Married	70.6	72.0	72.9
Other	0.1	0.0	0.0
Single	10.5	13.6	15.0
	(5,107)	(4,516)	(4,204)
Number of other siblings			
No siblings	39.1	19.9	11.4
1 sibling	36.4	47.3	46.3
2 siblings	16.4	22.5	28.7
3 siblings	5.2	6.9	9.4
4 or more	2.9	3.4	4.2
	(5,107)	(4,606)	(4,386)
Number of children's books in home			
None		0.7	0.3
1-10		7.5	5.0
11-20		11.7	7.0
21-30		11.8	9.3
More than 30		68.3	78.4
		(4,606)	(4,385)
Main language spoken at home is not English			
Not English	12.8	12.1	13.0
English	87.2	87.9	87.0
	(5,104)	(4,603)	(4,384)
ATSI			
Not aboriginal	95.1	94.9	95.1
Aboriginal/torres strait islander or both	4.9	5.1	4.9
	(5,107)	(4,606)	(4,386)
House is cluttered			
No	90.7	92.9	93.2
Yes	9.3	7.1	6.8
	(5,003)	(4,505)	(4,275)

Note: Authors' own computations based on LSAC 2003-08. Population-weighted results are presented. The total number of observations (children) for each variable is shown in parentheses.

Table 4 shows the parents' characteristics. The majority of parents are biological parents, with a slightly larger proportion of non-biological fathers which also increases to a larger extent

than the proportion of non-biological mothers from Wave 1 to Wave 3. This is a reflection of the fact that in a divorce, children usually remain living with their mothers. In Wave 1 (less than one year after birth of the study child), the mothers' average age is 31 years old while fathers are about 3 years older on average.

Around 73% of fathers and mothers are born in Australia. A further 3.5% of mothers and 2.2% of fathers are Australian with an Aboriginal/Torres Strait Islander background. Just over 20% of fathers and mothers were born overseas, with a slightly higher proportion from non-English speaking backgrounds than from English speaking backgrounds, in particular for mothers. The percentages are consistent with those on the proportion of households where English is not the main language.

The distribution over education levels is quite similar for fathers and mothers, with mothers being slightly more likely to have finished a degree or more, but also more likely to have dropped out of high school. Around 20% of mothers and 15% of fathers did not complete secondary school. In Wave 3, the proportion of fathers with a degree or more (29.5%) is nearly equal to the proportion of mothers with a degree or more (29.6%).

The majority of parents report no medical conditions. However, for both fathers and mothers the occurrence of medical conditions is substantially higher in Wave 1 than in the later waves.⁵ It is 20% and 25% in the first wave for fathers and mothers, respectively, which decreases to 10% and 11% in Wave 2 and then to 7% and 9% in Wave 3. It is not clear at this stage what is causing the relatively high prevalence of medical conditions in the first wave, and whether it is associated with the childbirth.

Parents' labour market situations are reported in Table 5. As expected, most fathers (close to 90%) are working full-time across all three waves, while in Wave 1 (less than one year after childbirth) nearly 50% of all mothers are out of the labour force. The proportion of mothers in full-time and part-time work increases from 39% at the time the study child's age is 0-1 to 59% once the child is 4-5 years old. Part-time work remains the most prevalent type of employment across all three waves, and in Wave 3 it is even the most prevalent labour force status, being slightly above the proportion of women out of the labour force. About 9% of all mothers are on maternity leave in the first year. Only a relatively small proportion of fathers and mothers are unemployed in any of the three waves.

⁵ It appears that the question was asked in a different way in the first wave compared to Wave 2 and Wave 3. In the first wave the question regarding health conditions is asked separately for each person in the household whereas in Wave 3, the question is asked for everyone in the household at once: that is, the question was "does anyone in the household have any health conditions?".

Table 4. Parents' characteristics (in % unless otherwise indicated)

Variables	Child is aged 0-1 (Wave 1)	Child is aged 2-3 (Wave 2)	Child is aged 4-5 (Wave 3)
Biological mother			
No	0.3	0.5	0.7
Yes	99.7	99.5	99.3
	(5,104)	(4,599)	(4,382)
Biological father			
No	0.6	0.7	2.3
Yes	99.4	99.3	97.7
	(4,627)	(4,021)	(3,779)
Mother's age (in years)	30.9	33.0	35.0
	(5,103)	(4,588)	(4,363)
Father's age (in years)	33.8	36.1	38.2
	(4,626)	(4,020)	(3,724)
Mother's Country of Birth			
Australia (not ATSI)	73.2	73.6	73.2
ATSI	3.5	3.7	3.4
ESB	8.7	8.5	8.4
NESB	12.1	11.9	12.6
Confidentialised	2.4	2.3	2.3
	(5,104)	(4,605)	(4,386)
Father's Country of Birth			
Australian born (not ATSI)	72.3	73.0	72.7
ATSI	2.2	2.4	2.0
ESB	11.2	10.9	11.1
NESB	11.7	11.2	11.8
Confidentialised	2.7	2.5	2.4
	(4,627)	(4,227)	(4,050)
Mother's education			
Degree+	29.1	28.3	29.6
Adv Diploma/Diploma	9.3	9.2	9.7
Comp HS	13.0	12.1	11.2
Certificate	26.6	29.6	30.7
Did not Comp HS	22.0	20.8	18.8
	(5,100)	(4,596)	(4,382)
Father's education			
Degree+	27.3	27.9	29.5
Adv Diploma/Diploma	8.2	8.0	9.0
Comp HS	11.6	11.1	10.6
Certificate	36.8	37.7	36.9
Did not Comp HS	16.0	15.4	14.0
	(4,578)	(3,993)	(3,751)
Mother has a medical condition			
No	75.1	89.0	91.1
Yes	24.9	11.0	8.9
	(5,104)	(4,589)	(4,363)
Father has a medical condition			
No	79.8	90.2	93.3
Yes	20.2	9.8	6.7
	(4,627)	(4,020)	(3,724)

Note: Authors' own computations based on LSAC 2003-08. Population-weighted results are presented. The total number of observations (children) for each variable is shown in parentheses.

Table 5. Parents' labour market characteristics (in % unless otherwise indicated)

Variables	Child is aged 0-1 (Wave 1)	Child is aged 2-3 (Wave 2)	Child is aged 4-5 (Wave 3)
Mother's work status			
Employed full-time (30+ hrs/week)	10.7	16.8	21.8
Employed part-time (or unknown hours)	28.2	35.2	37.6
Employed, but on maternity leave	8.9	3.4	1.7
Unemployed and looking for work	3.4	3.4	2.3
Not in the labour force	48.9	41.1	36.6
	(5,093)	(4,599)	(4,379)
Father's work status			
Employed full-time (30+ hrs/week)	87.3	89.2	89.3
Employed part-time (or unknown hours)	5.4	4.1	4.4
Employed, but on maternity leave	0.0	0.1	0.0
Unemployed and looking for work	3.1	2.2	1.7
Not in the labour force	4.2	4.4	4.6
	(4,622)	(4,017)	(3,776)
Couples by Employment Type			
No parent is working	4.6	3.3	2.7
1 parent is working	44.9	37.9	33.4
2 parents PT	1.5	1.2	1.3
1 FT/ 1 PT	29.9	38.1	41.7
2 parents FT	19.1	19.4	20.9
	(4,617)	(4,095)	(3,897)
Single Parents by Employment Type			
Not working	76.4	58.2	44.5
PT employed	14.7	26.6	29.7
FT employed	8.8	15.2	25.8
	(475)	(507)	(485)
Mother's usual hours of work (hrs/week)			
	22.8	22.9	24.3
	(2,524)	(2,698)	(2,853)
Father's usual hours of work (hrs/week)			
	46.1	46.3	47.1
	(4,264)	(3,815)	(3,596)
Mother's usual gross weekly income (\$)			
(conditional on working)	476.2	626.0	738.8
	(2,310)	(2,630)	(2,762)
Father's usual gross weekly income (\$)			
(conditional on working)	1025.0	1233.4	1469.1
	(3,720)	(3,683)	(3,431)
Received Welfare			
No	71.2	62.1	67.6
Yes	28.8	37.9	32.4
	(5,105)	(4,594)	(4,373)

Note: Authors' own computations based on LSAC 2003-08. Population-weighted results are presented. The total number of observations (children) for each variable is shown in parentheses.

Across the three waves, about 3 to 5% of children in couple households live in a household where neither parent is employed. The situation is very different for single parent families. A high proportion of single parents are not employed: 76% when the child is aged 0-1, and 58% and 49% when the child is aged 2-3 and 3-4 years, respectively. In the first wave, the most

common combined labour force status for couples is one parent being full-time employed, while in the later two waves, the combination of one working full-time and the other working part-time is most common. Single parents (who are mostly mothers) are much more likely to be out of the labour force than partnered mothers and they are less likely to work part time. Only in the third wave is a higher proportion of single parents working full time compared to partnered mothers.

Conditional on the mother being employed, average hours of work is fairly stable over the three waves around 23-24 hours per week, despite the change in the proportion working full time and part time. That is, there is no difference by children's age although the proportion of working mothers increases with the children's age. Conditional on employment, fathers work about twice as many hours compared to mothers in each of the waves.

Table 6 describes the parents' interactions and activities with the study child. The interviewer observes whether the parent praises the child spontaneously during the interview. Over 75% of parents praise their child at least twice, and this does not change much over the survey period. The reverse of whether the parent scolded, shouted at or belittled the child is also observed, but since this hardly occurs in any of the interviews we have left this out of the summary statistics.

A range of activities are reported in the second and third wave when the child is 2-3 years and 4-5 years old. These various day-to-day activities with their parents are potentially important for the development of the child's cognitive and non-cognitive skills. Nearly all parents (93%) read at least once a week to their child⁶ and play outdoors with them at least once a week. Nearly 80% of parents read books to their child on 3-7 days of the week and 67% of children have outdoor play activities on 3-7 days of the week with their parents. These activities are only reported for the children when they are 2-3 years old.

A number of activities are also reported when the children are 4-5 years old. Taking a child out to see a movie or sport, or to a museum, concert or library, clearly becomes more popular as the child grows older. However, these can be expensive activities and are not available at all locations, so they are not as pervasive as the reading to or playing with children. The amount of time spent watching television on weekdays does not change much for children aged 2-3 years compared to when they are 4-5 years old. On average, children spend about 2 hours watching TV/video on weekdays. However, the amount of time children spend

⁶ Telling a story to your child is clearly less popular. Possibly since this implies that the parent is making up their own story, which is clearly more challenging than reading a story from a book.

watching television during the weekend increases by nearly half an hour when children grow older. When children are 2 to 3 years old, they watch television for more time on weekdays, but as they grow older, they start watching more on weekend days.

Table 6. Children’s activities with parents (in % unless otherwise indicated)

Variables	Child is aged 0-1 (Wave 1)	Child is aged 2-3 (Wave 2)	Child is aged 4-5 (Wave 3)
Parent 1 spontaneously praises child during the interview			
Did not praise	21.8	24.3	23.8
Spontaneously praised (at least twice)	78.2 (4,872)	75.7 (4,505)	76.2 (4,310)
Told a story to a child			
None		39.7	
1 or 2 days		33.5	
3-5 days		15.2	
Every day (6-7 days)		11.5 (4,606)	
Read to child			
None		7.1	
1 or 2 days		13.3	
3-5 days		21.7	
Every day (6-7 days)		57.9 (4,606)	
Playing with a child (outdoors)			
None		7.3	
1 or 2 days		25.7	
3-5 days		39.8	
Every day (6-7 days)		27.2 (4,606)	
Taking a child out (movies/sport)			
No		63.6	42.6
Yes		36.4 (4,606)	57.4 (4,385)
Taking a child out (concert/museum/library)			
No		44.1	36.2
Yes		55.9 (4,606)	63.8 (4,385)
Average time of watching TV/video on weekdays (minutes)		123.0 (4,606)	124.7 (4,385)
Average time of watching TV/video on weekends (minutes)		105.6 (4,606)	133.9 (4,385)

Note: Authors’ own computations based on LSAC 2003-08. Population-weighted results are presented. The total number of observations (children) for each variable is shown in parentheses.

4.3 Childcare use

Based on the categories reported in LSAC, we categorise childcare into two types: informal and formal childcare. Informal childcare includes care provided by grandparents, other

relatives, and other persons such as friends or neighbours. In our tables, formal childcare is further subdivided into four different types of childcare: day care centre, other regular formal care, irregular formal care and education.⁷ Day care centre indicates the use of a long day care centre. Other regular formal care includes the use of family day care, before and after school care, or a nanny. Irregular formal care includes the use of occasional care, gym/leisure/community centre or mobile care unit. The latter two types of formal care include both regulated and unregulated care services. This means that some types of care included in this category need to participate in the Quality Improvement and Accreditation System (QIAS) for approved childcare whereas other types of care in this category do not need to participate. All types of formal care may employ qualified or unqualified staff, where the level of qualification may vary as well, although a certain proportion of staff in day care should have relevant qualifications. The fourth category education includes preschool, kindergarten/ reception/ preparatory and Year 1.

We now turn to describing the pattern of childcare use by the children's age. Table 7 shows that, overall, 35% of children aged 0-1 (wave1) are cared for by someone other than their parents for at least some of the time. This increases to 68% at the age of 2-3 (Wave 2) and 96% at the age of 4-5 (Wave 3). The high proportion in the third wave is due to the majority of children attending preschool at that stage.

Table 7. Childcare Use and Average Hours of Use (if using childcare) by Childcare Type

Childcare Type	Child is aged 0-1 (Wave 1)		Child is aged 2-3 (Wave 2)		Child is aged 4-5 (Wave 3)	
	% using this type	Average hours used	% using this type	Average hours used	% using this type	Average hours used
Informal care	21.9	13.2	21.9	13.9	24.8	11.3
Formal Care	17.3	18.2	59.0	17.8	94.3	20.7
Day care centre	10.8	18.6	42.6	18.3	30.3	19.5
Other regular formal care	5.2	20.1	9.5	20.1	8.9	12.9
Irregular formal care	1.9	4.0	5.4	4.5	1.7	4.5
Education	0.0		4.7	12.0	70.6	17.7
Using any childcare	35.0	17.2	68.4	19.8	95.5	23.4
Number of observations	5,106	1820	4,606	3231	4,386	4220

Note: Authors' own computations based on LSAC 2003-08. Population-weighted results are presented.

⁷ A table with full details on each of the childcare types used by parents is provided in Appendix Table B1.

Conditional on the children being in any type of childcare, the average weekly hours in childcare also increases by the age of children, from 17 hours at the age of 0-1 to 20 hours at the age of 2-3 and 23 hours at the age of 4-5. We do not consider children's time spent with parents living elsewhere as using childcare. Relatively few children (from 0.7% in Wave 1 to 2.6% in Wave 3) are cared for by parents living elsewhere. For this small group of children, the average weekly hours cared for by this parent is nearly 16 hours for children aged 0-1, and 30-31 hours for children aged 2-3 and children aged 4-5.

For children at the age of 0-1, parents use more informal care relative to formal care. As children grow up, proportionally more children start attending formal childcare. Just over 17% of 0-1 year olds use formal childcare, which increases to 59% by the age of 2-3 and 94% by the age of 4-5. The usage of informal care is very stable over children's age (between 22% and 25%). As children grow up, they spend increasingly more time with people other than their parents.

Among formal care, the use of a day care centre is the most prevalent type of care except for education for children aged 4-5. Regarding the average amount of time spent at the relevant care based on a usual week, average hours per week in other regular formal care is slightly higher than the average hours per week in a day care centre for children in Wave 1 and Wave 2 (20.1 hours versus about 18.5 hours). This may reflect the greater flexibility and longer hours available in other regular formal care. Once children turn 4-5 years old, the largest average amount of time is spent in a day care centre (19.5 hours) if this is used, followed by education (17.7 hours).

Table 8 provides additional information on the usage of childcare, by reporting the amount of time spent in each type of childcare by the child as a proportion of the child's total childcare hours.⁹ These proportions are computed at the individual level and averaged over all children using at least one type of childcare.

Children at the age of 0-1 spend a larger proportion of time in informal childcare than in formal care. Children aged 0-1 spend 55% of the total time in childcare with informal carers such as grandparents, other relatives or neighbours. Once children grow up, they spend proportionally less time with informal carers although Table 7 shows that the proportion of children using informal childcare is similar at the three reported ages.

⁹ Again, a table with full details on each of the childcare types used by parents can be found in Appendix Table B2.

In the first two waves, day care centres are the formal childcare type used for most of the time. The proportional increase in the use of formal care from Wave 1 to Wave 2 is mostly an increase in the use of day care centres. Children at the age of 2-3 spend on average 55% of their total childcare hours in a day care centre. Once children reach the age of 4-5, education is proportionally used the most (61%), but the day care centre is still the second most used form of childcare (at nearly 25%).

Table 8. Average Proportion of Total Childcare Hours Spent in Each Childcare Type (in %) (conditional on those using any childcare)

Childcare Type	Child is aged 0-1 (Wave 1)	Child is aged 2-3 (Wave 2)	Child is aged 4-5 (Wave 3)
Informal care	55.2	21.8	10.0
Formal care	44.8	78.2	90.0
Day care centre	27.4	55.4	24.8
Other regular formal care	13.2	12.0	3.6
Irregular formal care	4.2	5.2	0.4
Education	0.0	5.6	61.4
Average total hours of childcare	17.2	19.8	23.4

Note: Authors' own computations based on LSAC 2003-08. Population-weighted results are presented.

Table 9 examines the relationship between childcare use and the parents' labour market status. The upper panel is for children who live with both parents and the lower panel is for those who live with one parent only. As expected, Table 9 shows a positive association between childcare use and the intensity of parents' work regardless of the child's age and family type. Children with parents in employment are more likely to use childcare than children with non-employed parents. In addition, children spend, on average per week, more hours in childcare if the sum of parents' working hours is greater. Children with both parents working full time spend on average 26-28 hours in formal childcare regardless of the child's age. The pattern of informal childcare use is similar to that of formal childcare use with respect to parents' work status. However as children grow up, children with employed parents tend to spend less time in informal childcare while children of non-employed parents tend to spend more time in informal childcare as they grow up. Children with no parent in employment spend relatively longer hours in informal childcare when the child is aged 2-3 and 4-5, although the proportion of these children using informal or formal childcare is the lowest.

Table 9. Childcare Use and Average Hours for Those Using Childcare by Labour Force Status of the Parents for Wave 1 to Wave 3

	Child is aged 0-1 (Wave 1)		Child is aged 2-3 (Wave 2)		Child is aged 4-5 (Wave 3)	
	% using	Average hours	% using	Average hours	% using	Average hours
<u>Children living with two parents</u>						
<i>formal care use amongst children with</i>						
No parent working	4.5	12.6	34.6	17.0	78.4	17.8
One parent working	7.1	10.5	41.6	11.6	92.6	17.2
Two parents working (2 PT)	20.9	16.3	63.0	15.3	98.0	18.1
Two parents working (1FT/1PT)	29.7	15.1	70.0	15.9	97.0	19.5
Two parents working (2 FT)	28.3	28.0	74.9	26.4	96.6	27.1
	(4,617)	(841)	(4,095)	(2,446)	(3,897)	(3,719)
<i>informal care use amongst children with</i>						
No parent working	8.7	8.2	3.5	14.2	8.6	17.4
One parent working	10.4	7.1	9.1	8.6	10.3	9.5
Two parents working (2 PT)	37.2	9.2	31.6	7.6	23.2	8.1
Two parents working (1FT/1PT)	39.4	11.5	31.7	11.3	31.8	8.5
Two parents working (2 FT)	26.0	24.1	35.0	19.9	38.7	13.9
	(4,617)	(1,023)	(4,095)	(940)	(3,897)	(961)
<i>any care use amongst children with</i>						
No parent working	12.9	10.0	38.1	16.7	81.4	19.0
One parent working	16.5	9.0	47.2	11.9	93.8	18.1
Two parents working (2 PT)	50.5	13.6	80.2	15.0	98.0	20.5
Two parents working (1FT/1PT)	60.5	14.9	82.9	17.8	98.2	22.1
Two parents working (2 FT)	48.1	29.5	88.0	30.4	98.4	32.2
	(4,617)	(1,656)	(4,095)	(2,847)	(3,897)	(3,764)
<u>Children living with one parent only</u>						
<i>formal care use amongst children with</i>						
the parent not working	9.2	15.0	54.0	17.5	87.4	19.8
the parent working part time	37.9	16.0	82.7	20.1	97.2	24.0
the parent working full time	35.0	27.8	90.2	30.9	98.9	31.8
	(475)	(74)	(507)	(347)	(485)	(456)
<i>informal care use amongst children with</i>						
the parent not working	15.9	12.1	11.6	9.2	16.3	18.3
the parent working part time	51.1	12.6	30.1	14.6	37.8	10.6
the parent working full time	31.5	16.6	43.9	30.6	45.0	15.9
	(475)	(112)	(507)	(105)	(485)	(137)
<i>any care use amongst children with</i>						
the parent not working	23.7	13.9	60.3	17.4	90.7	22.4
the parent working part time	73.1	17.1	92.5	22.7	97.2	28.2
the parent working full time	46.8	32.0	96.7	42.8	100.0	38.6
	(475)	(162)	(507)	(383)	(485)	(463)

Note: Authors' own computations based on LSAC 2003-08. Population-weighted results are presented. The total number of observations (children) for each variable is shown in parentheses.

Comparing one- and two-parent families, a larger proportion of children with a single parent use childcare (both formal and informal) compared to children with two parents, conditional on the parents having a similar work status. In addition, children living with only one parent

spend, on average, more hours in (formal and informal) childcare relative to children living with both parents. Children living with one parent working full time spend, on average, 32 hours a week in childcare at the age of 0-1, 43 hours at the age of 2-3 and 39 hours at the age of 4-5, whereas children living with two parents who are both working only spend 30 hours in childcare at the age of 0-1, 30 hours at the age of 2-3 and 32 hours at the age of 4-5.

4.4 Childcare use and children's outcomes

The LSAC includes children's outcome measures for learning/cognitive, physical (health) and social/emotional outcomes in each wave. The outcome measures of child development used differ by the children's age, so the specific measures of these outcomes are attributed to the children at a particular point in time. A group of researchers associated with the LSAC has developed the LSAC Outcome Index using various child outcome measures in the LSAC (described in Sanson *et al.*, 2005). The Outcome Index is a composite measure to indicate how children are developing. The components of this index change over the waves (with the children's ages), but the meaning/interpretation of the index is broadly consistent across the waves (and children's ages).

The LSAC Outcome Index consists of three domains: physical, social and emotional, and learning, with each domain consisting of several subdomains. Appendix Table C1 lists these subdomains and the selected children outcome measures included from LSAC for each subdomain.¹⁰ In the first two waves the outcome measures are based on what the main carer reports. Although carers and teachers also assess the child, comparing him/her to other children, this information is of course only available when the child attends formal care or some form of education. In the third wave some of the measures are based on tests applied by the interviewer. This project focuses on two domains, socio-emotional and learning, which represent children's non-cognitive and cognitive skills, respectively.

The top panel of Table 10 presents the mean of the three domains of the LSAC Outcome Index by childcare use in the same wave. Note that the score for each domain is standardised to have a mean of 100 over all children in each wave. The statistical significance of differences between the "yes" and "no" column is indicated by stars (more stars indicate higher significance). In terms of physical outcomes, children not using childcare have slightly

¹⁰ A sub-domain score is computed as the sum of standardised scores on variables contributing to it, and a domain score is the sum of standardised sub-domain scores. All three domain scores were standardised again to have a mean of 100 and a standard deviation of 10.

better scores on average, in particular children at the age of 0-1, possibly due to the building up of immunity which means children at this age catch colds and infections very easily from other children at childcare.

For the socio-emotional and learning domains, the mean for children not attending childcare is slightly lower than the overall mean (100), and these differences increase slightly with children's age. However, we need to be careful when interpreting these differences, particularly for children at the age of 4-5, since 96% of children at that age attend some form of childcare (which includes education). The children not in childcare at that age might be quite different from those in childcare. It might also be of interest to explore the effect of childcare at age 2-3 on outcomes at age 4-5.

Table 10 also shows the mean values of a range of individual child outcome variables measured in the LSAC. (Note: this list of outcome variables in the LSAC is not exhaustive.) Some of these variables are used to construct the three domains of the Outcome Index. The average score of children using childcare is not much different from the score of those not using childcare for each outcome variable. There is a very slight pattern of better language/communication skills, and better social and emotional outcomes for children who attend childcare.

Table 11 only contains information on children who attended childcare in the relevant wave. It compares the average outcomes of children using any type of formal childcare with the outcomes of children only using informal childcare. Examining the three domains of the LSAC Outcome Index, the average score of children attending any formal childcare is slightly higher relative to those only using informal care for all ages in the socio-emotional domain and the learning domain. However in Wave 1, children who only attend informal care have slightly higher learning scores relative to children in formal care, although the difference is not statistically significant. Once children grow up, the average learning scores of children in formal care are slightly higher than those of children in only informal care. However, overall for all variables, the averages between the two groups of children are not much different from each other except for the MCDI Vocabulary score for children at the age of 2-3, and the Peabody Picture Vocabulary Test and Who Am I scores at age 4-5. However, as mentioned earlier, the average scores for children who only use informal care at the ages of 4-5 need to be interpreted very cautiously due to the small number of children that are in this category.

Table 10. Children's outcomes by childcare use (Mean Values)

Outcomes [Range]	Child is aged 0-1 (Wave 1)		Child is aged 2-3 (Wave 2)		Child is aged 4-5 (Wave 3)	
	no	yes	using any childcare		no	yes
<i>Three domains of LSAC Outcome Index</i>						
Physical [25.0-118.6] ^b	100.3**	99.4	100.2	99.9	100.2	100.0
Socio-emotional [37.0-125.0] ^b	99.9	100.2	99.1	100.5***	96.5	100.1***
Learning [57.3-128.6] ^b	100.0	100.0	99.3	100.3*	95.3	100.2***
<i>Specific outcomes in the LSAC</i>						
Short Temperament Scale for Infants [1-6]						
Approachability	4.7	4.7				
Cooperativeness	4.2***	4.1				
Irritability	2.5	2.5				
Approachability			3.8	3.9**		
Persistence			4.3	4.3		
Reactivity			3.0	3.0		
Social ^a					7.4	7.7^
Persistence ^a					3.6	3.9*
Reactivity ^a					2.7	2.6
Brief Infant-Toddler Social Emotional Assessment (BITSEA)						
Problems Scale [20-54] ^b			31.0***	30.4		
Competence Scale [13-33] ^b			28.4	28.6*		
Strengths and Difficulties Questionnaire [0-10] ^a						
<i>Teacher assessed:</i>						
Sociability						7.1
Peer problems						1.4
Emotional						1.0
Hyperactive						2.5
Conduct Problems						1.1
<i>Parent assessed:</i>						
Sociability					7.4	7.7
Peer problems					2.1***	1.4
Emotional					1.7	1.5
Hyperactive					3.9**	3.4
Conduct Problems					2.6*	2.2
Parental Evaluations of Developmental Status (v1) [14.3-100] ^a						
MCDI Vocabulary [0-98]			52.1	54.4*	83.5	82.5
MCDI Grammar [0-12]			5.5	6.1***		
CCC2 Communication [1-3] ^b			2.4	2.4		
Peabody Picture Vocabulary Test [34.2-84.8] ^{a b}					62.2	64.7***
Who Am I [30.0-96.9] ^{a b}					60.0	65.4***
Teacher rating on reading [0-5] ^{a b}						1.9**
Teacher rating on writing [0-6] ^{a b}						3.4**
Teacher rating on numeracy [0-5] ^{a b}						3.5**
Parent rating of reading [0-3] ^{a b}					0.4	0.6***

Notes: Authors' own computations based on LSAC 2003-08. Population-weighted results are presented. Childcare use is with respect to the relevant wave in each column, not earlier waves. Significance level of difference between no-yes column is indicated by: ^ for 10%, * for 5%, ** for 1% and *** for 0.1%.

a) This variable is only available for Wave 3.

b) Sample minimum and maximum values in parentheses (as opposed to theoretical minimum and maximum values for the other rows, such as the short temperament scale for infants).

Table 11. Children's outcomes by the type of childcare use (Mean Values)

Outcomes [Range]	Child is aged 0-1 (Wave 1)		Child is aged 2-3 (Wave 2)		Child is aged 4-5 (Wave 3)	
	Formal / mixed	Informal only	Formal / mixed	Informal only	Formal / mixed	Informal only
<i>Three domains of LSAC Outcome Index</i>						
Physical [25.0-118.6] ^b	98.6	100.2***	99.7	101.1*	100.0	101.9
Socio-emotional [37.0-125.0] ^b	100.3***	100.0	100.6	100.0	100.3***	89.8
Learning [57.3-128.6] ^b	99.0	101.1	100.4	100.1	100.3**	91.8
<i>Specific outcomes in the LSAC</i>						
Short Temperament Scale for Infants [1-6]						
Approachability	4.7	4.7				
Cooperativeness	4.0	4.1 [^]				
Irritability	2.5	2.5				
Approachability			4.0	3.9		
Persistence			4.3	4.2		
Reactivity			3.0	2.9		
Social ^a					3.8	3.9
Persistence ^a					3.9	3.6
Reactivity ^a					2.6	2.7
Brief Infant-Toddler Social Emotional Assessment (BITSEA)						
Problems Scale [20-54] ^b			30.4	30.4		
Competence Scale [13-33] ^b			28.6 [^]	28.4		
Strengths and Difficulties Questionnaire [0-10] ^a						
<i>Teacher assessed:</i>						
Sociability					7.1	-
Peer problems					1.4	-
Emotional					1.0	-
Hyperactive					2.5	-
Conduct Problems					1.1	-
<i>Parent assessed:</i>						
Sociability					7.7	7.2
Peer problems					1.4	2.7***
Emotional					1.5	2.3*
Hyperactive					3.4	3.9
Conduct Problems					2.2	3.2*
Parental Eval. of Dev. Status (v1) [14.3-100] ^a					82.5	84.3
MCDI Vocabulary [0-98]			54.9*	51.1		
MCDI Grammar [0-12]			6.1	6.0		
CCC2 Communication [1-3] ^b			2.4	2.4		
Peabody Picture Vocabulary Test [34.2-84.8] ^{a b}					64.8***	59.2
Who Am I [30.0-96.9] ^{a b}					65.5***	58.2
Teacher rating on reading [0-5] ^{a b}					1.9	-
Teacher rating on writing [0-6] ^{a b}					3.4	-
Teacher rating on numeracy [0-5] ^{a b}					3.5	-
Parent rating of reading [0-3] ^{a b}					0.6	0.6

Notes: Authors' own computations based on LSAC 2003-08. Population-weighted results are presented. Childcare use is with respect to the relevant wave in each column, not earlier waves. – indicates that there is a very small number of children in that cell. Significance level of difference between no-yes column is indicated by: [^] for 10%, * for 5%, ** for 1% and *** for 0.1%.

a) This variable is only available for Wave 3.

b) Sample minimum and maximum values in parentheses (as opposed to theoretical minimum and maximum values for the other rows, such as the short temperament scale for infants).

5. Methodology

In this section we investigate the factors shaping children's cognitive and non-cognitive skills in early childhood using multivariate regression analyses. In particular, we are interested in the role of formal childcare attendance in developing these skills. From the recent literature (Cunha and Heckman 2007a, 2008), which describes the multi-period process for the formation of these skills at different stages of the life cycle of children, we can gain insights into the important factors associated with early childhood development.

Cunha and Heckman identify many factors which affect childhood development and particularly observe that the development of cognitive and non-cognitive skills at each stage of a child's life depends on the previous level of these skills. The key factors they identify as being important for the development of children's skills are the child's inherited endowment and the child's parental investment. A child's inherited endowment makes reference to the child's innate ability (or the genetic components inherited from the child's parents) while a child's parental investment refers to the resources and time devoted to a child by his or her parents. In addition, if children attend childcare (or an educational institution as they grow up), the quality of childcare (as reflected in the activities and environment) also contributes towards shaping children's skills. As other additional factors potentially affecting children's cognitive and non-cognitive development, we could include children's and parents' physical (health) conditions, home environment, and parental/family/neighbourhood characteristics

How each of the above factors separately affects the development of children's cognitive and non-cognitive abilities in their early childhood is not a simple question to answer. In particular, isolating the causal effect of a single factor on skills formation, while controlling for other factors, is an extremely difficult (intractable) econometric task because many of these factors are endogenously correlated with each other. Therefore, before continuing our discussion regarding the appropriate multivariate analysis to use, we need to note that any proposed analysis will measure the correlation between a range of factors and children's cognitive and non-cognitive achievement, rather than being able to identify the causal effects of these factors.

In the empirical literature studying the factors which determine children's cognitive and non-cognitive achievement, there are two broad approaches (Todd and Wolpin, 2003). The Early Childhood Development (ECD) approach is the literature which explores the role of parental/family characteristics and early family environments in the formation of a child's

cognitive and non-cognitive skills. The second approach is based on an education production function (EPF). Through analogy, the latter approach tries to understand the skill acquisition processes of a child within the framework of the production process of a firm. That is, this literature aims to understand the technology of combining inputs, such as parental or school inputs, in order to produce children’s cognitive and non-cognitive skills.

In this project, we are particularly interested in the effect of childcare and also the effects of different types of childcare on child development. We propose to estimate a “value-added” model which is common in the EPF approach. The value-added specification uses a lagged child outcome variable as a control variable. The key underlying assumption is that this lagged outcome variable provides sufficient information summarising all previous historical inputs before the current period including the child’s inherited endowments. This model is commonly used to measure the effect of schooling on children’s outcomes, such as literacy or numeracy test scores, because many of the datasets used in these studies do not include sufficient information on the earlier stages in children’s lives.

Through the use of a value-added model, researchers try to overcome this shortcoming of having limited data on earlier life stages by applying the assumption that a lagged outcome variable incorporates all this missing information. Our main analysis is based on data from Wave 2. We observe children from their birth year and so we are able to control for certain observable characteristics from the beginning of children’s lives. We note that taking the alternative approach of measuring inherited endowments through the inclusion of proxy variables would require careful analysis and consideration for each variable.

To formalise notation, let S_{it} be our child outcome variable, representing cognitive and non-cognitive skills for child i at age (wave) t , and X_{it} are the current inputs, contributing to child development, from the parents and through childcare (if a child attends any type of care).

$$S_{it} = S_t[X_{it}, S_{t-1}(X_i(t-1), \mu_{i0})]$$

The current level of child outcome depends on current inputs (X_{it}) and the child’s skills at the previous stage (S_{t-1}) which is determined by all previous inputs up to age $t-1$, $X_i(t-1)$, and a child’s ability endowment (μ_{i0}). We consider two outcome measures of a child’s skill: the standardised scores of the derived learning index as a measure of cognitive skill and the socio-emotional index as a measure of non-cognitive skill, as described in section 4.4. We estimate

models for the learning and social-emotional outcomes separately using the Ordinary Least Squares (OLS) estimator.

We use wave 2 data from the LSAC (in which children are 2-3 years olds) as the current time period for our multivariate analysis to examine the effects of childcare on the child outcomes. Wave 3 data is not suitable for use to analyse these effects because almost all of the children (at age 4-5) attend formal care in the shape of education, such as preschool, kindergarten or a preparatory year. Due to the lack of variation in education participation, this limits our ability to draw conclusions from the data.

We define the type of childcare in a number of alternative ways to capture the effects from the different types of childcare. The baseline category is “no childcare” for all our analyses. In Section 6.1, we describe how the different types of childcare are exactly defined in the different specifications. In alternative specifications, we also attempt to control for the quality of childcare by including the children to staff ratio conditional on attendance of any formal care and the proportion of childcare staff with early childhood qualifications.

The control variables included in the estimations, with the base category shown in parentheses for categorical variables, are listed below by type of variable:

- Child characteristics: age of child in months, gender of the child (girl), birth weight (between 2.5kg and 4.5kg)¹¹, child is from aboriginal/Torres Strait Islander descent (not from aboriginal/Torres Strait Islander descent), whether the child has a medical condition (no conditions), and whether the child has sleeping problems (no sleeping problems).
- Parental and family characteristics: parents’ medical conditions (no medical condition), the highest education level of the main carer ¹² (completed secondary school) – in most cases the main carer is the mother, number of siblings (no siblings), whether English is the main language spoken at home (English is main language), eligibility for welfare

¹¹ Existing studies find that low or high birth weight is correlated with slower child development (Cesur and Rashad, 2008).

¹² We include the main carer’s highest level of educational attainment to control for the quality of nurturing rather than to control for the child’s innate ability. This is denoted as intergenerational IQ transmission in the economic literature. Most of the parental inputs in LSAC tend to measure the quantity of time spent with a child in certain activities, but do not measure the quality of the time spent in those activities. The learning outcome index in Wave 2 measures crystallised intelligence (that is, verbal fluency), not fluid intelligence (that is, cognitive speed). These are factors of general intelligence categorised by psychologist Cattell (1987). While the former is based on learning, the latter is related to child’s innate abilities.

payments¹³ as an indicator for low-income families (no eligibility), whether the study child's house is cluttered (house is not cluttered), and living arrangement (child lives with both parents). We further group children who live with one parent into two categories: single parents receiving financial support from the parent living elsewhere, and single parents who do not receive financial support from the other parent.

- Parental inputs: number of children's books at home (more than 10), told a story to the child (on 1 or 2 days per week), read to the child (1 or 2 days per week), played with the child outdoors (3 to 5 days per week), took the child out to a concert/museum/library (did not take the child out), took child out to movies/sports (did not take the child out), average time spent by child watching TV/video on weekdays (1 to 3 hours per day), and hostile parenting (no hostile parenting).
- Neighbourhood: the Socio-Economic Indexes for Areas (SEIFA)¹⁴ disadvantage measure (between 10% and 90%), and residence is located in a remote or very remote area (residence is not in a remote or very remote location).

A concern in our analyses is that the attendance of childcare may not be random (that is, determined by chance). Observed and unobserved factors that affect the choice of parents to use childcare may be correlated with the children's outcomes. Consequently, this may introduce a selection bias when estimating the effect of childcare on children's outcomes. We were not able to find a valid instrument to control for this potential selection bias. However, to investigate the issue further, we estimated models explaining the probability of childcare use and examined the characteristics correlated with the probability of childcare attendance. We estimated separate models for the probability of attending any childcare, attending any formal childcare, and attending any day care. These results are discussed in the next section (Subsection 6.4).

Before discussing the estimation results in the next section, we first provide a guide on how to interpret the coefficients from the tables. The outcome variables are expressed as standardised

¹³ We derive the welfare eligibility variable by first imputing the amount of family tax benefit (FTB) payments a family of the relevant composition would receive assuming full entitlement. We then subtract the imputed FTB amount from the family's reported total income. This derived income variable we then compare to the allowance/pension cut-out thresholds reported in the government's Payment Guide of the relevant year to impute eligibility for a pension or allowance. We also explored using a variable indicating self-reported income support receipt. However, several households indicating income support receipt had relatively high levels of income.

¹⁴ SEIFA is an index of social advantage and disadvantage measured at the postcode level, whereby a low SEIFA value indicates lower social and human capital in an area. See Australian Bureau of Statistics (ABS) (2004, 2008) for more information.

scores with a mean of 100 and a standard deviation of 10. Therefore, the unit of measurement for the outcome variables is 1 point of the standardised score for each outcome variable. The mean values for the two outcome variables within each decile of the score values are in Table 12. Most coefficients in the results in the next section are moderately small. The values in Table 12 assist in interpreting the relative importance of the effect of one variable on the outcome measure compared to other variables.

Table 12. Mean values for the two children’s outcomes within decile ranges

	<u>LSAC Outcome Index deciles</u>									
	1	2	3	4	5	6	7	8	9	10
Learning	81.58	88.79	92.90	96.63	99.88	102.89	105.54	108.40	111.63	115.85
Socio-emotional	80.78	91.19	95.45	98.45	100.97	103.23	105.43	107.59	110.47	114.86

6. Results

First, results on a number of models with alternatively specified childcare use are presented in Section 6.1. Then the sensitivity of the childcare use effects on learning and socio-emotional outcomes to the weekly amount of childcare use is checked in Section 6.2. In addition, the length of time since the child first spent time in childcare is accessed. This is followed in Section 6.3 by an exploration of the effect of the child to staff ratio and the effect of staff having early childhood qualifications on the learning and socio-emotional outcomes. Section 6.4 discusses the characteristics that affect the probability of using childcare by the parents in relation to the issue of selection into childcare.

6.1 Childcare type

Table 13 presents coefficients of the learning and socio-emotional indices models with childcare defined in three different ways. This gives us three specifications for each outcome, (i) to (iii), with each column representing a separate model specification. In specification (i), a childcare dummy takes the value of 1 if a child attends any type of childcare and 0 if the child does not attend childcare. Specifications (ii) and (iii) include categorical childcare variables, whereby the categories are mutually exclusive, and are defined as follows. In specification (ii), the childcare variable comprises the categories “no childcare”, “formal only”, a mixed category of “formal and informal”, and “informal only”. In specification (iii), the childcare categories are “no childcare”, “any day care”, “any other formal” (which is any formal care excluding day care) and “informal only”. Given the limited number of observations on each of the more specific childcare types, we can only distinguish between formal and informal, where formal care can be further disaggregated into day care and other formal care. The same sets of childcare definitions are also used for Table 13-a and Table 13-b. The different definitions allow us to examine different aspects of childcare.

In Table 13, for comparative purposes, we only include the child’s lagged outcome score with the childcare dummies as explanatory variables to examine the effect of childcare on children’s outcomes. Then in Tables 13-a and 13-b, we add the other control variables, discussed in the previous section, into the models.

Without other controls, children attending childcare show significantly higher scores in the learning and socio-emotional indices relative to children who do not attend childcare, and only receive parental care. Comparing the size of the coefficients to the values in Table 12, shows that both coefficients are equivalent to moving up about half a decile in the outcome

ranking for children with outcomes around the median values. In general, the absolute effects on learning are somewhat higher than those on the socio-emotional index.

Table 13. Estimated Coefficients of Childcare and Lagged Outcomes in the Children’s Outcome Models (No Other Control Variables)

	LSAC Outcome Index					
	Learning			Socio-emotional		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
no childcare is omitted category						
childcare	1.496*** (0.392)			1.038*** (0.326)		
no childcare is omitted category						
formal only		1.208*** (0.417)			0.727** (0.348)	
formal & informal		2.566*** (0.586)			1.911*** (0.488)	
informal only		1.447** (0.673)			1.370** (0.553)	
no childcare is omitted category						
any day care			1.421*** (0.426)			0.767** (0.355)
any other formal			1.701*** (0.532)			1.525*** (0.446)
informal only			1.449** (0.674)			1.371** (0.553)
Lagged learning	0.293*** (0.018)	0.291*** (0.018)	0.293*** (0.018)			
Lagged socio-emotional				0.239*** (0.015)	0.237*** (0.015)	0.239*** (0.015)
Constant	70.327*** (1.866)	70.459*** (1.865)	70.339*** (1.867)	76.326*** (1.506)	76.480*** (1.507)	76.304*** (1.506)
Number of observations	3091	3091	3091	3941	3941	3941
R-squared	0.079	0.081	0.079	0.065	0.066	0.066

Note: *** significant at 1%; ** significant at 5%; * significant at 10%. Robust standard errors are in parentheses.

When distinguishing childcare types, we observe that all types/combinations of childcare have positive effects on the two outcomes compared to the situation where only parental care is provided. The effect of the mixed category combining formal care and informal care is the largest relative to no childcare (equivalent to moving up nearly a full decile in the ranking around the median). We infer from the estimations that informal care on its own also has a positive correlation with child development as measured by the two outcome indices. We observe that the coefficient estimates for informal care only and any day care are smaller in

size compared to any formal care, and that the coefficients are larger for the learning outcome index compared to the socio-emotional outcome index.

Appendix D shows the results of a slight variation on the specification in Table 13. In Table 13, care provided by a nanny is included in formal care on the grounds that parents usually pay a substantial fee for this service so it is expected that a nanny would be selected on her ability to care for children. However, the service by nannies is not subject to the same regulations as the care provided by a long day care centre is (and to a lesser extent family day care is as well). For this reason, the model in Table 13 is re-estimated using data in which care by a nanny is categorised as informal care. Only about 90 children receive care by a nanny. Table D1 shows that the results are very similar to those in Table 13.

In Tables 13-a and 13-b, one for each of the outcome indices, we estimate four different specifications of the model. In the first variation, column (i), we include the basic definition of childcare and we control only for the child's characteristics and two basic family characteristics. The aim is to explore how additional controls affect the coefficient of the childcare variable. In specifications (ii) to (iv), we include the full set of explanatory variables, including all the parental input variables, and use all three different definitions of childcare, as described above.

Comparing column (i) of Table 13-a to column (i) of Table 13, the childcare coefficients are still statistically significant but to a lesser extent and their magnitudes have become smaller (equivalent to moving up about a third of a decile around the median). When we control for the parental input variables along with basic controls in column (ii), the magnitude of childcare variables is further reduced (equivalent to moving up just over a quarter of a decile around the median) but remains significant. We find that non-parental childcare has a positive effect on both child outcomes relative to no childcare in column (ii). Its effect on the learning outcome remains larger than the effect on the socio-emotional outcome (see Table 13-b).

Table 13-a. Estimated Coefficients of Childcare and Lagged Outcomes in the Children's Learning Outcome Models (Including Other Control Variables)

	LSAC Outcome Learning Index							
	(i)		(ii)		(iii)		(iv)	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
no childcare omitted category								
childcare	1.086***	(0.394)	0.835**	(0.389)				
no childcare omitted category								
formal only					0.654	(0.412)		
formal & informal					1.424***	(0.542)		
informal only					0.984	(0.663)		
no childcare omitted category								
any day care							0.805*	(0.419)
any other formal							0.822	(0.520)
informal only							0.974	(0.663)
Lagged learning	0.282***	(0.018)	0.256***	(0.018)	0.256***	(0.018)	0.256***	(0.018)
<i>Characteristics of the child</i>								
<i>Birth weight</i>								
less than 2.5 kg	-2.230**	(0.873)	-1.669*	(0.853)	-1.672**	(0.852)	-1.671*	(0.854)
over 4.5 kg	-1.204	(1.151)	-1.684	(1.166)	-1.685	(1.161)	-1.687	(1.165)
Male (boy)	-2.954***	(0.343)	-2.851***	(0.338)	-2.860***	(0.339)	-2.852***	(0.338)
ATSI	-4.930***	(1.109)	-2.889***	(1.098)	-2.878***	(1.100)	-2.893***	(1.099)
Age (months)	0.040	(0.065)	0.032	(0.063)	0.033	(0.063)	0.034	(0.064)
Medical conditions present	-6.502***	(0.765)	-5.887***	(0.775)	-5.880***	(0.775)	-5.883***	(0.776)
Have sleeping problems	-1.513***	(0.482)	-1.353***	(0.475)	-1.336***	(0.475)	-1.354***	(0.475)
<i>Characteristics of the family</i>								
<i>Number of siblings</i>								
one	1.129**	(0.456)	0.921**	(0.448)	0.959**	(0.448)	0.920**	(0.448)
two and more	-0.143	(0.504)	0.109	(0.503)	0.175	(0.506)	0.105	(0.505)
Main language spoken at home								
Not English	-4.240***	(0.565)	-2.854***	(0.610)	-2.861***	(0.609)	-2.870***	(0.609)
Parents type (two parents omitted)								
single with the other's support			-1.131	(0.920)	-1.105	(0.922)	-1.126	(0.921)
single with no support			-0.612	(1.025)	-0.651	(1.022)	-0.603	(1.027)
Eligible for welfare payment			-0.578	(0.530)	-0.530	(0.529)	-0.575	(0.530)
House is cluttered			-1.314*	(0.725)	-1.319*	(0.724)	-1.317*	(0.726)
Parents having medical condition			-0.837*	(0.465)	-0.849*	(0.465)	-0.837*	(0.465)
Main carer(parent)'s education (completed HS omitted)								
Degree +			2.301***	(0.522)	2.260***	(0.523)	2.300***	(0.523)
Adv Diploma/ Diploma			0.793	(0.690)	0.725	(0.691)	0.793	(0.690)
certificates			1.070*	(0.556)	1.036*	(0.557)	1.070*	(0.556)
not complete HS			0.597	(0.669)	0.570	(0.670)	0.593	(0.669)
Children's books at home (more than 10 omitted)								
0-10 books			-1.337	(0.886)	-1.323	(0.886)	-1.340	(0.887)
<i>Activities with the child</i>								
<i>Told a story to a child (1 or 2 days omitted)</i>								
None			-2.384***	(0.404)	-2.344***	(0.405)	-2.382***	(0.404)
3-5 days			0.880*	(0.507)	0.901*	(0.507)	0.875*	(0.507)
every day (6-7days)			2.278***	(0.538)	2.267***	(0.539)	2.273***	(0.539)

Table 13-a. Continued

	LSAC Outcome Learning Index							
	(i)		(ii)		(iii)		(iv)	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Read to a child (1 or 2 days omitted)								
None			-1.759*	(1.020)	-1.807*	(1.022)	-1.767*	(1.022)
3-5 days			0.438	(0.652)	0.446	(0.652)	0.435	(0.652)
every day (6-7days)			2.396***	(0.591)	2.409***	(0.591)	2.396***	(0.592)
Playing with a child outdoor (3-5 days omitted)								
None			-0.366	(0.809)	-0.372	(0.810)	-0.360	(0.811)
1 or 2 days			-0.194	(0.431)	-0.195	(0.431)	-0.190	(0.431)
every day (6-7days)			-0.581	(0.409)	-0.581	(0.409)	-0.587	(0.409)
Taking out to concert/museum/library (YES)			0.891**	(0.348)	0.873**	(0.349)	0.887**	(0.348)
Taking out to movies/sports (YES)			0.912***	(0.346)	0.913***	(0.346)	0.913***	(0.346)
Average time of watching TV/Video on weekdays (1-3 hours omitted)								
less than 1 hours			1.222**	(0.482)	1.233**	(0.482)	1.226**	(0.483)
3 hours and more			-1.412***	(0.416)	-1.398***	(0.416)	-1.416***	(0.417)
Hostile parenting (YES)			-0.069	(1.046)	-0.075	(1.047)	-0.063	(1.046)
<i>Neighbourhood characteristics</i>								
SEIFA disadvantage								
bottom 10%			0.593	(0.585)	0.562	(0.585)	0.588	(0.586)
top 10%			0.333	(0.573)	0.359	(0.573)	0.335	(0.574)
Remoteness of residence								
remote and very remote			-0.300	(1.006)	-0.302	(1.009)	-0.298	(1.008)
not determined			0.428	(1.240)	0.367	(1.246)	0.425	(1.243)
Constant	72.600***	(2.810)	73.038***	(2.901)	73.011***	(2.906)	72.997***	(2.927)
Number of observations	3077		2974		2974		2974	
R-squared	0.164		0.248		0.248		0.248	

Note: *** significant at 1%; ** significant at 5%; * significant at 10%. Robust standard errors are in parentheses.

Table 13-b. Estimated Coefficients of Childcare and Lagged Outcomes in the Children's Socio-Emotional Outcome Models (Including Other Control Variables)

	<u>LSAC Outcome Socio-Emotional Index</u>							
	(i)		(ii)		(iii)		(iv)	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
no childcare omitted category								
childcare	0.831**	(0.325)	0.692*	(0.359)				
no childcare omitted category								
formal only					0.527	(0.383)		
formal & informal					1.118**	(0.504)		
informal only					0.940*	(0.557)		
no childcare omitted category								
any day care							0.560	(0.390)
any other formal							0.852*	(0.477)
informal only							0.930*	(0.557)
Lagged socio-emotional	0.219***	(0.015)	0.202***	(0.017)	0.201***	(0.017)	0.202***	(0.017)
<i>Characteristics of the child</i>								
Birth weight								
less than 2.5 kg	-1.485**	(0.735)	-1.322	(0.811)	-1.335	(0.812)	-1.326	(0.811)
over 4.5 kg	0.830	(1.036)	0.794	(1.165)	0.781	(1.163)	0.804	(1.164)
Male (boy)	-3.006***	(0.282)	-2.773***	(0.305)	-2.779***	(0.306)	-2.769***	(0.305)
ATSI	-3.029***	(0.828)	-1.639*	(0.980)	-1.631*	(0.978)	-1.653*	(0.978)
Age (months)	0.052	(0.050)	0.104*	(0.054)	0.106*	(0.054)	0.104*	(0.054)
Medical conditions present	-5.089***	(0.734)	-4.949***	(0.864)	-4.942***	(0.863)	-4.938***	(0.865)
Have sleeping problems	-4.519***	(0.416)	-3.989***	(0.451)	-3.971***	(0.452)	-3.988***	(0.451)
<i>Characteristics of the family</i>								
Number of siblings								
one	0.278	(0.383)	0.318	(0.411)	0.354	(0.413)	0.301	(0.412)
two and more	-0.152	(0.424)	0.336	(0.465)	0.386	(0.468)	0.303	(0.467)
Main language spoken at home (English omitted)								
Not English	-3.463***	(0.572)	-1.847***	(0.617)	-1.875***	(0.617)	-1.874***	(0.616)
Parent type (two parents omitted)								
single with the other's support			-0.803	(0.861)	-0.771	(0.860)	-0.780	(0.861)
single with no support			-2.120**	(1.043)	-2.137**	(1.042)	-2.095**	(1.042)
Eligible welfare payment			-0.807	(0.506)	-0.772	(0.507)	-0.815	(0.507)
House cluttered			-0.133	(0.694)	-0.147	(0.694)	-0.148	(0.696)
Parents having medical condition			-1.134***	(0.422)	-1.152***	(0.423)	-1.136***	(0.422)
Main carer(parent)'s education (completed HS omitted)								
Degree +			1.219***	(0.470)	1.196**	(0.469)	1.230***	(0.471)
Adv Diploma/ Diploma			0.995*	(0.594)	0.963	(0.595)	1.001*	(0.594)
certificates			0.115	(0.503)	0.097	(0.503)	0.119	(0.503)
not complete HS			-1.085*	(0.647)	-1.097*	(0.647)	-1.084*	(0.648)
Children's books at home (more than 10 omitted)								
0-10 books			-3.283***	(1.018)	-3.262***	(1.019)	-3.277***	(1.018)
<i>Activities with the child</i>								
Told a story to a child (1 or 2 days omitted)								
None			-1.141***	(0.356)	-1.108***	(0.358)	-1.145***	(0.356)
3-5 days			0.345	(0.479)	0.355	(0.478)	0.331	(0.478)
every day (6-7days)			0.908*	(0.492)	0.901*	(0.492)	0.895*	(0.492)

Table 13-b. Continued

	LSAC Outcome Socio-Emotional Index							
	(i)		(ii)		(iii)		(iv)	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Read to a child (1 or 2 days omitted)								
None			0.163	(1.037)	0.136	(1.036)	0.150	(1.036)
3-5 days			0.238	(0.603)	0.248	(0.602)	0.225	(0.603)
every day (6-7days)			1.210**	(0.542)	1.223**	(0.541)	1.195**	(0.543)
Playing with a child outdoor (3-5 days omitted)								
None			-0.917	(0.722)	-0.922	(0.726)	-0.900	(0.724)
1 or 2 days			-0.547	(0.378)	-0.544	(0.378)	-0.539	(0.378)
every day (6-7days)			0.658*	(0.391)	0.648*	(0.392)	0.638	(0.391)
Taking out to concert/museum/library (YES)			0.526*	(0.309)	0.511*	(0.310)	0.510	(0.311)
Taking out to movies/sports (YES)			0.592*	(0.309)	0.594*	(0.310)	0.591*	(0.310)
Average time of watching TV/Video on weekdays (1-3 hours omitted)								
less than 1 hours			0.358	(0.424)	0.369	(0.424)	0.381	(0.425)
3 hours and more			-1.063***	(0.396)	-1.065***	(0.396)	-1.063***	(0.397)
Hostile parenting (YES)			-5.475***	(1.156)	-5.474***	(1.159)	-5.459***	(1.158)
<i>Neighbourhood characteristics</i>								
SEIFA disadvantage								
bottom 10%			-0.482	(0.583)	-0.499	(0.583)	-0.491	(0.583)
top 10%			0.068	(0.559)	0.092	(0.561)	0.065	(0.559)
Remoteness								
remote and very remote			-0.001	(0.808)	-0.003	(0.808)	-0.008	(0.809)
not determined			2.304**	(1.141)	2.256**	(1.146)	2.313**	(1.142)
Constant	79.676***	(2.287)	78.820***	(2.748)	78.765***	(2.753)	78.819***	(2.760)
Number of observations	3920		3138		3138		3138	
R-squared	0.158		0.225		0.225		0.225	

Note: *** significant at 1%; ** significant at 5%; * significant at 10%. Robust standard errors are in parentheses.

As we move from column (ii) to columns (iii) and (iv) and compare these to columns (ii) and (iii) in Table 13, we observe that the magnitude of the coefficient estimates for the different types of childcare has become smaller (equivalent to moving up about a quarter to half a decile in the outcome rankings) and loses statistical significance for two of the three categories (one for the socio-emotional outcomes) after inclusion of other explanatory variables. However, the estimated effects of all types/combinations of childcare on outcomes compared to the outcomes for children without any non-parental childcare remain positive. In column (iii) for Tables 13-a and 13-b, the effect of the mixed category, combining formal care and informal care, on children's outcomes is the largest when compared to the effect of formal care only or informal care only. As mentioned earlier, these are all measured relative to the default category of no childcare attendance.

In columns (iv) of Tables 13-a and 13-b, our estimations indicate that attending "any day care" seems to have a positive effect on the child learning outcome index although it is not

statistically significant for the child's socio-emotional index. "Any other formal" and "informal only" both have larger effects on both outcomes, compared to the effect of "any day care". However, these two effects are only statistically significant (at the 10%-level) for the socio-emotional outcome index and not for the learning outcome index.

A similar alternative specification is estimated for these models including a wide range of control variables as for the models without control variables. That is, care provided by a nanny is included in informal care instead of other formal care. The results for these specifications are presented in Table D2. The results are very similar to those presented in Tables 13-a and 13-b. Using the alternative specification, formal only and any other formal appear to have a slightly larger and statistically more significant effect on the learning outcome, while informal only now seems to have a larger and statistically more significant effect on the socio-emotional outcome than before.

The effects of the other control variables on both child outcomes are very similar across columns (ii), (iii), and (iv) in Tables 13-a and 13-b, and they are according to expectations. The definition of the childcare variable does not seem to affect the coefficients of these other explanatory variables much. First, the lagged outcome variables are all positive and significant. Learning outcomes seem somewhat more strongly correlated from one period to the next, compared to socio-emotional outcomes. That is, the current outcome increases by 0.25 for every increase by 1 unit in the previous learning outcome, and about 0.20 for the previous socio-emotional outcome. That is, the outcomes in earlier periods matter for the outcomes in later periods, even at this very young age.

Conforming with findings from the literature (Kirkegaard *et al.*, 2006), a lower birth weight is negatively correlated with both child outcomes, while boys are slower in development relative to girls. Compared to children from English speaking families, children from non-English speaking families have lower scores on both outcomes. The latter effect could be due to the learning outcomes being based on English language ability. All these differences are statistically significant. Whether the father or mother was born overseas had no significant effect after inclusion of the language spoken at home. Children from ATSI descent have lower outcome scores than other children. Children with medical conditions also have lower learning outcome scores relative to children without medical conditions. This latter effect is the largest among all explanatory variables in the child's learning outcome model. For the socio-emotional outcome (in Table 13-b), it is the second largest. Children with sleeping

problems have lower scores for both outcomes, but the impact is considerably larger in the socio-emotional outcome model.

Children with single parents have lower outcome scores when compared to children with couple parents. But most of the differences are not statistically significant, except for the negative effect on the socio-emotional score for children of single parents who have no support from the parent living elsewhere. The small magnitude in the coefficient for the other group of single parents may be an indication of this other parent's contribution to the study child (that is, parental investments in terms of time and resources). We also find a positive effect on child development for children with a main carer that has a high educational attainment. To further explore potential differences in the correlations of childcare and child outcomes for subgroups, Appendix E presents results of the basic model for three subsamples: single parents, low-educated main carers, main language at home is not English.¹⁵ Compared to the basic model for the full sample, the effects of childcare on the learning and socio-emotional outcomes are larger in the single parent group, although those for the socio-emotional outcomes are statistically insignificant/less significant. The combined formal and informal category remains the most effective but "formal only" now has a larger effect than informal only. Compared to single parents, the estimated effects are less significant and much smaller for the sample of main carers who did not complete high school (although the effects are still larger than for the general population). None of the variables in the socio-emotional model are statistically significant. However, a similar effect regarding the importance of formal care versus informal care as for the single parents emerges. The effect of childcare on learning outcomes in the non-English speaking subsample is in between that of single parents and low-educated main carers. Again formal care appears important. The effect of (any type of) childcare on socio-emotional outcomes is much larger than for the other two subsamples and the full sample. Once we include our full set of explanatory variables, the childcare variables are no longer statistically significant in the first two subgroups. This may be due to the relatively small size of the subsamples.

We also estimated a basic model for children from ATSI descent (see Appendix Table E4). However, although formal childcare appeared to have a larger positive effect on the learning

¹⁵ We have also estimated specifications in which we added interaction terms of single parent and parental education dummies with the childcare variables, but none of these interactions were statistically significant in the full models. This indicates that some of the differences between the effects of childcare for these groups could be due to the characteristics of these groups and stronger selection effects into childcare. We also explored interactions of low income/eligibility for welfare with the childcare variables, but again no differences were observed.

outcome than for the general population, none of the variables in the model were statistically significant except for the lagged outcome variable. This may be due to the small number of children in this subsample: only 83 in the learning outcome model and 127 in the socio-emotional outcome model. For the learning outcome, informal childcare appeared to have a negative effect. However, due to the small sample size, these estimates are very imprecise so we cannot draw any conclusions from these results. Childcare appeared to have a negative effect on the socio-emotional outcomes for children in this group, but again the estimates are very imprecise. To investigate the effect of childcare on children of indigenous descent, other data surveying this group specifically, such as the Longitudinal Study of Indigenous Children (LSIC) would be required.¹⁶

The variables which measure the time parents spend with their child in activities have a positive impact on the development scores. Namely, children with parents who tell a story or read a book to them more frequently, have better learning outcomes. The results further indicate that children who watch longer hours of TV/video have lower outcomes and also indicate that hostile parenting style is negatively associated with both outcome indices, but only significantly with the socio-emotional outcome. We note the possibility that this negative correlation could reflect a reverse causality: that is, a “difficult” child could have caused some of the hostile parenting. Child development outcomes for children living in disadvantaged neighbourhoods, or in a remote or very remote area are not significantly different from those for other children.

6.2 Hours of childcare use

In the previous section, we examined how having any non-parental care affects child development. We now turn our attention to the effect of the number of hours that were spent in different types of childcare. We examine the effect of the hours spent in any childcare, the hours spent in any formal care, the hours spent in any day care and the hours spent in any informal care on children’s outcomes. Using the distribution of weekly childcare hours for the different types, we generate three groups of hours of childcare use — the bottom 25%, the middle 50% between the 25th and 75th percentiles, and the top 25% — for each type of childcare. They represent low, medium and high childcare use for each type.

¹⁶ The LSIC has started fairly recently, so only the first wave is currently available which is not sufficient to replicate this study now.

Table 14-a shows the effects of hours of childcare use on children’s outcome without additional control variables, while table 14-b shows these effects with a full set of control variables. The results on the control variables are very similar to those presented in Tables 13-a and 13-b. Therefore, we only present the estimated coefficients on the childcare variables in Table 14-b. In both tables, specification (i) includes the basic definition of childcare, specification (ii) includes only “any formal care”, specification (iii) includes only “any day care” while specification (iv) includes “any formal care” and “any informal care” (these two sets of variables are not mutually exclusive).¹⁷

Similar to childcare use in Table 13, the effects of hours spent in childcare on the outcome variables become smaller and less significant when we introduce a full set of control variables. However the patterns of the effects of time spent in childcare remain similar with and without the control variables.

For the learning outcome index, regardless of childcare type, children with medium childcare use have better outcomes than children with patterns of either low or high childcare use. All childcare use is better than no childcare use at all (which is the reference group), except for two small statistically insignificant negative effects from high day care or high formal care use in the specification including all control variables (Table 14-b).

For the socio-emotional outcome, low or medium childcare use seems best. However, after controlling for a wide range of other characteristics, only medium and high informal care use seem to have statistically significant positive effects and these are larger than for any of the other groups.

¹⁷ We do not report the results for the models in which the care by a nanny is moved from other formal to informal childcare. The results for these alternative models are even more similar to those in Tables 14-a and 14-b than the results presented in Tables 13, 13-a and 13-b are to the results in Appendix D.

Table 14-a. Estimated Coefficients of Childcare Hours in the Children's Outcome Models (No Control Variables)

	LSAC Outcome Index							
	Learning				Socio-emotional			
	(i)	(ii)	(iii)	(iv)	(i)	(ii)	(iii)	(iv)
Hours if any childcare (no childcare is omitted)								
bottom 25% (<=8 hr)	1.100** (0.539)				1.114** (0.459)			
middle	1.848*** (0.449)				1.098*** (0.373)			
top 25% (>=28 hr)	1.178** (0.541)				0.848* (0.456)			
Hours if any formal care (no childcare is omitted)								
bottom 25% (<=8 hr)		1.073** (0.504)		1.029** (0.504)		0.867** (0.440)		0.873** (0.441)
middle		1.471** *		1.413*** (0.454)		0.787** (0.370)		0.754** (0.371)
top 25% (>=24 hr)		0.730 (0.507)		0.791 (0.510)		0.194 (0.415)		0.263 (0.418)
Hours if any day care (no childcare is omitted)								
bottom 25% (<=9 hr)			0.857 (0.556)				0.278 (0.482)	
middle			0.701 (0.464)				-0.002 (0.377)	
top 25% (>=24 hr)			0.299 (0.542)				-0.078 (0.433)	
Hours if any informal care (no childcare is omitted)								
bottom 25% (<=6 hr)				0.690 (0.663)				0.649 (0.543)
middle				2.205*** (0.582)				1.758*** (0.449)
top 25% (>=18 hr)				0.722 (0.738)				0.949 (0.667)
Number of observations	3087	3091	3091	3088	3936	3941	3941	3938
R-squared	0.079	0.078	0.076	0.082	0.065	0.064	0.062	0.067

Note: Only the lagged index variable is included in each estimation. *** significant at 1%; ** significant at 5%; * significant at 10%. Robust standard errors are in parentheses.

Table 14-b. Estimated Coefficients of Childcare Hours in the Children’s Outcome Models (Including All Control Variables)

	LSAC Outcome Index							
	Learning				Socio-emotional			
	(i)	(ii)	(iii)	(iv)	(i)	(ii)	(iii)	(iv)
Hours if any childcare (no childcare is omitted)								
bottom 25% (<=8 hr)	0.543				0.346			
	(0.501)				(0.472)			
middle	1.092**				0.758*			
	(0.438)				(0.395)			
top 25% (>=28 hr)	0.651				1.118**			
	(0.543)				(0.501)			
Hours if any formal care (no childcare is omitted)								
bottom 25% (<=8 hr)		0.537		0.532		0.255		0.297
		(0.470)		(0.471)		(0.440)		(0.442)
middle		0.911**		0.909**		0.592		0.612
		(0.437)		(0.438)		(0.393)		(0.394)
top 25% (>=24 hr)		-0.059		0.032		0.300		0.415
		(0.512)		(0.519)		(0.456)		(0.463)
Hours if any day care (no childcare is omitted)								
bottom 25% (<=9 hr)			0.886*				0.250	
			(0.502)				(0.476)	
middle			0.273				-0.002	
			(0.434)				(0.405)	
top 25% (>=24 hr)			-0.156				0.107	
			(0.536)				(0.468)	
Hours if any informal care (no childcare is omitted)								
bottom 25% (<=6 hr)				0.036				-0.030
				(0.629)				(0.582)
middle				1.312**				0.912*
				(0.557)				(0.480)
top 25% (>=18 hr)				0.830				1.338**
				(0.733)				(0.665)
Number of observations	2970	2974	2974	2971	3133	3138	3138	3135
R-squared	0.248	0.248	0.248	0.250	0.225	0.224	0.224	0.226

Note: Coefficients of the control variables are not presented in this table. *** significant at 1%; ** significant at 5%; * significant at 10%. Robust standard errors are in parentheses.

In Table 15, we use the age at which the study child first attends childcare. This age allows us to compute a duration variable of the length of time that a child has potentially been attending childcare. We create this duration variable by subtracting this age of first attending childcare from the child’s age at the time of interview, conditional on the child being presently enrolled in childcare. It appears from the results that children who are currently not enrolled in childcare but have previously attended childcare have better learning scores relative to those who never have had childcare. The effect is larger when the first time of attending childcare was longer ago. This effect decreases only slightly when introducing the full set of control

variables. There is only a small significant effect of duration of childcare amongst those currently attending childcare, which disappears once the full set of control variables is introduced.

Table 15. Estimated Coefficients of Childcare Use and Childcare Duration in the Children’s Outcome Models

Only lagged index variable is included	LSAC Outcome Index	
	Learning	Socio-emotional
Any childcare currently	1.279* (0.668)	0.385 (0.552)
Any current childcare × duration	0.033 (0.021)	0.031* (0.018)
No current childcare × duration	0.064** (0.026)	0.002 (0.023)
Number of observations	3089	3939
R-squared	0.081	0.065

Full set of control variables is included	LSAC Outcome Index	
	Learning	Socio-emotional
Any childcare currently	1.124* (0.627)	0.381 (0.577)
Any current childcare × duration	0.009 (0.021)	0.016 (0.019)
No current childcare × duration	0.058** (0.024)	0.003 (0.024)
Number of observations	2973	3137
R-squared	0.250	0.225

Note: *** significant at 1%; ** significant at 5%; * significant at 10%. Robust standard errors are in parentheses.

6.3 Quality of Childcare

As discussed earlier, the quality of childcare may be an important aspect for how childcare influences children’s development outcomes. In a set of alternative specifications of our models, we use the ratio of children to staff¹⁸ at the childcare facility as a proxy for childcare quality. We interact this ratio of children to staff with day care use and formal care use respectively, to determine whether there is an effect of this interaction term on the outcome variables.¹⁹

¹⁸ The children-to-staff ratio variable is derived from the number of paid adults present and also the number of children present during childcare. In the LSAC data, the number of children present was measured in the ranges 1-5, 6-10, 11-20, 21-30, and 31 or more while the number of paid staff was measured in the values 1, 2, 3, 4, and 5 or more. The mid-point of the ranges was taken and the lowest value was taken for the unbounded ranges (i.e. the value of 5 was taken for the range 5 or more and the value 31 was taken for the range 31 or more).

¹⁹ We do not report the results for the models in which the care by a nanny is moved from other formal to informal childcare. The results for these alternative models are even more similar to those in Table 16 than the results presented in Tables 13, 13-a and 13-b are to the results in Appendix D.

These additional results are presented in Table 16, with and without a full set of controls. We do not find any statistically significant effect of this ratio on the learning outcomes. A possible explanation is the lack of precision in collecting this information, resulting in considerable measurement error. There is a modest effect of the interaction with day care use on the socio-emotional outcome, which indicates that when there are more children per staff member, the positive effect of day care use is reduced. This effect even becomes slightly larger and stronger when all control variables are included. One extra child per staff member reduces the positive effect of day care on the socio-emotional index by 17% (the effect of 0.980 is reduced by 0.163).

Table 16. Estimated Coefficients of Childcare Use Interacted with Children-to-Staff Ratio in the Children’s Outcome Models

	LSAC Outcome Index					
	Learning			Socio-emotional		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
Only lagged index variable is included						
Any Day care	0.658			0.779		
	(0.617)			(0.510)		
Day care × children-to-staff ratio	-0.006			-0.136*		
	(0.094)			(0.075)		
Any formal care		1.263**	1.101**		0.838*	0.695
		(0.508)	(0.514)		(0.434)	(0.436)
Formal × children-to-staff ratio		-0.015	0.016		-0.028	0.000
		(0.053)	(0.055)		(0.047)	(0.048)
Any informal care			1.371***			1.261***
			(0.422)			(0.346)
Number of observations	3069	3061	3061	3908	3898	3898
R-squared	0.074	0.077	0.080	0.062	0.063	0.066

	LSAC Outcome Index					
	Learning			Socio-emotional		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
Full set of control variables is included						
Any Day care	0.605			0.980*		
	(0.582)			(0.524)		
Day care × children-to-staff ratio	-0.047			-0.163**		
	(0.087)			(0.079)		
Any formal care		0.656	0.579		0.388	0.326
		(0.488)	(0.492)		(0.443)	(0.445)
Formal × children-to-staff ratio		-0.009	0.009		0.003	0.019
		(0.051)	(0.052)		(0.046)	(0.047)
Any informal care			0.828**			0.748**
			(0.407)			(0.363)
Number of observations	2952	2945	2945	3110	3103	3103
R-squared	0.247	0.248	0.249	0.225	0.224	0.225

Note: *** significant at 1%; ** significant at 5%; * significant at 10%. Robust standard errors are in parentheses.

In addition, some information is collected on the qualifications of staff in the care facility attended by the study child. Three categories are distinguished: staff with a certificate, diploma or degree. However, we do not know which staff member cares for which group of children so the qualification may not be relevant to the study child's outcomes. Based on this limited information, none of the interaction variables with childcare use were statistically significant in this case for either the learning or the socio-emotional learning outcomes.

6.4 The factors associated with the probability of childcare use

Earlier, we touched on our concerns that the attendance of childcare may not be statistically random. Certain characteristics of a child or the child's parents may be positively associated with an increase of the probability of childcare use. This may be of particular concern if some of these characteristics are unobservable and are also affecting children's outcomes. This could bias the effect of childcare use through confounding characteristics of households using childcare with childcare use per se. Table 17 presents the average marginal effects of child and parental characteristics on this probability. We calculate these average marginal effects based on the estimated coefficients of probit models. The dependent variable in these probit models is binary and reflects whether or not a child attends childcare, or whether or not a child attends a particular type of childcare.

We find that regardless of childcare type, the following characteristics are indicative of lower childcare usage: the study child has two or more siblings; the study child's family is eligible for welfare payment (that is, they are a low-income family); the study child is from a mainly non-English speaking family; and the study child lives in a very disadvantaged neighbourhood. On the other hand, we find that, consistent with our expectations, children with a main carer who is working and children living in a single-parent family are more likely to use childcare. In fact, the most important factor (that is, the variable with the largest estimated marginal effect) for predicting whether a child attends childcare is having a main carer who works full time. The probability of a child with a main carer working full time attending childcare is about 38 percentage points larger than for children with a main carer who is not working.

The above effects explain why the effect of childcare is reduced when a range of other variables is included, as we observed in the previous subsections. The question is whether there are any unobserved factors remaining which may bias the coefficient on childcare use.

Table 17. Marginal Effects on the Attendance of Childcare (in Changes in the Proportion of Attending) Derived from a Probit Model

	<u>Any childcare</u>		<u>Any formal care</u>		<u>Any day care</u>	
	Marginal Effect	Std. Err.	Marginal Effect	Std. Err.	Marginal Effect	Std. Err.
Age (in months)	0.005**	(0.002)	0.009***	(0.002)	0.001	(0.002)
Number of siblings						
one	-0.002	(0.017)	-0.002	(0.019)	-0.032	(0.020)
two or more	-0.081***	(0.019)	-0.084***	(0.021)	-0.120***	(0.022)
Medical conditions present	0.030	(0.023)	0.042*	(0.025)	0.058**	(0.026)
Main carer's age	0.000	(0.001)	0.001	(0.001)	-0.002	(0.001)
Main carer's education (completed HS is omitted)						
Degree +	0.025	(0.019)	0.020	(0.022)	0.030	(0.022)
Adv Diploma/ Diploma certificates	-0.004	(0.025)	0.015	(0.028)	0.035	(0.029)
Did not complete HS	-0.074***	(0.023)	-0.058**	(0.026)	-0.008	(0.027)
Main carer work status (no work is omitted)						
Part time	0.298***	(0.015)	0.223***	(0.016)	0.194***	(0.016)
Full time	0.378***	(0.016)	0.307***	(0.019)	0.281***	(0.021)
Parents having medical condition	0.006	(0.016)	0.001	(0.018)	-0.012	(0.019)
Parents' type (two parents is omitted)						
single with the other's support	0.165***	(0.021)	0.196***	(0.026)	0.180***	(0.033)
single with no support	0.156***	(0.025)	0.159***	(0.031)	0.190***	(0.037)
Eligibility for welfare payment	-0.075***	(0.019)	-0.068***	(0.021)	-0.063***	(0.022)
Main language spoken at home (English is omitted)						
Not English	-0.106***	(0.023)	-0.177***	(0.025)	-0.112***	(0.024)
From ATSI descent	0.038	(0.032)	0.024	(0.036)	0.054	(0.038)
SEIFA disadvantage						
bottom 10%	-0.032	(0.020)	-0.075***	(0.023)	-0.046**	(0.023)
top 10%	0.036	(0.023)	0.059**	(0.025)	0.008	(0.027)
Remoteness (not remote/very remote)						
remote or very remote	-0.060*	(0.033)	-0.041	(0.036)	-0.094**	(0.037)
not determined	-0.060	(0.060)	-0.044	(0.064)	-0.010	(0.066)
Number of observations	4514		4514		4514	

Note: *** significant at 1%; ** significant at 5%; * significant at 10%. Robust standard errors (obtained using the Delta-method approach) are in parentheses.

6.5 Discussion of the Results

In Section 2 and in Appendix Table A1, a range of results from other studies are presented. Most of these results are for the US, but there have been a limited number of Australian studies as well. In this section, we compare our results with these other results and discuss the differences/similarities in approach and findings.

The most comparable study appears to be the paper by Leigh and Yamauchi (2009). They focussed on behavioural outcomes as measured by three aspects of the Short Temperament Scale for Infants. The mostly positive effects found in this report on the socio-emotional

outcomes are different from the results found by Leigh and Yamauchi (2009) who found a small negative association of childcare with behavioural outcomes as measured by three aspects of the Short Temperament Scale for Infants. Their measures are related to the socio-emotional outcome index that we use, but they are not the same. Similarly, although there is a large amount of overlap in the variables used by Leigh and Yamauchi (2009) and those used by us, the two sets are not the same. For example, in the analyses in this report we have included information on number of books in the household and on activities undertaken with the children. Leigh and Yamauchi (2009) included income in more detail whereas in this report we only have an indicator variable for eligibility for income support which is meant to identify low-income households. It seems most likely that the difference in results is caused by the different dependent variable used to represent children's outcomes in the two studies.

Another Australian study using the LSAC by Harrison (2008) is descriptive in nature. She finds that non-parental childcare has a very small but significantly positive effect on socio-emotional outcomes. She also finds similar to our results that a mixture of formal and informal care seems to be best. In addition, she found slightly better outcomes for children attending care in smaller groups. However, she notes that she has not controlled for other factors affecting both childcare use and children's outcomes. A report by Wake *et al.* (2008) was also mostly descriptive in nature, but they did control for family and child characteristics (but not for lagged outcomes) in a number of multivariate analyses, including analyses of childcare use on children's physical, socio-emotional and learning outcomes. They also find a relatively large positive effect from combining formal and informal care on socio-emotional and learning outcomes. The results reported on the effect of a range of other variables on children's outcomes, such as the family and child characteristics or activities undertaken with children, are in the same direction as found in this report.

The international literature displays a wide range of results, including both positive and negative effects of childcare on cognitive and non-cognitive skills of children. Approaches taken and samples of children used may vary considerably, and are difficult to compare directly with the results that are obtained in this report. It is often mentioned that children from disadvantaged backgrounds would benefit more from childcare, particularly from formal or centre-based childcare (e.g. Magnuson, Ruhm and Waldfogel, 2007; Sylva *et al.* 2004; Waldfogel, 2004; Havnes and Mogstad, 2009b). Datta Gupta and Simonsen (2010) do not find that disadvantaged children benefit more from centre-based care, but they find that children of low-educated mothers experience more negative effects from using family day

care (compared to parental care) than children of higher-educated mothers. We find larger effects from childcare (particularly formal care) for children of single parents, children of main carers with a lower education level, or children in families where the main language is not English. However, as soon as the full set of explanatory variables is added to our basic model, which only included lagged outcome and childcare variables, the effects are no longer statistically significant for the first two groups. This may be due to the small sample size for these subsamples.

The LSAC data contain a limited amount of potential indicators for the quality of childcare, which are not measured very well. We examined two of these: staff-to-child ratio and proportion of early-childhood-qualified staff. The staff-to-child ratio is only important for day care, while the early-childhood-qualified staff variable was not statistically significant for any of the types of care included. The staff-to-child ratio had the expected effect, and is similar in direction to what is found by Leigh and Yamauchi (2009). That is, only for day care (what they call centre-based care) is the staff-to-child ratio significant. Leigh and Yamauchi (2009) also found that early childhood qualifications appear statistically insignificant in their analyses. In addition, they included an external quality assessment interaction and an accreditation status interaction to capture quality differences, but neither was found to be significant. NICHD and Duncan (2003) include both group size and child-to-staff ratio in their analyses and find results consistent with the results here, although the child-to-staff ratio is not so strong, possibly due to the inclusion of group size.

Some European studies identified a positive effect of a higher proportion of staff with childhood qualifications on children's outcomes (NICHD and Duncan, 2003; Sylva *et al.*, 2004; Datta Gupta and Simonsen, 2010). Other studies examine quality more broadly. Hill *et al.* (2002) evaluate an experiment that provided high-quality centre-based care to some children but not others. Through a matching of comparable families, the randomised assignment to treatment and control group allowed for an analysis by the type of care that *would* have been chosen if no high-quality care had been offered. Although all children benefit from the high-quality care, they find that high-quality care benefits children who would otherwise have been placed in home-based care or who would have had no non-maternal care more than children who would have been placed in centre-based care anyway. This is despite the fact that this latter centre-based care would have been of lower quality. Hill *et al.* (2002) do not describe what high-quality care means or how it differs from the centre-based care potentially used by the control group children. NICHD and Duncan (2003)

construct a quality measure based on the carer's interactions with the relevant child which consist of five components (measured on five 4-point subscales): sensitivity to child's non-distress signals, stimulation of child's development, positive regard toward child, detachment [reflected], and flatness of affect [reflected]. At 36 months two additional subscales were included: fosters child's exploration and is intrusive (reflected). At 4½ years, the positive care-giving consisted of the mean of 4-point ratings of caregivers' sensitivity and responsiveness, stimulation of cognitive development, intrusiveness (reflected), and detachment (reflected). They find positive effects of higher values for this measure on children's outcomes. The importance of the quality of the interactions between children and staff is also mentioned by Sylva *et al.* (2004). They state that where staff showed warmth and were responsive to the individual needs of children, children made more progress. However, in addition they found that staff qualifications (especially of the manager) were important to explain a higher quality of the centre. They construct a quality measure based on eleven subscales. They find that care-oriented provision usually offers the lowest salaries to staff, employs workers with the lowest level of qualifications, has limited access to training, and has higher staff turnover. All these factors lower the quality of care. Higher quality results in better cognitive and non-cognitive outcomes for children.

Finally, our analyses examined the effect of the intensity of childcare, as reflected by the hours of childcare per week, and the effect of the duration of childcare as measured by the period elapsed since first attending childcare. The results indicate that a moderate amount of childcare (formal and informal) may be best for children's development in terms of learning outcomes. A moderate amount of childcare is defined as the middle 50 per cent of childcare usage, which is for all childcare taken together, in between 8 and 28 hours per week. None of the formal care amounts have a statistically significant effect on the socio-emotional outcomes, while moderate (more than 6 hours per week) to high amounts (more than 18 hours per week) of informal care appear most beneficial.

With regard to the effect of duration, although all effects are positive, only the coefficient on the duration since first using childcare for children who are currently not in childcare is significant for the learning outcome index. This indicates that even if childcare is currently not used, there is a lasting positive association of children's learning outcomes with having used childcare (and having used childcare for a longer period of time).

The intensity of childcare used by Leigh and Yamauchi (2009) in their model is a linear specification. They find a negative effect of more intense childcare use, which is similar to the

effect found in this report when comparing moderate to high use. However, moderate use seems associated with better outcomes than low use, which indicates a non-linear specification may be more suitable than a linear specification. In addition, we find that all use is better than no childcare use at all. For the UK, Sylva *et al.* (2004) found a positive effect of duration in preschool (starting from the age of 2 years) on cognitive development, but full-time attendance did not improve development more than part-time attendance. This is in line with our finding that moderate amounts of childcare appear best for children's development. Similarly Datta Gupta and Simonsen (2010) found that, although childcare in general has no effect on non-cognitive outcomes (that is, it is as good as home/parental care), using childcare for over 30 hours per week negatively affects these outcomes. This pattern is similar to the decreasing effect of childcare when hours increase beyond a certain level, as is found in our analysis.

7. Conclusions

This report has provided information about characteristics that affect child development and the role which early childhood non-parental care, such as formal and informal childcare, play in child development using Australian data. The Birth Cohort observations in the LSAC data are used to produce a range of descriptive statistics and carry out a multivariate analysis.

The report provides summary statistics for a wide range of characteristics observed in the data across the three available waves following children from birth to age 4 to 5. The LSAC distinguish a number of different childcare types, which for the main descriptive analyses we have grouped in five categories. First, we categorise childcare into two types: informal and formal childcare. Informal childcare includes care provided by grandparents, other relatives, and other persons such as friends or neighbours. In our descriptive tables, formal childcare is further subdivided into four different types of childcare: long day care centre, other regular formal care (includes family day care, before and after school care or a nanny), irregular formal care (includes occasional care, gym/leisure/community centre or mobile care unit) and education (includes preschool, kindergarten/ reception/ preparatory or Year 1). The latter two types of formal care include both regulated and unregulated care services. This means that some types of care included in this category need to participate in the Quality Improvement and Accreditation System (QIAS) for approved childcare whereas other types of care in this category do not need to participate. All types of formal care may employ qualified or unqualified staff, where the level of qualification may vary as well.

We observe a clear move from informal care in the first wave, to day care centre use in wave 2 and education-related care in wave 3. A similar move in the average proportion of time spent in the different types of childcare is observed over the three waves. That is, in wave 1 informal care is used for the largest proportion of time; in wave 2, day care centre time is highest; and in wave 3, time in education is highest. This change occurs at the same time as the overall increase in non-parental childcare use. Not surprisingly, when parents are more involved in the labour market, more non-parental childcare is used for their children. Compared to couple families, single-parent families use more childcare at a comparable intensity of labour market involvement.

Comparing the raw data of children's outcomes on learning, and physical and socio-emotional development by childcare use, a few small differences are observed. Children in childcare, excluding those in informal childcare only, appear slightly worse off physically, possibly due

to the spreading of colds and other infections for which children still need to build their immunity. However, they are slightly better off in socio-emotional development and in learning. Children attending informal childcare only are slightly better off physically but attendance in at least some formal childcare is associated with slightly better learning (except in the first wave) and better socio-emotional outcomes.

Simple regression analyses are used to estimate a number of Education Production Functions, where a child's current outcome depends on the child's outcome in the previous period and a number of "inputs" into the child between the previous and current period. In our model, Wave 2 (when children are aged 2 to 3) is the current period and Wave 1 is the previous period. Examples of inputs are parent's activities with children, childcare attendance, or whether the child lives in a one- or two-parent family. In the multivariate analyses, we only distinguish the effects of (centre-based) long day care, other formal care and informal care separately. We distinguish four groups of control variables in addition to childcare use and child outcome in the previous period: child characteristics, parental and family characteristics, parental inputs and neighbourhood characteristics.

Including this wide range of control variables, we find that childcare use remains a statistically significant factor in the children's outcome model. As expected, compared to the model only including child outcome in the previous period and childcare use variables, the significance and size of the effect of childcare reduce when more control variables are included since many of the control variables are also affecting the probability of childcare use (confounding its effect).

Exploring the effect of childcare use further, we find that a combination of formal and informal childcare has the largest effect on learning and socio-emotional outcomes, and that informal care only, and any other formal have larger effects on socio-emotional outcomes compared to using a day care centre (although using a day care centre has a substantial positive effect as well compared to not using any care). This seems to indicate that informal care could be equally important to a child's development as formal care. This pattern remains after inclusion of the control variables, but the effects are smaller and less statistically significant. After controlling for a wide range of variables, only children that use any day care experience a significant positive effect on learning outcomes. The effects on learning outcomes of using informal care only and any other formal are no longer significant after we control for a range of other factors.

Distinguishing the amount of childcare used shows that low and medium use (up to 28 hours per week) of any childcare, particularly low and medium use (up to 24 hours per week) of any formal care, low use (up to 9 hours per week) of day care, and medium use (between 6 and 18 hours per week) of informal care are associated with better outcomes compared to other levels of usage. However, there are no significant negative effects from using any level of childcare compared to not using childcare. The estimated effects are either positive or zero. High use of more than 18 hours of informal care appears associated with higher socio-emotional outcomes when controlling for a range of factors.

We developed a variable to proxy quality of care by constructing a ratio of the number of children per staff member. This variable was then interacted with childcare use. Only the interaction with day care in the socio-emotional model was negatively (and significantly) associated with outcomes. This indicates that a higher number of children per staff member reduced the beneficial effect of day care on socio-emotional outcomes of children. However, the number of staff and number of children is imprecisely measured so the variable is likely to be a rough proxy for the quality of care.

Although we cannot claim that any of the above associations are causal effects arising from childcare, we have controlled for as many other potential factors determining children's outcomes as was possible. As expected, this reduces the size and statistical significance of the estimated coefficients, but it does not eliminate the effect of childcare on outcomes completely and they remain positive.

Finally, to assess the likelihood of differences in the associations of childcare with children's outcomes, we estimated a basic model which included the lagged outcome variable and the different childcare variables for subgroups of the population. Note that there were too few observations in these subgroups to allow sensible interactions with the childcare variables in addition to including all the control variables. The subgroups of interest were children living with a single parent, children whose main carer did not complete high school, and children living in a home where English is not the main language.

The effects of childcare for the children of single parents appear to be larger than for the general population. The effects of formal childcare (both day care and other formal) appear to have a larger positive association with learning and socio-emotional outcomes, whereas informal childcare has a smaller positive association for this group compared to the general population. Compared to children of single parents, the associations between childcare and outcomes are smaller for children of low-educated main carers. However, compared to the

general population, formal childcare still appears to have a stronger positive association with child outcomes for children of low-educated main carers, whereas informal childcare has a weaker positive association. Children living in households where the main language is not English were observed to have a larger positive correlation of their learning outcomes with childcare use than children of low-educated main carers but lower than children of single parents and these effects were only significant if formal care was used. With regard to socio-emotional outcomes all types of childcare appeared to have similarly large effects for this group, indicating they benefit considerably from childcare, and all effects are much larger than for the general population, or the children of single parents or low-educated main carers.

References

- Almond, D. and Currie, J. 2010. "Human capital development before age five". Working Paper 15827, National Bureau of Economic Research, March 2010.
- Australian Bureau of Statistics, 2004. *Census of Population and Housing: Socio-Economic Indexes for Areas (SEIFA): Australia 2001*, Technical Paper, ABS catalogue no. 2039.0.55.001, Commonwealth of Australia: Canberra.
- Australian Bureau of Statistics, 2008. *Socio-Economic Indexes for Areas (SEIFA) -Technical Paper 2006*, ABS catalogue no. 2039.0.55.001, Commonwealth of Australia: Canberra.
- Australian Institute of Family Studies, 2009. "Longitudinal Study of Australian Children Data User Guide – August 2009". Melbourne.
- Averett, S.L., Gennetian, L.A., and Peters, H.E., 2005. "Paternal Child Care and Children's Development." *Journal of Population Economics*, 18(3): 391 – 414.
- Baker, M., Gruber, J., and Milligan, K., 2008. "Universal Child Care, Maternal Labor Supply, and Family Well-Being." *Journal of Political Economy*, 116(4): 709 – 745.
- Bauer, P.C. and Riphahn, R.T., 2009. "Age at School Entry and Intergenerational Educational Mobility." *Economics Letters*, 103(2): 87 – 90.
- Berger, L.M., Hill, J., and Waldfogel, J., 2005. "Maternity Leave, Early Maternal Employment and Child Health and Development in the US." *Economic Journal*, 115(501): F29 – 47.
- Bernal, R. and Keane, M., 2009. "Child Care Choices and Children's Cognitive Achievement: The Case of Single Mothers." Working Paper. <http://www.bus.uts.edu.au/fin&econ/staff/MichaelK/research.html>
- Bernal, R., and Keane, M.P., 2010. "Quasi Structural estimation of a model of child care Choices and child cognitive ability production", *Journal of Econometrics*, 156 (1): 164-189.
- Berthelsen, D. and Walker, S. 2008. "Parents' Involvement in Their Children's Education", *Family Matters* 79: 34-41.
- Bradbury, B. (2007) Child Outcomes and Family Socio-economic Characteristics, Social Policy Research Centre Report 10/07, University of New South Wales.

- Brinkman, S., Silburn, S., Lawrence, D., Goldfield, S., Sayers, M., and Oberklaid, F., 2007. "Investigating the Validity of the Australian Early Development Index.", *Early Education and Development*, 18(3): 427-451.
- Cattell, R.B., 1987. *Intelligence: its structure, growth and action*. Elsevier, New York.
- Cesur, R. and Rashad, I., 2008. "High Birth Weight and Cognitive Outcomes" *NBER Working Paper*, no 14524.
- Claessens, A., Duncan, G., and Engel, M., 2009. "Kindergarten Skills and Fifth-Grade Achievement: Evidence from the ECLS-K." *Economics of Education Review*, 28(4): 415 – 427.
- Council of Australian Governments (COAG) (2009) *Investing in the Early Years – A National Early Childhood Development Strategy*. Commonwealth of Australia, Canberra.
- Cunha, F. and Heckman, J.J., 2007. "Identifying and Estimating the Distributions of Ex Post and Ex Ante Returns to Schooling." *Labour Economics*, 14(6): 870 – 893.
- Cunha, F. and Heckman, J.J. 2007a. "The Technology of Skill Formation." *American Economic Review*, 97(2): 31 – 47.
- Cunha, F. and Heckman, J.J. 2008. "Formulating, Identifying and Estimating the Technology of Cognitive and Noncognitive Skill Formation." *Journal of Human Resources*, 43(4): 738 – 782.
- Cunha, F., Heckman, J. J., and Schennach, S., 2010. "Estimating the Technology of Cognitive and Noncognitive Skill Formation". Institute for the Study of Labor (IZA) Discussion Paper no. 4702, Bonn.
- Currie, J. and Duncan, T., 1995. "Does Head Start Make a Difference?." *American Economic Review*, 85(3): 341 – 364.
- Datta Gupta, N. and Simonsen, M., 2010. "Non-cognitive Child Outcomes and Universal High Quality Child Care." *Journal of Public Economics*, 94(1-2): 30 – 43.
- Del Boca, D., Flinn, C. and Wiswall, M., 2010. "Household Choices and Child Development". Institute for the Study of Labor (IZA) Discussion Paper No. 5155, Bonn.
- Elder, T.E. and Lubotsky, D.H., 2009. "Kindergarten Entrance Age and Children's Achievement: Impacts of State Policies, Family Background, and Peers." *Journal of Human Resources*, 44(3): 641 – 683.

- Edwards, B., Bromfield, L. M., 2009. "Neighborhood influences on young children's conduct problems and pro-social behavior: Evidence from an Australian national sample". *Children and Youth Services Review* 31: 317-324.
- Fiorini, M., and Keane, M., 2009. "How the Allocation of Children's Time Affects Cognitive and Non-Cognitive Development". Longitudinal Survey of Australian Children Conference Presentation 2009.
- Frijters, P., Johnston, D.W., Shah, M., and Shields, M.A., 2009. "To Work or Not to Work? Child Development and Maternal Labor Supply." *American Economic Journal: Applied Economics*, 1(3): 97 – 110.
- Garces, E., Thomas, D., and Currie, J., 2002. "Longer-Term Effects of Head Start." *American Economic Review*, 92(4): 999 – 1012.
- Gormley, W. T. J., Gayer, T., Phillips, D., and Dawson, B., 2005. "The Effects of Universal Pre-K on Cognitive Development". *Developmental Psychology*, 41(6): 872-884.
- Gormley, W. T. J. and Gayer, T., 2005. "Promoting School Readiness in Oklahoma: An Evaluation of Tulsa's Pre-K Program." *Journal of Human Resources*, 40(3): 533 – 558.
- Gregg, P., Washbrook, E., Propper, C., and Burgess, S., 2005. "The Effects of a Mother's Return to Work Decision on Child Development in the UK." *Economic Journal*, 115(501): F48 – 80.
- Haan, P., and Wrohlich, K., 2009. "Can Child Care Policy Encourage Employment and Fertility? Evidence from a Structural Model". Institute for the Study of Labor (IZA) Discussion Paper no. 4503, Bonn.
- Harrison, L. (2008) Does child care quality matter? Associations between socio-emotional development and non-parental child care in a representative sample of Australian children. *Family Matters* 79, pp. 14-25.
- Harrison, L. and Ungerer, J. (2005) What can the Longitudinal Study of Australian Children tell us about infants' and 4 to 5 year olds' experiences of early childhood education and care? *Family Matters* 72, pp. 26-35.
- Havnes, T., and Mogstad, M., 2009a. "Money for Nothing? Universal Child Care and Maternal Employment". Institute for the Study of Labor (IZA) Discussion Paper no. 4504, Bonn.

- Havnes, T., and Mogstad, M., 2009b. “No Child Left Behind: Universal Child Care and Children’s Long-Run Outcomes”. Institute for the Study of Labor (IZA) Discussion Paper no. 4561, Bonn.
- Heckman, J.J. and Rubinstein, Y., 2001. “The Importance of Noncognitive Skills: Lessons from the GED Testing Program.” *American Economic Review*, 91(2): 145 – 149.
- Heckman, J.J., Stixrud, J., and Urzua, S., 2006. “The Effects of Cognitive and Noncognitive Abilities on Labor Market Outcomes and Social Behavior.” *Journal of Labor Economics*, 24(3): 411 – 482.
- Hill, J., Waldfogel, J., and Brooks-Gunn, J., 2002. “Differential Effects of High-Quality Child Care.” *Journal of Policy Analysis and Management*, 21(4): 601 – 627.
- Hiscock, H., Canterford L., Ukuomunne, O. C., and Wake, M. 2007. “Adverse Associations of Sleep Problems in Australian Preschoolers: National Population Study” *Pediatrics*, 119: 86-93.
- Johnston, D.W., Nicholls, M.E.R., Shah, M., and Shields, M.A., 2009. “Nature’s Experiment? Handedness and Early Childhood Development.” *Demography*, 46(2): 281 – 301.
- Kalb, G. (2009) Children, Labour Supply and Childcare: Challenges for Empirical Analysis, *Australian Economic Review*, 42(3), 276-299.
- Kirkegaard, I., Obel, C., Hedegaard, M., Henriksen, T., 2006. “Gestational Age and Birth Weight in Relation to School Performance of 10-Year-Old Children: A Follow-up Study of Children Born After 32 Weeks.” *Pediatrics*, 118, 1600-1606.
- Leigh, A. and Gong, X., 2009. “Estimating Cognitive Gaps between Indigenous and Non-indigenous Australians.” *Education Economics*, 17(2): 239 – 261.
- Leigh, A. and Gong, X., 2010. “Does Maternal Age Affect Children’s Test Scores?.” *Australian Economic Review*, 43(1): 12 – 27.
- Leigh, A. and Yamauchi, C., 2009. Working Paper, Research School of Social Sciences, Australian National University.
- Ludwig, J. and Miller, D.L., 2007. “Does Head Start Improve Children’s Life Chances? Evidence from a Regression Discontinuity Design.” *Quarterly Journal of Economics*, 122(1): 159 – 208.
- Magnuson, K.A., Ruhm, C., and Waldfogel, J., 2007. “Does Prekindergarten Improve School

Preparation and Performance?." *Economics of Education Review*, 26(1): 33 – 51.

Mogstad, M. and Wiswall, M., 2009. Institute for the Study of Labor (IZA) Discussion Paper no. 4562, Bonn.

National Institute of Child Health and Human Development Early Child Care Research Network and Duncan, G. J., 2003. "Modeling the Impacts of Child Care Quality on Children's Preschool Cognitive Achievement." *Child Development*, 74(5): 1454-1475.

Sanson, A., Misson, S., Wake, M., Zubrick, S.R., Silburn, S., Rothman, S. and Dickenson, J., 2005. "Summarising children's wellbeing: the LSAC Outcome Index". LSAC Technical Paper no. 2, Australian Institute of Family Studies.

Smart, D., Sanson, A., Baxter, J., Edwards, B., Hayes, A., 2008. "Home-to-school transitions for financially disadvantaged children". The Smith Family/Australian Institute of Family Studies.

Smart, D. and Sanson, A., 2005. "A Comparison of Children's Temperament and Adjustment Across 20 Years." *Family Matters*, 72: 50-57.

Sylva, K., Melhuish, E., Sammons, P., Siraj-Blatchford, I., and Taggard, B., 2004. "The Effective Provision of Pre-School Education [EPPE] Project". Institute of Education, University of London.

Todd, P. and Wolpin, K. 2003. "On the Specification and Estimation of the Production Function for Cognitive Achievement." *Economic Journal*, 113: F3-F33.

Wake, M., Sanson, A., Berthelsen, D., Hardy, P., Mission, S., Smith, K., Ungerer, J., and The LSAC Research Consortium, 2008. "How Well Are Australian Infants and Children Aged 4 to 5 Years Doing?", Australian Government Department of Families, Housing, Community Services and Indigenous Affairs, Social Policy Research Paper No. 36.

Waldfogel, J., 2004. "Social Mobility, Life Chances, and the Early Years". Center for Analysis of Social Exclusion. CASEpaper 88.

Walker, S and Berthelsen, D., 2009. "Quality of Home Learning Environment and the Transition to School." Centre for Learning Innovation, Queensland University of Technology, Brisbane, Presentation Slides.

Appendix A: Literature Review Summary

Table A1 Literature Review Summary by Topic and Country

Authors	Title	Outcome Var.	Explanatory Vars	Methodology	Data	Findings
<i>Effects of childcare/kindergarten</i>						
US findings						
Bernal and Keane 2009	Child Care Choices and Children's Cognitive Achievement: The Case of Single Mothers.	Peabody Picture Vocabulary Test at ages 3, 4 and 5. Peabody Individual Achievement Test at ages 5 and 6.		Instrumental variables	NLSY 1979 1,464 mother/child pair observations, 3,787 test score observations.	Baseline estimate of a year of childcare reducing child test scores by 2.1% (robust across a range of specifications and instrument sets). Only informal care leads to significant reductions in cognitive outcomes. The value of maternal time input is greater for more educated mothers, and girls are more adversely affected by childcare than boys. No differential effects for child age/ race/ethnicity.
Claessens, Duncan and Engel 2006	Kindergarten Skills and Fifth Grade Achievement	fifth grade achievement IRT	kindergarten academic skills, teacher assessed attention behaviours and socio-emotional skills, family and child characteristics	In Todd-Wolpin taxonomy: value-added plus model, like Cunha/ Heckman (2006)	Early Childhood Longitudinal Study, Kindergarten cohort (ECLS-K). (21, 260) Kindergarten in 1998-99	Considerable predictive power of fifth grade achievement from school-entry academic skills but, with the exception of kindergartner's capacity to pay attention, virtually none for the collection of socio-emotional skills. The most powerful avenue for boosting fifth grade achievement appears to be to improve basic academic skills of low-achieving children prior to kindergarten entry.
Currie and Duncan 1995	Does Head Start Make a Difference?	4 measures of child outcomes: 2 academic: PPVT and Child's progress through school without repeating a grade 2 health related: immunisation for measles and height standardised for age and gender using national norms (height for age).	Age group, mother's and grandmother's educational characteristics, height and income, child's birth order, sex, ethnicity, other preschool.	Comparisons drawn between siblings to control for selection.	NLSY 1988 and 1990 NLSYM	Head Start is associated with significant gains in test scores among both whites and African-Americans. However, among African-Americans, these gains are quickly lost. Head Start significantly reduces the probability of a white child repeating a grade but has no effect on African-Americans' grade repetition.

Authors	Title	Outcome Var.	Explanatory Vars	Methodology	Data	Findings
Elder and Lubotsky 2009	Kindergarten Entrance Age and Children's Achievement	Item Response Theory (IRT) test scores. 8 th grade reading and math scores	Family background, city type, region, child characteristics, actual and predicted entrance age	OLS, IV	US Early Childhood Longitudinal Study, Kindergarten cohort (ECLS-K). 1988	Present evidence that the positive relationship between kindergarten entrance age and school achievement reflects skill accumulation prior to kindergarten, rather than a heightened ability to learn among older children. Having older classmates boosts a child's test scores but increases the probability of grade repetition and diagnosis of learning disabilities such as ADHD.
Gormley, Gayer, Phillips and Dawson 2005	The Effects of Universal Pre-K on Cognitive Development	Teacher-administered Woodcock Johnson Achievement test scores: Letter –Word Identification, Spelling and Applied Problems	Ethnicity, mother's education, child sex, lunch price (full-price, reduced price, free lunch).	Quasi-experimental regression discontinuity design	Pre-K and kindergarten children enrolled in Tulsa Oklahoma public schools 2002-2003. 1,567 (85%) of 1,843 pre-K students were tested and 3,149 (84.5%) of 3,727 kindergarten students were tested. Tests were administered by teachers.	Authors conclude that Oklahoma's universal pre-K program has succeeded in enhancing school readiness of a diverse group of children. Find test impacts of 3.0 (0.79 standard deviation of the control group) for the Letter-Word Identification score, 1.86 (0.64 standard deviation of the control group), and 1.94 (0.38 standard deviation of the control group) for the Applied Problems Score.
Hill, Waldfogel and Brooks-Gunn 2002	Differential Effects of High-Quality Child Care	PPVT –R (Age 3) S-B, WPPSI, WISC	Child's physical characteristics, mother's education, behaviour during pregnancy, ethnicity, location	Propensity score matching	361 subjects from the Infant Health and Development Program and Study data	Find that children not participating in non-maternal care and children participating in home-based non-maternal care (compared to centre-based care) would have gained the most from high-quality centre-based care and would have retained the bulk of these benefits over time.
Ludwig and Miller 2007	Does Head Start Improve Children's Life Chances? Evidence from a regression discontinuity design	Educational attainment, county child mortality rate,	Head Start spending, age groups, ethnicity, county population,	Regression discontinuity design	1964 Census Bureau re-analysis of 1960 Census data. Child mortality data from Vital Statistics County level schooling by age Individual level data is restricted use geo-coded version of the National Education Longitudinal Study NELS which tracks a national sample of eighth graders in 1988.	In 1965 the Office of Economic Opportunity (OEO) provided technical assistance to the 300 poorest counties to develop Head Start proposals. Find evidence of a large drop at the OEO cut-off in mortality rates for children from causes that could be affected by Head Start, as well as suggestive evidence for a positive effect on educational attainment.

Authors	Title	Outcome Var.	Explanatory Vars	Methodology	Data	Findings
Magnuson, Ruhm and Waldfogel 2007	Does prekindergarten improve school preparation and performance?	Maths and reading skills. Teacher reports are used to measure externalising behaviour (child fights, impulsive or angry, Social Rating Scale) and self-control	Controls for child, family background, and neighbourhood characteristics. Home environment, childcare, education experiences. Learning environment is proxied by activities such as reading books, and singing songs.	OLS, fixed effects, propensity score and IV	Early Childhood Longitudinal Study, Kindergarten cohort (ECLS-K). 1998 and 2000. 10, 244 observations.	Find that pre-kindergarten is associated with higher reading and mathematical skills at school entry, but also higher levels of behaviour problems. By spring of the first grade, estimated effects on academic skills have largely dissipated, but the behaviour problems persist. Larger and longer-lasting associations with academic gains are found for disadvantaged children.
NICHHD, Duncan 2003	Modelling the impacts of Child Care Quality on Children's preschool cognitive development	Cognitive outcomes	Childcare quality	Multiple regressions, change models of differences in 24 and 54 months outcomes, and residualised change models.	National Institute of Child Health and Human Development (NICHD) Study of Early Child Care 1991. ~ 1364 observations	Find childcare quality predicted cognitive outcomes with effect sizes of 0.04 and 0.08 for both infant and preschool ages.
Canadian findings						
Baker, Gruber and Milligan 2008	Universally Accessible Child Care	Ranging from aggression, motor & social skills to illness.	Policy, Province, Year, Parental Education, Age Group and Immigration Status.	difference in difference	NLSCY Canadian longitudinal data 0-11 year olds 1994-95, 1996-97, 1998-99, 2000-2001, and 2002-3 waves	Evidence of a shift to new childcare use with some crowding out. Children are worse off on outcome vars. Evidence of more hostile parenting, worse parental health, and lower quality parental relationships

Authors	Title	Outcome Var.	Explanatory Vars	Methodology	Data	Findings
UK findings						
Sylva, Melhuish, Sammons, Siraj-Blatchford and Taggart	The Effective Provision of Pre-School Education (EPPE) Project: Final Report	Children's development aged 3-7	pre-school education		EPPE sample (UK)	<p>Findings over the pre-school period:</p> <ul style="list-style-type: none"> -pre-school attendance, compared to none, enhances all-round development in children - duration of attendance is important - full-time attendance led to no better gains than part-time attendance -disadvantaged children benefit significantly from good quality pre-school experiences, especially where they are with a mixture of children from different social backgrounds -Higher quality pre-schooling is related to better intellectual and social/behavioural development for children - Settings that have staff with higher qualifications have higher quality scores and their children make more progress - Home learning environment is more important than parental occupation, education or income. <p>Findings at the end of Key Stage 1:</p> <ul style="list-style-type: none"> - the beneficial effects of pre-school remained evident but some outcomes were not as strong as they had been at school entry
Waldfoegel 2004	Social Mobility, Life Chances and the Early Years			Literature review and policy recommendations (with UK focus)		<p>Discussion paper which concludes that research points to policy steps such as:</p> <ul style="list-style-type: none"> extending parental leave to 12 months, offering a more flexible package of supports to families with children under the age of 2 or 3, providing high-quality centre based care to 2 year olds, starting with the most disadvantaged, and providing a more integrated system of high-quality care and education to 3 to 5 year olds.

Authors	Title	Outcome Var.	Explanatory Vars	Methodology	Data	Findings
Australian findings						
Harrison 2008	Does child care quality matter	Child socioeconomic outcomes – BITSEA Social competence, behaviour problems	regular childcare, types of childcare	Correlations (R-squared), ANOVA	LSAC birth cohort, 2-3 year olds, wave 2	Children receiving regular childcare were rated by their parents as being more socially competent (small but significant). Favourable ratings were reported for social competence and behavioural problems for children receiving regular childcare in mixed and informal settings compared to children who were not in childcare. Behaviour problems were higher for children attending formal childcare settings (compared to mixed formal and informal care). These measures showed few associations with hours of childcare received. As carers reported spending more time in active engagement, both parent and carer-rated scores for social competence increased. Ratings for behaviour problems increased when carers reported spending more time on organisational aspects of their work.
Leigh and Yamauchi 2009	Which Children benefit from Non-Parental Care	Short Temperament Scale for Infants. 3 Components: Approach scale (e.g. outgoing with strangers), Persistence scale (consistently plays with toy > 10 min), Reactivity scale (tendency to scream, moodiness)	Non-parental care at 2-3. Full-time non-parental care. Also types of care. Controls: child, parent, household, parenting style, lagged temperament	Control for observable characteristics, propensity score matching, estimating unobs bias, instrumenting use of care with supply-side/demand side shocks	LSAC 2-3, 4-5	Find that non-parental care is associated with worse behavioural outcomes, but the magnitude of the difference is quite small. Cannot reject the hypothesis that the effects are solely due to selection. The association between non-parental care and behavioural outcomes appears to be more negative in high-SES families, and less negative in day care centres with smaller group sizes (relationships may not be causal).

Authors	Title	Outcome Var.	Explanatory Vars	Methodology	Data	Findings
Wake <i>et al.</i> 2008	How well are Australian infants and children aged 4-5 years doing?	Composite outcome indices comprising physical domain, social-emotional domain, learning domain and full outcome.	Early literacy environments	descriptive statistics	LSAC both cohorts	Socio-demographic factors are more strongly related to child than infant developmental outcomes. Girls in the child cohort consistently had more positive outcomes than boys. In the child cohort, ATSI children have poorer outcomes in all but the physical domain. Children in the infant cohort participating in group-based childcare were most at risk for impaired physical outcomes in the first year. Children in the infant cohort who experienced only informal care tended to have higher learning scores than infants not in care (most of this care was provided by grandparents). Children in the child cohort attending pre-Year 1 education programs had higher overall and learning outcomes than children who had only informal care arrangements.
Findings from other European countries						
Bauer and Riphahn 2009	Kindergarten enrolment & intergenerational mobility	Educational track attended by child	Parental education, household level, regional, individual characteristics, and kindergarten provision	multinomial logit regression models	Swiss 2000 census (62,535) 17 and also 4-5 year olds.	Using heterogeneity across cantons, they found that early kindergarten enrolment increases educational mobility
Havnes and Mogstad 2009b	Universal Child Care and Children's Long-Run Outcomes	Educational attainment and labour market participation, reduced welfare dependency.	Siblings, sex, mother father's age, education, immigrant, relocated	difference in difference	administrative registers Norway Children born 1967–1976. 499,026 children	Childcare had strong positive effects on children's educational attainment and labour market participation, and also reduced welfare dependency. Subsample analysis indicates that children with low-educated mothers and girls benefit most from childcare.
Datta Gupta, and Simonsen 2010	Non-cognitive child outcomes and universal high quality child care	strengths and difficulties index, SDQ, at age 7	Effect of participation in non-parental care at age 3. Controlling for a wide range of background characteristics over time	OLS and instrumental variable regression	Danish Longitudinal Survey of Children (1995 birth cohort) merged with administrative records	Overall, participation in non-parental care has no effect compared to home care, but the results differ by type of non-parental care. Preschool with highly qualified staff and more male staff is as good as home care. Family day care reduces non-cognitive skills for boys born to mothers with low levels of education. Using more than 30 hours/week deteriorates child outcomes.

Authors	Title	Outcome Var.	Explanatory Vars	Methodology	Data	Findings
<i>Mother's employment/father's care</i>						
US findings						
Averett, Gennetian and Peters 2005	Paternal Child Care and Children's development	Peabody Picture Vocabulary Test (PPVT) and Peabody Individual Achievement Test (PIAT)	Used father care, only one type of childcare, proportion of weeks mother employed during years 1 and 2, and 3 and 4. Parental education and income characteristics, ethnicity, region and number of siblings.	OLS (with Huber correction due to correlation in error term arising from multiple children from the same family)	NLSY Child data. Annually from 1979–1992, and bi-annually since 1994.	Assesses the effect of father care on child development within two-parent families with working mothers. No evidence father care is different for infants but non-paternal modes of care for toddlers showed better cognitive outcomes.
Berger, Hill and Waldfogel 2005	Maternity Leave, Early Maternal Employment and Child Health and Development in the US	7 outcome variables including whether the child was breastfed or received certain immunisations, externalising behaviours and PPVT score.	Return to work within 12 weeks of child birth.	OLS and propensity score matching (to account for selection bias)	NLSY 1987 to 2000	Associations between early returns to work and children's outcomes are found, suggesting causal relationships between early returns to work and reductions in breastfeeding and immunisations, as well as increases in externalising behaviour problems.
UK findings						
Gregg, Washbrook, Propper and Burgess 2005	The effects of a mother's return to work decision on child development in the UK	Two school-based tests: entry assessment test at age 4 or 5, and the Key Stage 1 test at age 6 or 7, 3 rd test is a literacy test administered by ALSPAC at the age of 7	Type of mother's employment, mother's age and education, ethnicity, siblings, financial difficulties, birth weight, childcare	OLS	Avon Longitudinal Study of Parents and Children (ALSPAC) – a near census cohort study of around 12,000 children born in the Avon area of UK in 1991 and 1992.	On average, only full-time work before a child is 18 months of age seems to have any adverse consequences for children's cognitive development and these effects are quantitatively small and often insignificant. Part-time work and work after 18 months appear not to be harmful.

Authors	Title	Outcome Var.	Explanatory Vars	Methodology	Data	Findings
<i>Child development more generally</i>						
US findings						
Almond and Currie 2010	Human capital development before age five			Theory/ survey paper		The paper reviews the literature on a broad range of factors affecting child development and on the effectiveness of a broad range of policies. Early childhood and prenatal experiences are important but there is scope for remediation later.
Cunha and Heckman 2007a	The technology of skill formation			Theory/ survey paper		The paper develops a model of skill formation that explains findings established in the child development and child intervention literatures.
Cunha <i>et al.</i> 2010	Estimating the technology of cognitive and noncognitive skill formation			Estimate elasticity of substitution between periods	CNLSY 1979 1986 assessed every two years	The authors estimate the elasticity of substitution between investments in one period and stocks of skills in that period. Substitutability decreases in later stages for cognitive skills but increases slightly for non-cognitive skills. For some configurations of disadvantage and for some outcomes, it is optimal to invest relatively more later in childhood .
Heckman and Rubinstein 2001	Importance of non-cognitive skills	Armed Forces Qualifying Test	Index of Illicit Activity		Subsample of white males aged 16-18 in 1980	IQ is fairly set at age 8. Social policy should be more active aiming to alter motivation and self discipline. GED is a mixed signal and conveys information about cognitive / non-cognitive skills.
Heckman, Stixrud and Urzua 2006	Effect of Cognitive and Non-Cognitive Abilities on Labor Market Outcomes and Social Behavior	Labour market and behavioural outcomes (see table 2): log hourly wages, educational choice (high school dropout, HS grad, etc) work exp, and fertility choice model	Cognitive and non-cognitive abilities: arithmetic reasoning, word knowledge, paragraph comprehension, numerical operations, coding speed, Rosenberg Self-Esteem Scale, Rotter Internal-External Locus of Control Scale, schooling level by age 30. Ethnicity, regional characteristics, parental education, broken home		NLSY79	A low-dimensional vector of cognitive and non-cognitive skills explains a variety of labour market and behavioural outcomes.

Authors	Title	Outcome Var.	Explanatory Vars	Methodology	Data	Findings
Australian findings						
Bradbury 2007	Child Outcomes and Socioeconomic Characteristics	2 of 3 Sanson, Misson <i>et al.</i> outcome measures: <i>Social/Emotional and Learning</i>	Family economic resources, income, employment outcomes, locality, family background	OLS	LSAC child cohort	Association between family economic status and child outcomes is stronger in the child cohort than the infant cohort. Social/emotional outcomes tend to have a stronger association with socio-economic indicators than do learning outcomes. Learning outcomes are lower when family size is larger.
Berthelsen and Walker, 2008	Parental Involvement			descriptive statistics	LSAC wave 2 of the kindergarten cohort 6-7 years old	Exploratory analyses indicate relatively high levels of parental engagement. For language and literacy (Academic Rating Scales), 8% of the variability was accounted for by the set of parental involvement variables. For Mathematics, the value was 6% while for approaches to learning, the parental involvement variables also accounted for 6% of the variability.
Brinkman <i>et al.</i> , 2007	Validity of the Early Development Index			correlations	LSAC 4 year olds	Aims to contribute to the evaluation of the Australian Early Development Index. Concurrent validity was explored but with no criterion measure, findings were inconclusive prior to predictive validity assessment.
Edwards and Bromfield 2009	Neighbourhood influences on children's conduct and pro-social behaviour	Child functioning: 2 of the 5 scales from parent-reported SDQ. <i>Pro-social and Conduct Problems</i>	Parental perceptions of neighbourhood, family demographic characteristics	Multilevel models in MlwiN using Iterative Least Squares, a ML procedure.	LSAC 4-5 year olds	Children's conduct problems were found to be associated with neighbourhood economic status, safety and belonging after accounting for family demographic variables. Neighbourhood cleanliness, and belonging had a direct association with pro-social behaviour.
Fiorini and Keane 2009 [set of presentation slides, look for paper]	Time allocation and cognitive and non-cognitive development	PPVT, matrix reasoning, restlessness, good relations, emotional problems		OLS, Value Added, Fixed Effects, Cumulative, Cumulative + Value Added;	LSAC child cohort	Cognitive skills: Education time with parents or other adults are the most productive inputs, media time ranks high. Non-cognitive skills: no consistent ranking of the time inputs. Home care factors show up strongly (mother warmth and mother harshness).

Authors	Title	Outcome Var.	Explanatory Vars	Methodology	Data	Findings
Johnston, Nicholls, Shah and Shields 2009	Handedness and early childhood development	PPVT, Who am I?, teacher assessed competencies (social/emotional, approaches to learning, gross motor skills, fine motor skills, expressive language, receptive language)	Handedness (from Who am I test)	OLS, ordered probit	LSAC ~5000 4-5 year olds	Find that the probability of a child being left-handed is not significantly related to child health at birth, family composition, parental employment or household income. Robust evidence that left-handed (and mixed-handed) children perform significantly worse in nearly all measures of development, with the relative disadvantage larger for boys than for girls. These differentials cannot be explained by different socioeconomic characteristics of the household, parental attitude or investments in learning resources.
Kalb 2009	Children, Labour Supply and Child Care: Challenges for Empirical Analysis			Literature review/discussion	HILDA, Child Care Survey	
Leigh and Gong 2009	Estimating cognitive gaps between Indigenous and non-Indigenous Australians	Vocabulary and School Readiness. Who Am I? (school readiness) PPVT (language)	Income, parental education Birth weight, socioeconomic controls	OLS	LSAC 4973 4-5 year olds, 3% indigenous	Estimated the test score gap between Indigenous and non-Indigenous Australians to be 0.3-0.4 standard deviations. Estimated gaps are lower than that of the other literature in this area. May imply that the test gap widens during school years.
Smart <i>et al.</i> 2008	Home to School Transitions for financially disadvantaged children	School readiness: pre-literacy, pre-numeracy, language skills and social/emotional behaviour	Financial disadvantage persistent temperament mother's education, inconsistent parenting style, formal care, how many times read to, less than 30 books,	descriptive statistics	LSAC Child cohort	

Authors	Title	Outcome Var.	Explanatory Vars	Methodology	Data	Findings
Walker and Berthelsen 2009	Quality of Home Learning Environment and Transition to School	Academic Outcomes at age 8 Academic Rating Scale	Early home learning environments. E.g. home learning activities. How often done the following with your child: told a story, drawn a picture, etc.	OLS, also correlations between ARS and: Wave 1: Approaches to learning, PPVT, and Who Am I, wave 2: PPVT Matrix Reasoning	LSAC Child cohort, w1 2, 3	Variables that made a significant contribution to children's learning outcomes: Socioeconomic position Sex of child LOTE and ATSI Home learning environment PPVT and WAI tests in wave 1 PPVT Matrix reasoning in wave 2 High scores on approaches to learning
Findings from other European countries						
Mogstad and Wiswall 2009	How much should we trust linear instrumental estimators?	Educational attainment	Family size, birth order, predicted fertility (propensity scores) to instrument for number of siblings.	OLS, IV	administrative registers from Statistics Norway	With linear IV, tests for treatment effects, selection bias and treatment effect heterogeneity are biased if the true relationship is non-linear. They find that the linear specification masks substantial marginal family size effects.
LSAC more generally						
Harrison and Ungerer 2005	What can LSAC tell us about infants' and 4-5 year olds experiences of early childhood education and care	Type of childcare, type of early childhood program, hours per week, and duration		descriptive statistics	LSAC both cohorts	
Hiscock <i>et al.</i> 2007	Adverse Associations of Sleep problems in Australian Preschoolers	Behaviour SDQ, ADD, ADHD, HRQoL /Peds, PPVT, Who Am I?	Age, gender, number of caregivers, educational status, employment status, income, snoring, difficulty sleeping, wakes over night, seems tired in the morning	Linear regressions		Sleep problems were common, and compared with children without sleep problems, children with sleep problems had poorer child health-related quality of life, more behavioural problems and higher rates of attention-deficit/hyperactivity disorder. Difficulty going to sleep and morning tiredness had greater adverse associations than snoring and night waking.

Authors	Title	Outcome Var.	Explanatory Vars	Methodology	Data	Findings
Smart and Sanson 2005	A comparison of children's temperament and adjustment across 20 years	SDQ: hyperactivity, conduct problems, emotional symptoms, peer problems, and pro-social behaviour <i>Hyperactivity, aggression, anxiety, peer problems and pro-social behaviour</i>		Descriptive statistics	ATP and LSAC Both cohorts	No marked shifts in temperament or adjustment over time despite substantial demographic changes, and remarkably similar connections between temperament and adjustment.
<i>Use of childcare</i>						
Findings from other European countries						
Haan and Wrohlich 2009	Can child care policy encourage employment and fertility	Employment and fertility	demographic characteristics, number of children	Maximum likelihood	German SOEP (11, 000) 2006-2007	Authors develop a structural model of female employment and fertility which accounts for the intertemporal feedback effects between the two. They show that increasing childcare subsidies conditional on employment increases labour supply of all women as well as fertility of childless and highly educated women.
Havnes and Mogstad 2009a	Universal Child Care and Maternal Employment	maternal employment	childcare	difference in difference	administrative registers Norway	Find there is little, if any, causal effect of childcare on maternal employment, despite a strong correlation. New subsidised childcare mostly crowds out informal childcare arrangements, suggesting a significant net cost of the childcare subsidies.

Appendix B Fully Detailed Childcare Tables

Table B1. Childcare Use and Average Hours of Use (if using childcare) by Childcare Type

Childcare Type	Child is aged 0-1 (Wave 1)		Child is aged 2-3 (Wave 2)		Child is aged 4-5 (Wave 3)	
	% using this type	Average hours used	% using this type	Average hours used	% using this type	Average hours used
Day care centre	10.8	18.6	42.6	18.3	30.3	19.5
Family day care	3.7	19.8	7.8	20.4	4.0	19.3
Before/After school care					3.3	7.4
Nanny	1.6	20.4	1.8	18.0	1.8	14.4
Occasional care	0.5	5.4	20.3	5.2	17.7	7.7
Gym, leisure or community centre	1.3	3.5	1.8	2.8	1.1	2.6
Mobile Care Unit	0.1*	4.1*	0.1*	4.3*	0.0*	4.2*
Grandparent	18.0	12.6	18.4	13.6	19.9	11.0
Other relative	3.0	10.3	2.3	11.4	3.1	12.0
Other	2.6	13.3	2.2	13.2	3.9	7.9
Preschool			4.7	12.0	52.4	13.5
Kindergarten/ Reception/Preparatory					18.2	29.6
Year 1 (Grade 1)					0.1	31.1

* There are fewer than 20 observations in this cell

Table B2. Average Proportion of Total Childcare Hours Spent in Each Childcare Type (in %) (conditional on those using any childcare)

Childcare Type	Child is aged 0-1 (Wave 1)		Child is aged 2-3 (Wave 2)		Child is aged 4-5 (Wave 3)	
Day care centre	27.4		55.4		24.8	
Family day care	9.3		10.3		2.2	
Before/After school care					0.6	
Nanny	3.9		1.7		0.7	
Occasional care	1.1		3.9		0.2	
Gym, leisure or community centre	3.0		1.3		0.2	
Mobile Care Unit	0.1		0.0		0.0	
Grandparent	44.0		17.6		7.5	
Other relative	5.6		2.0		1.1	
Other	5.6		2.2		1.4	
Preschool			5.6		43.7	
Kindergarten/ Reception/Preparatory					17.6	
Year 1 (Grade 1)					0.1	
Average total hours of childcare	17.2		19.8		23.4	

Appendix C Measures Used in the Outcome Index

Table 1. Measures included in the Outcome Index in each cohort at Waves 1, 2 and 3

Domain	Subdomain	Age 0-1	Age 2-3	Age 4-5	Ages 6-7 and 8-9
Physical	Health	Overall rating of health Special Health Care Needs Health Problems Index	Overall rating of health Special Health Care Needs Health Problems Index Weight status	Overall rating of health Special Health Care Needs Health Problems Index Weight status	Overall rating of health Special Health Care Needs Health Problems Index Weight status
	Motor		PEDS QL Physical	PEDS QL Physical	Gross motor coordination scale PEDS QL Physical
Social/ Emotional	Internalising	STSI Approach STSI Irritability STSI Cooperativeness	Factor Analysed BITSEA Internalising	SDQ Emotional	SDQ Emotional
	Externalising		Factor Analysed BITSEA Externalising	SDQ Conduct SDQ Hyperactivity	SDQ Conduct SDQ Hyperactivity
	Social Competence		Factor analysed BITSEA Social Competence	SDQ Peer SDQ <u>Prosocial</u>	SDQ Peer SDQ <u>Prosocial</u>
Learning	Language and Literacy	CSBS Total Standardised Score	Child's communication skills MCDI-III Vocabulary MCDI-III Grammatical Markers	ACER Who Am I? Peabody Picture Vocabulary Test	PPVT ARS Language and Literacy
	Numeracy and Cognition			Teacher rating of numeracy	Matrix Reasoning ARS Mathematical Thinking

Source: LSAC Technical paper #2 update (forthcoming)

Appendix D: Alternative specification of formal childcare

Table D1. Estimated Coefficients of Childcare and Lagged Outcomes in the Children's Outcome Models (No Other Control Variables)

	LSAC Outcome Index					
	Learning			Socio-emotional		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
no childcare is omitted category childcare	1.496*** (0.392)			1.038*** (0.326)		
no childcare is omitted category formal only		1.176*** (0.420)			0.635* (0.350)	
formal & informal		2.558*** (0.574)			1.804*** (0.478)	
informal only		1.468** (0.645)			1.771*** (0.534)	
no childcare is omitted category any day care			1.421*** (0.426)			0.767** (0.355)
any other formal			1.705*** (0.543)			1.285*** (0.453)
informal only			1.469** (0.646)			1.772*** (0.534)
Lagged learning	0.293*** (0.018)	0.292*** (0.018)	0.293*** (0.018)			
Lagged socio-emotional				0.239*** (0.015)	0.238*** (0.015)	0.240*** (0.015)
Constant	70.327*** (1.866)	70.430*** (1.865)	70.332*** (1.866)	76.326*** (1.506)	76.415*** (1.507)	76.264*** (1.506)
Number of observations	3091	3091	3091	3941	3941	3941
R-squared	0.079	0.081	0.079	0.065	0.067	0.066

Note: *** significant at 1%; ** significant at 5%; * significant at 10%. Robust standard errors are in parentheses. In this specification, care provided by a nanny is included in informal care instead of other formal care (as is the case in Table 13).

Table D2. Estimated Coefficients of Childcare and Lagged Outcomes in the Children's Outcome Models (Including All Control Variables)

	LSAC Outcome Index					
	Learning			Socio-emotional		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
no childcare is omitted category childcare	0.835*** (0.389)			0.692* (0.359)		
no childcare is omitted category formal only		0.716* (0.415)			0.454 (0.385)	
formal & informal		1.349** (0.533)			0.970** (0.494)	
informal only		0.749 (0.627)			1.330** (0.540)	
no childcare is omitted category any day care			0.810* (0.419)			0.553 (0.390)
any other formal			0.963* (0.533)			0.603 (0.485)
informal only			0.736 (0.626)			1.322** (0.540)
Lagged learning	0.256*** (0.018)	0.256*** (0.018)	0.256*** (0.018)			
Lagged socio-emotional				0.202*** (0.017)	0.202*** (0.017)	0.203*** (0.017)
Constant	73.038*** (2.901)	73.083*** (2.905)	73.146*** (2.926)	78.820*** (2.748)	78.614*** (2.750)	78.603*** (2.757)
Number of observations	2974	2974	2974	3138	3138	3138
R-squared	0.248	0.248	0.248	0.225	0.226	0.225

Note: *** significant at 1%; ** significant at 5%; * significant at 10%. Robust standard errors are in parentheses. In this specification, care provided by a nanny is included in informal care instead of other formal care (as is the case in Tables 13-a and 13-b). Coefficients for control variables are not presented in this table, since these are very close to those presented in Tables 13-a and 13-b.

Appendix E: Tables presenting outcome models for subsamples

Table E1. Outcome models for the sample of single parents

	LSAC Outcome Index					
	Learning			Socio-emotional		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
no childcare is omitted category						
childcare	4.356***			1.766		
	(1.597)			(1.307)		
no childcare is omitted category						
formal only		4.148**		0.984		
		(1.646)		(1.354)		
formal & informal		6.458***		4.204**		
		(2.297)		(1.867)		
informal only		1.776		3.352		
		(3.073)		(2.305)		
no childcare is omitted category						
any day care			4.397***			0.999
			(1.670)			(1.365)
any other formal			5.025**			3.608**
			(2.085)			(1.762)
informal only			1.775			3.369
			(3.080)			(2.308)
Number of observations	264	264	264	397	397	397
R-squared	0.089	0.097	0.093	0.052	0.063	0.060

Note: only lagged index variable included in each specification.

Table E2. Outcome models for the sample of low-educated main carers (did not complete High School)

	LSAC Outcome Index					
	Learning			Socio-emotional		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
no childcare is omitted category						
childcare	1.793			0.497		
	(1.136)			(0.932)		
no childcare is omitted category						
formal only		2.092*		0.243		
		(1.219)		(1.005)		
formal & informal		3.424*		1.590		
		(2.065)		(1.747)		
informal only		-1.119		0.708		
		(1.995)		(1.744)		
no childcare is omitted category						
any day care			1.513			-0.155
			(1.263)			(1.033)
any other formal			4.279**			2.274
			(1.663)			(1.462)
informal only			-1.127			0.709
			(1.988)			(1.740)
Number of observations	363	363	363	517	517	517
R-squared	0.061	0.070	0.076	0.062	0.063	0.067

Note: only lagged index variable included in each specification.

Table E3. Outcome models for the sample of children whose main language at home is not English.

	LSAC Outcome Index					
	Learning			Socio-emotional		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
no childcare is omitted category childcare	2.241** (1.125)			4.293*** (1.133)		
no childcare is omitted category formal only		2.363* (1.294)		4.046*** (1.302)		
formal & informal		1.822 (2.127)		5.407*** (2.049)		
informal only		2.202 (1.610)		4.164** (1.676)		
no childcare is omitted category any day care			1.118 (1.291)			4.340*** (1.317)
any other formal			6.211*** (1.999)			4.342** (1.947)
informal only			2.213 (1.592)			4.162** (1.677)
Number of observations	269	269	269	329	329	329
R-squared	0.093	0.093	0.114	0.120	0.122	0.121

Note: only lagged index variable included in each specification.

Table E4. Outcome models for the sample of indigenous children

	LSAC Outcome Index					
	Learning			Socio-emotional		
	(i)	(ii)	(iii)	(i)	(ii)	(iii)
no childcare is omitted category childcare	1.696 (2.400)			-1.287 (1.718)		
no childcare is omitted category formal only		1.648 (2.591)		-1.503 (1.844)		
formal & informal		4.787 (4.759)		-1.499 (3.231)		
informal only		-0.382 (4.227)		-0.017 (3.021)		
no childcare is omitted category any day care			1.136 (2.702)			-2.047 (1.890)
any other formal			4.504 (3.611)			0.122 (2.625)
informal only			-0.383 (4.216)			-0.030 (3.012)
Number of observations	83	83	83	127	127	127
R-squared	0.122	0.131	0.136	0.038	0.041	0.046

Note: only lagged index variable included in each specification.