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Too late and not enough for some children: early childhood education and care (ECEC) program usage patterns in the years before school in Australia

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Abstract

This paper uses data from a major Australian longitudinal study to test the extent to which children recruited on the basis of attending an early childhood education and care (ECEC) setting when they were 3–4 years of age received an ‘optimal’ dosage of education and care. The idea of an optimal dosage is drawn from research literature on what level of dosage leads to improved learning and development outcomes for children. This dosage level is then compared with the actual level received by Australian children, through examining the age of entry of Australian children into ECEC and the number of hours of education and care they receive before school entry. Key predictors of the total hours of ECEC usage and the year of commencement in formal ECEC programs are reported, and demonstrate the variability and correlates of participation in ECEC programs. Patterns of ECEC usage were predicted by family advantage and disadvantage factors. Children from homes with less employment, and more siblings, tend to use fewer hours of ECEC before school and/or start later. The findings suggest sub-optimal levels of participation given the policy goal of improving learning and developmental outcomes for all children and particularly for children from disadvantaged backgrounds. Policy implications are addressed.

Keywords: Child care, Kindergarten, Early childhood education and care (ECEC), Disadvantaged, E4Kids study, Policy

Background

Policy and research context

The benefit of early childhood education, particularly targeted toward children living in disadvantaged circumstances—vulnerable children—in the years before school has been well established through evaluations of model programs in the US dating back to the late 1960s (Anderson et al. 2003). Benefits of model programs were established in the areas of cognitive, educational and social gains for individual children, savings in public expenditure through lowered grade retention rates in schools, lower welfare and criminal justice expenditure and broader benefits of human capital development (Heckman and Masterov 2006). More recently, improved child outcomes have been linked to the provision of high-quality pre-kindergarten classrooms (Burchinal et al. 2010, 2014).

Evidence from neuroscience on how human brain architecture is established in the first three years of life (NSCDC 2008) has created new public interest within and beyond OECD countries in investing in children's education in this period. While interest in model programs for highly vulnerable children continues (Leseman 2002; Burchinal et al. 2006, 2010), there has also been a shift to examining the extent to which mainstream programs can help deliver on this promise of early childhood for all children (Burger 2010), notably in the US (Howes et al. 2008; Vandell et al. 2010), the UK with the EPPE study (Sylva et al. 2004), Canada (Cleveland and Forer 2010), Germany (Caniato et al. 2010), Denmark (Bauchmillar et al. 2011; Jensen 2013) and China (Li et al. 2014).

Early childhood program participation

The knowledge base is strongest around positive cognitive/academic gains from participation in kindergarten in the year before school (Duncan and NICHD ECCRN 2003; Gormley et al. 2005; Loeb et al. 2007; Magnuson et al. 2004; Spiess et al. 2003), including studies in Australia (Warren and Haisken-DeNew 2013). However, there is also a smaller, though increasing, evidence base of the value of intervening in the first 3 years of life (Campbell et al. 2012; Coley et al. 2015; Li et al. 2014; Sylva et al. 2004).

The national and international implications of findings from Australian research studies require an understanding of the Australian early childhood education and care (ECEC) system. In essence, it is a complex system of care and education managed by a range of different organisations, including local government, community-based organisations, for-profit providers and schools. Programs are delivered through centre-based programs providing Long Day Care, Occasional Care and stand-alone Kindergarten programs and also in the form of home-based care through Family Day Care. Kindergarten programs are also delivered within Long Day Care programs and traditional stand-alone Kindergartens are increasingly extending their programs to include child care. Funding for child care is mostly a national responsibility whilst kindergarten programs are funded by State and Territory Governments.

Australian national research has recently found that there are significant and stronger cognitive gains for children attending ECEC programs from the infant/toddler age through to preschools, rather than preschool attendance only, as well as for those children with a greater intensity of exposure. These findings from the Longitudinal Study of Australian Children (LSAC) were irrespective of ECEC quality, which was not assessed within the LSAC study, emphasising the importance of focussing on dosage issues in ECEC provision when considering children's cognitive outcome effects (Coley et al. 2015).

In Australia the ECEC participation rates include about 8% of children under 1 year of age, about 37% of children 1–2 years of age and about 55% of children 2–3 years of age (Productivity Commission 2014). About 41% of children attend child care in the 3–5 age range and 70% attend 4-year-old kindergarten, (Productivity Commission 2014) though this latter figure can be expected to extend to over 90% with the national adoption of a Universal Access policy. The estimated 30 per cent of children under 3 years of age who attended ECEC programs in Australia in 2009 is at a similar level to a number of other

OECD countries such as the UK (35%), US (31%) and Canada (24%), but is lower than in a number of others, such as Denmark (73%) (Moss 2012).

Four groupings of Australian children are less likely to participate in ECEC programs: those in low income families, having a disability, at risk of abuse or neglect or being developmentally disadvantaged because of the characteristics of their family, culture or community (Productivity Commission 2014). Similar groupings of Australian children have also been identified as less likely to participate in ECEC programs in other research: those from low socio-economic backgrounds, remote communities, Indigenous background, non-English speaking background, and having a disability or special health care needs (Baxter and Hand 2013; Biddle 2011).

The challenge to public policy is how to ensure that children enter the ECEC system early enough, for a sufficient period of time on a weekly basis and at high enough quality to make a positive difference to their learning and life trajectories. Despite manifest interest in all children, a particular interest in vulnerable children continues because their poor outcomes are of great public concern, represent additional public costs and are a loss of human capital. They are also the children who have potentially the most to gain from early intervention (Burchinal et al. 2014).

Impacts of program participation for children from disadvantaged families

A review of research studies (Burger 2010) on the compensatory impacts of ECEC on the cognitive abilities of children found a mix of findings for whether vulnerable or non-vulnerable children benefited more in mainstream settings, with some studies finding that vulnerable children gained more, whilst others found that vulnerable and non-vulnerable children gained equally (and hence their relative positions remained unchanged) and, in one study, non-vulnerable children gained more. An earlier review on the same question also found mixed findings with possible explanations being a lack of capacity of the families of vulnerable children to input into ECEC programs, and poor attachment of children translating into barriers to learning within ECEC settings (Leseman 2002).

The difficulties of establishing cause and effect relationships between ECEC participation and longer term academic/cognitive attainment are well illustrated in 50 case studies drawn from the EPPSE study (a follow-on from the EPPE study) in the UK (Siraj-Blatchford et al. 2010). In this research four groupings of children were identified at age 16 years. In one grouping, children from low socio-economic status (SES) backgrounds had expected low attainment, with factors such as low home learning support from parents, poor self-image, low-quality ECEC environments, perceived poor quality teaching in schools, lack of peer support and poor access to written materials and computers prominent. The same factors, but in reverse, were true for children from high SES environments with high attainment at age 16 years of age. For children from low SES environments 'who succeeded against the odds' factors included the persistence of parents in providing children good early and later learning experiences despite poorer home learning environments, greater ability of children to take advantage of learning opportunities in ECEC settings, higher quality ECEC and school settings, parental selection of ECEC programs based on a belief of its importance, careful parental evaluation of its suitability for their child, and children's perception that they were assisted by teachers when facing

difficult tasks at school. For children from high SES environments with low attainment, issues included ineffective learning strategies and externalising problem behaviour when approaching puberty (Siraj-Blatchford et al. 2010).

Maintaining a sufficiently high focus on vulnerable children in mainstream settings, where there is likely to be a mix of highly vulnerable, less vulnerable and essentially non-vulnerable children, has a number of different challenges from model programs comprising only vulnerable children. Educators need to be able to identify the vulnerable children and then be able to provide a sufficiently intensive intervention that is matched to the range of capabilities and interests of the children. Without this, there is evidence that it may be the advantaged children who are best placed to take advantage of the learning opportunities in mainstream settings (Burger 2010).

Optimal patterns of ECEC attendance

Government has an understandable cost effectiveness interest in what is the optimum level of attendance or dosage that will bring about worthwhile cognitive/school success changes in child outcomes, especially for vulnerable children. Some studies of mainstream programs have found that part-time versus full-time provision in any given year makes no significant difference to cognitive gains (Cleveland and Forer 2010; Sylva et al. 2004; Howes et al. 2008). Others have been able to differentiate effects between children from lower and higher income families, with longer hours leading to higher cognitive gains for low income children but no additional gains for higher income children beyond 15 h per week (Loeb et al. 2004). In the evaluation of model programs with vulnerable children only, part-time attendance has been shown to be less effective than full-time attendance; for example the evaluation of the Abecedarian approach found 350+ hours per annum (an average of 3.3+ days per week) had a lower impact on children's cognitive development than 400+ hours per annum (an average of 3.8+ days per week) (Campbell et al. 2012).

Although policy makers may seek thresholds for optimal patterns of attendance in early childhood programs to guide funding decisions about the provision of early childhood programs, research findings provide no clear guidance. It needs to be acknowledged that a minimum threshold of attendance and participation is yet to be firmly established in research—probably because of the complexity of the interactions between ECEC quality, attendance, dosage and degree of child vulnerability. Reasons for a lack of consistency in studies on the effects of different dosages of attendance include: varying degrees of program quality, a split focus on current participation and cumulative participation, different measures of attendance (hours per week, full and part day, attendance at particular types of program, cumulative hours over a number of years and age of entry) and reliance on enrolment of the child in a program as the proxy for attendance, rather than their actual attendance. Assessing the effects of early entry to ECEC programs is further complicated by this being less common, with less data available. It is also difficult to differentiate the effects of the timing of entry into ECEC from family background factors and program quality factors (Zaslow et al. 2010).

Despite these differences and ambiguities in research findings, policy decisions still need to be made by governments and it is important that there is a 'best estimate' distillation of research findings. In relation to model programs, two major conclusions can be drawn: earlier is better and more is better. Plausibly, this relates to the high quality

and level of resourcing with a concentrated focus on vulnerable children and the much higher quality of the program environment relative to that of home. In relation to mainstream programs, there is some evidence that cognitive advantages do not accrue to children under 2 years of age and that part-time attendance may be as advantageous to cognitive development as full-time attendance—though there is also evidence supports the ‘more and earlier’ view (Li et al. 2014).

Behavioural outcomes

Whilst this paper focuses on new Australian data on dosage patterns, and how this compares with what the broader literature has to say about optimum dosage patterns for improving cognitive outcomes, it is worth noting that there have been consistent research findings that more extensive hours of ECEC, often expressed as being over 30 h per week, contribute to social and emotional difficulties for children, evidenced by more difficult/externalising behaviour. However, high quality has been shown to moderate externalising behaviour, whilst association with large groups of peers increases such behaviour (McCartney et al. 2010). Multiple care arrangements have also been shown to be associated with poorer behavioural outcomes across a number of studies, though recent more nuanced research indicates that this is the case for unstable multiple arrangements only (Pilarz and Hill 2014).

Research questions and study context

The findings reported below relate to the following questions:

- What are the ‘weekly hours’ patterns of attendance in typical Australian ECEC programs in each of the years before school?
- What are the predictors of overall hours of ECEC attendance, and overall kindergarten hours of attendance.
- What are the predictors of early age entry into ECEC programs?

The policy interest is the extent to which patterns of children’s attendance promote the improvement in children’s cognitive outcomes that high quality model programs predict—for children already enrolled in ECEC programs when 3–4 years of age. The interest here is also the extent to which more vulnerable children are more or less likely to have optimum levels of attendance; that is, do patterns of attendance potentially promote greater equality or inequality of cognitive outcomes? Following the findings from other research, the interest is in total ECEC participation, which includes both child care and kindergarten programs, and in kindergarten programs separately.

Methods

The dosage of ECEC programs that children experience is analysed using data collected from a cohort of some 2,600 young children recruited through ECEC settings in Victoria and Queensland (the E4kids study) (see Tayler et al. 2013 for more information). The sample selection began with the identification of every approved long day care, family day care, kindergarten and occasional care program in the greater capital city regions, in a large regional centre in Victoria and in a remote city in north western Queensland. A random

selection was then drawn to include programs operating in a range of high and low socio-economic status (SES) communities based upon the postcode data of where these services were located. The rooms in which 3- and 4-year-old children were enrolled were then identified and the parents of all children in these rooms were invited to join the study. An annual data collection was implemented (2010–2012), including attendance, individual assessment of the children's learning and development, family circumstances and observational measures of the quality of the programs attended by children. The data presented on ECEC attendance used in this paper are drawn from parent self-report data collected from three-waves of an annual survey. Parent responses were checked against observed patterns of attendance by fieldworkers during the 3 years of data collection and this served to limit parental reporting errors during this period. There were, however, no checks against inaccurate parental memories of earlier ECEC attendance patterns [as has been provided in other studies through triangulation of parental data against multiple sources of data (Miles and Huberman 1994)].

The program dosage patterns presented in this paper are 're-weighted' to ensure that the sample drawn is representative of typical Australian capital city ECEC populations—as well as including a regional and remote site. Measures of the latent traits of the child, the characteristics of the family and home environment, and inventories of ECEC usage were conducted by annual survey. We re-weight the influence of children to parameter estimates to account for the complex, cluster-based sample design, and to produce population estimates and confidence intervals that allow generalisation to the broader population from which the sample is drawn. Though the sample is not technically representative of the Australian population, findings can claim to be indicative of Australian ECEC programs.

In large non-experimental studies, such as the E4Kids Study, it is essential to control for child, family and other selection factors which may drive the choice to use ECEC programs (the type, the hours, the price and quality) and are correlated with children's developmental outcomes (Duncan and Gibson-Davis 2006). Otherwise, child outcomes can be incorrectly attributed to ECEC participation which is due to parental choices of programs. Major non-experimental studies have focused on accounting for selection bias in order to isolate the effect of ECEC programs on children's outcomes. Similarly, this study seeks to utilise the variation of family choices and selection processes to describe not only the presence (or not) of important patterns of ECEC use, but to explain the likelihood of different families engaging in what were identified earlier in this article as optimum patterns of use.

A review of 20 studies conducted using the Study of Child Care and Youth Development (SECCYD) data found a total pool of 33 child and family selection variables that were used: many of these were highly correlated and no individual study used more than eleven to account for selection. The review concludes that a range of key variables are required to sufficiently account for selection while avoiding issues of multi-collinearity. Variables identified of significant importance were those related to the child (temperament, gender and attachment), the caregivers (income relative to need, education, marital status, mother's receptive vocabulary, personality and 'sensitivity') and the home (home learning environment) (Duncan and Gibson-Davis 2006). Selection variables explain a complex production of ECEC choices.

Results and discussion

Findings

Because children’s minimum age at school entry in Australia varies across States and Territories, and some children repeat the 4-year-old kindergarten program, we present the attendance data as formal ECEC usage and non-parental care in each of the years before school rather than focussing on children’s ages; specifically we present ECEC usage by children who were 1 year before school, 2 years before school, 3 years before school, and so on. As would be expected children’s ages bear a systematic relationship with these categories, with an average age at entry to the first year of school being 5.2 years, 4.2 years for one year before school, 3.2 years at entry to 2 years before school, 2.2 years at entry to 3 years before school and 1.2 years at entry to 4 years before school. Children’s ages were calculated as of 1 January for each year for this purpose.

Data on ECEC usage are included for those children for whom their main caregiver completed at least one survey and, as noted earlier, the data were re-weighted to be representative of the Victorian and Queensland populations. In the first year of data collection, the state-wide participation rates in 4-year-old kindergarten were markedly different in the two Australian States, Victoria and Queensland, being an estimated 94 and 30%, respectively.

Table 1 presents the patterns of attendance for formal ECEC and Results and discussion for each of the years before school.

Similar to other Australian ECEC data reviewed above (Productivity Commission 2014), formal ECEC usage is common, with the proportion of children in formal ECEC settings increasing with age; being highest for the year before school and lowest for 4 years before school—the reverse trend is also present for use of informal non-parental care as this usage decreases over time in the years before school. These data also demonstrate that participation in ECEC at age 3–4 years predicts higher ECEC program usage rates in earlier years than is true for the general population.

Table 1 Usage patterns for formal ECEC programs in the years before school

Years before school	State location of ECEC	Formal ECEC program usage	pro-%	No formal ECEC program usage	%	Total	%
1 year before school	QLD	649	85.2	113	14.8	762	100
	VIC	545	94.3	33	5.7	578	100
	Total	1,194	89.1	146	10.9	1,340	100
2 years prior to school	QLD	564	71.7	223	28.3	787	100
	VIC	567	81.5	129	18.5	696	100
	Total	1,131	76.2	352	23.8	1,483	100
3 years prior to school	QLD	459	58.4	327	41.6	786	100
	VIC	440	63.1	257	36.9	697	100
	TOTAL	899	60.6	584	39.4	1,483	100
4 years prior to school	QLD	366	46.7	417	53.3	783	100
	VIC	318	46.3	369	53.7	687	100
	Total	684	46.5	786	53.5	1,470	100

NB: Data collected in this study indicate that some informal non-parental care is also common, averaging 63% across the 4 years before school and decreasing as children get older; being 75% 4 years before school reducing to 48% in the year before school.

Table 2 examines the above data on the use on formal ECEC programs in terms of the average and median hours of weekly attendance in each of the years before school. Values in parenthesis are estimates for children who attended ECEC for 1 h or more in the period whilst overall sample numbers include children who did not attend programs in particular years.

As might be expected in the Australian ECEC system, and also illustrated by LSAC and other Australian attendance data, younger children are less likely to attend programs (as also indicated in Table 1) and attend for fewer hours; for example, fewer than half the children attend 4 years of ECEC before school compared to over 90% of children in the year before school and the average weekly hours of attendance increase from about 22 h per week 4 years before school entry to about 26 h per week in the year before school.

Table 3 presents these same data disaggregated into smaller categories of dosage, these being of interest in light of known effects on child outcomes. Values in parenthesis are estimates for children who attended ECEC for 1 h or more in the period whilst overall sample numbers include children who did not attend programs in particular years.

The data indicate a low rate of ECEC participation for children 3 and 4 years before school entry. In addition, about 2/3 of the children attend less than 20 h of ECEC on average in the years prior to school entry. Of those children attending some hours of ECEC in any given year, just under a quarter (23%) attended for fewer than 10 h of ECEC 3 and 4 years before school with this percentage reducing to just under one-fifth 2 years before school and fewer than one in ten children (7%) in the year before school. At the other extreme of participation hours, approximately one quarter of the children attended over 30 h per week of ECEC in the second, third and fourth years before school increasing to over a third (36%) in the year before school

Attendance in one component of formal ECEC programs, kindergarten, is examined separately below in Table 4. Kindergarten has been a state-funded (rather than national) form of provision, and has been available to different degrees in Victoria and Queensland, although this is changing in light of a national impetus to ensure all children access kindergarten programs in the year before school. At the time of collecting the first round of data in 2010, some 94% of children in Victoria attended 4-year-old kindergarten compared to 30% in Queensland—though these proportions are only partly reflected here because of the method of sampling children within ECEC programs. Only a minority of children attend 3-year-old kindergarten in Queensland and Victoria.

Table 2 Hours of formal ECEC in each of the years before school overview

Hours of formal ECEC per week	Sample <i>n</i>	Minimum	Maximum	Mean	Std. deviation	Median
1 year before school entry	1,224 (1181)	0 (2)	50	25.09 (26.11)	14.60 (14.60)	21.00 (24.00)
2 years before school entry	1,373 (1119)	0 (2)	50	17.74 (22.80)	15.11 (13.35)	16.00 (20.00)
3 years before school entry	1,484 (883)	0 (2)	50	13.17 (21.89)	14.55 (12.69)	8.00 (19.00)
4 years before school entry	1,480 (673)	0 (1)	50	10.10 (21.77)	13.93 (12.82)	0.00 (18.00)
Average in the years prior to school	1,109 (525)	0 (6)	50	17.61 (26.48)	12.29 (10.59)	15.00 (25.53)

Values in parenthesis are estimates for children who attended ECEC for 1 h or more in the period whilst overall sample numbers include children who did not attend programs in particular years.

Population estimates given by sampling weights.

Table 3 Hours of formal ECEC in each of the years before school by different categories of attendance

Hours of formal ECEC per week	Sample <i>n</i>	% 0 h	% 0 < <i>x</i> ≤ 10 h	% 10 < <i>x</i> ≤ 20 h	% 20 < <i>x</i> ≤ 30 h	% >30 h
1 year before school entry	1,224 (1181)	4 (0)	6 (7)	39 (40)	17 (17)	34 (36)
2 years before school entry	1,373 (1119)	22 (0)	15 (19)	25 (32)	18 (23)	20 (26)
3 years before school entry	1,484 (883)	40 (0)	14 (23)	19 (31)	13 (22)	14 (24)
4 years before school entry	1,480 (673)	54 (0)	10 (23)	15 (33)	10 (21)	11 (23)
Average number of hours across the 4 years prior to school entry	1,109 (525)	3 ^a (0)	32 (4)	27 (26)	19 (32)	19 (37)

Population estimates given by sampling weights.

^a Whilst these children were enrolled in an ECEC program at point of entry to the study, this included Occasional Care. Main caregivers were asked to identify typical patterns of ECEC attendance used in most weeks of the year only. Some will not have regularly used ECEC programs following recruitment to the study. This number may also include cases of parental error in completing the survey.

Table 4 Hours of Kindergarten attendance in the last 2 years before school

Hours per week of kindergarten attendance	<i>N</i> attending kindergarten	Minimum	Maximum	Mean ^a	Std. deviation ^a	Median ^a	Per cent not attending kindergarten ^a (%)
1 year before school entry	906	2	15	12.94	2.74	14	38
2 years before school entry	491	2	15	9.72	4.8	11	74
Average of 1 and 2 years before school entry	398	2	15	11.38	3.2	12	37

^a Population estimates given by sampling weights.

As would be expected from known trends in kindergarten provision in Victoria and Queensland, attendance is much less common 2 years before school than in the year before school and weekly hours of attendance are also lower for 2 years before school. Given that providers of 4-year-old kindergarten for the extended hours of 15 h per week may not have received additional funding until 2013, many of the services from which data were collected in 2010 and 2011 had yet to extend their hours—although some did so in expectation of the change.

Table 5 provides findings of a linear regression analysis of the extent to which selected child, family and community factors predict the total hours of ECEC attendance in the years before school, which includes both child care and kindergarten program attendance. The factors tested here align with the range of factors identified by Duncan. The unstandardized coefficients can be interpreted as the change, measured in hours, given a one-unit change in the predictor while all other predictors are held constant.

The factors that predict more hours of ECEC participation include, in order of the strength of their association, higher family income, having two parents in paid work, fewer children in a family, lower scores on the HLE, being in receipt of a Health Care Card and having an easier child temperament. The factors that are on the cusp of being significant predictors of longer hours include not having a child disability and having a

Table 5 Results of the hierarchical regression analyses for the prediction of total hours of attendance of formal ECEC (explained variance: $R^2 = 0.14$)

Variable	Unstandardised regression coefficient	SE	T value
Child age	0.091	0.179	0.508
Sex (0 = male; 1 = female)	-1.024	1.935	-0.529
Disability (1)	-8.852	5.077	-1.743
Intelligence (BIA)	-0.273	0.106	-2.565*
Temperament	3.742	1.565	2.391*
Low birth weight (1)	3.478	3.842	0.905
both parents working (0) vs. rest (1)	-21.551	2.048	-10.523***
Both parents not working (1) vs. rest (0)	11.163	8.925	1.251
Single parent (1)	-1.083	10.280	-0.105
Income	1.767	0.438	4.031***
Education	1.251	0.734	1.704
Health Care Card (1)	6.039	2.984	2.024*
Renting (1)	3.222	2.489	1.294
Language other than English (1)	7.054	5.093	1.385
Home Learning Environment	-0.294	0.078	-3.774***
Number of children	-7.009	1.094	-6.407***
Stressful life events (1)	4.615	4.035	1.144
Parental mental health issues (1)	-0.270	0.233	-1.158
SEIFA	0.848	0.794	1.069

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$; (1) indicates that the variable has a value of 1 or 0, for example, the family is either renting or is not.

higher level of parental education. Having regard to the cost of participation it is likely that the children of families with Health Care Cards (entitling families to a range of free services for their children) attend longer hours than the children in families with lower incomes; child care is cheaper for families with Health Care Cards, and 4-year-old kindergarten programs in Victoria are effectively free for all.

Table 6 presents the predictors of total hours of attendance in kindergarten, applying the same analysis used for predicting ECEC attendance, including attendance at both 3- and 4-year-old kindergarten only.

Family income and both parents working were also predictors of total hours of kindergarten programs attended. In comparison to total hours of attendance of all formal ECEC settings, total hours of kinder program attendance was predicted by higher HLE ratings. Factors that were no longer predictive were higher numbers of children in a family and easier temperament. In contrast, there are additional predictors of using longer hours of kindergarten; namely, higher Socio-Economic Indexes for Areas (SEIFA), higher educational levels of parents and not renting the family home. Other non-predictors remain the same for both ECEC program usage and kindergarten program usage.

Overall this model of analysis explains some 14% of the variance.

Finally, a multinomial regression analysis was used to predict ECEC usage before school entry. Here, 1 year of ECEC program attendance was introduced as a reference, and the background variables were then compared for groups of children with 2, 3, or 4 years of ECEC program experience. No significant predictors for attending 2 years of ECEC in comparison to 1 year were found ($p > 0.05$). However, families with fewer

Table 6 Results of the hierarchical regression analyses for the prediction of total hours of attendance of Kinder programs (explained variance: $R^2 = 0.14$)

Variable	Unstandardised regression coefficient	SE	T value
Child age	-0.018	0.047	-0.374
Sex (0 = male; 1 = female)	-0.680	0.488	-1.393
Disability (1)	1.917	1.413	1.356
Intelligence	-0.015	0.028	-0.517
Temperament	0.334	0.516	0.647
Low birth weight (1)	0.350	1.024	0.341
both parents working (0) vs. rest (1)	1.228	0.601	2.043*
Both parents not working (1) vs. rest (0)	4.147	2.883	1.438
Single parent (1)	-3.574	3.097	-1.154
Income	0.534	0.125	4.266***
Education	0.738	0.212	3.487**
Health Care Card (1)	0.816	0.700	1.164
Renting (1)	-1.905	0.745	-2.557*
Language other than English (1)	-0.948	1.263	-0.751
Home Learning Environment	0.072	0.021	3.455**
Number of children	-0.020	0.333	-0.059
Stressful life events (1)	0.074	1.027	0.072
Parental mental health issues (1)	-0.095	0.076	-1.249
SEIFA	1.092	0.231	4.733***

* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$, (1) indicates that the variable has a value of 1 or 0, for example, the family is either renting or is not.

children tended to send their children earlier to formal ECEC settings ($p < 0.05$ for both 1 vs. 3 and 1 vs. 4 years of ECEC). In addition, having parents with a higher education, families with two working parents and families providing a less favourable HLE lead to earlier attendance (1 vs. 4 years of ECEC attendance, $p < 0.05$).

Discussion

A common ECEC policy challenge is ensuring that young children have access to, and attend, the ECEC programs that are available in a community. Further, there is an aspiration that starting children early enough, and for long enough to make a positive (and not negative) difference to their learning and life trajectories, yet in essence ECEC programs are generally not compulsory and parents decide on the timing and amount of their children’s attendance. This paper reviewed data from the E4Kids study on the extent to which the patterns of attendance in ECEC programs in Australia are likely to be optimal for children’s learning and development in light of parameters of optimum attendance that are reported in the research literature. This analysis is based on a weighted sample of children enrolled in ECEC at age 3–4 years in two States. The findings in relation to the three research questions are discussed below. They address the implications of attendance patterns alone, though it is acknowledged that the potential of particular attendance patterns translating into improved outcomes, or moderating adverse behavioural effects depend on the level of quality of the programs, and this is the substance of further research.

The analysis of attendance patterns of young children within a large-scale longitudinal study—E4Kids –indicated that Australian children’s attendance in ECEC programs followed an expected pattern in each of the years before school: it is less common for very

young children to attend ECEC settings, and increasing likely that children take part in ECEC programs as they approach school age. Similarly, the average weekly hours spent within ECEC settings increase as children get closer to their first school year. These data suggest that even among those children attending ECEC programs at age 3–4 years there remains a significant group of children who either do not attend ECEC programs in the formative first 3 years of life or who attend at a level (under 10 h per week) which is unlikely to lead to significant developmental benefit.

In terms of the predictors of taking part in ECEC programs, the overall usage of programs was predicted by family advantage factors (principally high income) and family disadvantage factors (principally having a Health Care Card and lower Home Learning Environment (HLE) scores). In brief the enrolment of children in ECEC program hours was predicted by parental employment, favouring higher income earners and access to cheaper fees favouring a specific category of families on low income. That lower HLE was also a predictive factor of earlier entry to ECEC programs, presents an opportunity to make a difference to the developmental progression of at least some of the more vulnerable population of children, since the HLE has been proven to be a good predictor of children's outcomes (Niklas 2015).

This Australian snapshot of overall ECEC attendance shifts markedly when examining kindergarten program attendance by itself. The predictors of higher hours of kindergarten program attendance was strongly associated with family advantage factors including both parents working, higher SEIFA (SES), higher HLE and parents not renting the family home. In brief, the children from more advantaged households were more likely to receive the benefit of kinder programs before school. This usage of kindergarten includes participation in both 3-year-old and 4-year-old programs and runs counter to the prevailing research evidence and policy logic of ensuring that more disadvantaged children receive access to early learning programs, preferably high-quality programs in the years before school. These findings underscore the importance of contemporary Council of Australian Governments efforts toward the provision of universal access to 4-year-old kindergarten programs for Australian children—an approach that was beginning to gain momentum when the first round of E4Kids data was collected in 2010. Under this policy initiative, in the context of what is a non-compulsory system of provision, particular care needs to be taken to ensure that a sub-group—the most vulnerable children—do not miss out. Three-year-old kindergarten programs (typically 2 years before school entry) largely remain the preserve of more advantaged families as fees do not usually attract a public subsidy.

In terms of the age of entry to ECEC programs, there were no child or family predictors of using 1 year versus 2 years of ECEC program before school. However, one family advantage factor—higher parental education—predicted the earlier entry of children into ECEC programs 3 and 4 years before school. Further, one family disadvantage factor—low HLE—alongside having both parents in the paid workforce also predicted earlier ECEC program usage. Parental participation in the paid workforce is typically aligned with family advantage, since paid employment is an antidote to poverty, yet some parents may feel driven to employment for financial reasons when they would prefer to be at home personally supporting the development of their children.

There are a number of messages for public policy in these data. Clearly for countries that provide universal (albeit non-compulsory) ECEC programs for children in the early

years of life, issues related to ECEC program access and dosage may be small. In contrast, these issues are major in countries such as Australia where universal provision is a quest at the level of 1 year before school, and not a consideration prior to that year. In Australia program usage is dependent on the ability of families to purchase programs, and the views of parents regarding the relevance and quality of programs for their children. Policy implications that arise in light of our analyses of the E4Kids sample include that children who access ECEC programs before school typically reside in families having particular characteristics, including higher parental education, full engagement in the paid workforce and, for some, having a poor home learning environment—that in turn has a relationship with low income that ensures fee relief (and therefore greater likelihood of accessing ECEC programs. If different constituent groups are the target of ECEC provision specific solutions are needed to engage such groups. To address differential access and usage of ECEC programs by Australian children a shift to universal provision for children less than 4 years of age would represent a major change, and is not currently on the short or even medium term political horizon. To the extent that vulnerable children are already enrolled in ECEC programs in Australia an immediate focus can be on their identification and the assurance of continued access, attendance and a quality of program that can make a difference to children's cognitive and social outcomes. Targeted model programs will continue to have a place for highly vulnerable children, including within universal provision systems, given the higher magnitude of positive change that research has demonstrated is likely for such programs.

Conclusion

Governments are increasingly looking to additional opportunities within the ECEC system to promote children's wellbeing and cognitive development. Problems of access and the challenge of providing of a sufficient dosage of program, especially to vulnerable children, underscores the level of challenge for public policy in Australia if the provision of ECEC programs is to achieve the specified policy intention to improve children's learning and development outcomes.

Abbreviations

ECEC: Early childhood education and care; HLE: Home learning environment; LSAC: Longitudinal study of Australian children; SES: Socio-economic status; SEIFA: Socio-economic indexes of areas.

Authors' contribution

TG conceptualised the research focus on this paper and was lead author for all sections of the paper. CT provided significant suggestions and direct input into the background and discussion sections of the paper. FN and DC were jointly responsible for formulating the data analysis approach, the data analysis and data presentation in table form. All authors read and approved the final manuscript.

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Acknowledgements

E4Kids is a project of the Melbourne Graduate School of Education and is conducted in partnership with Queensland University of Technology. E4Kids is funded by the Australian Research Councils Linkage Projects Scheme (Grant LP0990200), the Victorian Department of Education and Training and the Queensland Department of Education, Training and Employment. E4kids is conducted with academic collaboration with the University of Toronto, Scarborough, the Institute of Education at the University of London and the Royal Children's Hospital, Melbourne. E4Kids thanks the Australian Government Department of Education and Training. This work was also supported by a fellowship within the Postdoctoral Programme of the German Academic Exchange Services (DAAD).

Compliance with ethical guidelines

Competing interests

The authors declare that they have no competing interests.

Received: 23 March 2015 Accepted: 9 June 2015

Published online: 03 July 2015

References

- Anderson, L., Shinn, C., Fullilove, M., Scrimshaw, S., Jonathan, E., Fielding, J., et al. (2003). The effectiveness of early childhood development programs: a systematic review. *American Journal of Preventive Medicine*, *24*(3), 32–46.
- Bauchmillar, R., Gortz, M., & Rasmussen, A. (2011). *Long-run benefits from universal high-quality pre-schooling*. Copenhagen: AKF Danish Institute of Government Research.
- Baxter, J., & Hand, K. (2013). *Access to early childhood education in Australia. Research Report 24*. Melbourne: Australian Institute of Family Studies (AIFS).
- Biddle, N. (2011). *An exploratory analysis of the Longitudinal Survey of Indigenous Children. Working paper no. 77*. Canberra: Centre for Aboriginal Economic Policy and Research.
- Burchinal, M., Roberts, J. E., Zeisel, S. A., Hennon, E. A., & Hooper, S. (2006). Social risk and protective child, parenting, and child care factors in early elementary school years. *Parenting-Science and Practice*, *6*(1), 79–113.
- Burchinal, M., Vandergrift, N., Pianta, R., & Mashburn, A. (2010). Threshold analysis of association between child care quality and child outcomes for low-income children in pre-kindergarten programs. *Early Childhood Research Quarterly*, *25*(2), 166–176.
- Burchinal, M., Vernon-Feagans, L., Vitiello, V., & Greenberg, M. (2014). Thresholds in the association between child care quality and child outcomes in rural preschool children. *Early Childhood Research Quarterly*, *29*, 41–51.
- Burger, K. (2010). How does early childhood care and education affect cognitive development? An international review of early interventions for children from different social backgrounds. *Early Childhood Research Quarterly*, *25*, 140–165.
- Campbell, F., Pungello, P., Burchinal, M., Kainz, K., Pan, Y., Wasik, B., et al. (2012). Adult outcomes as a function of early childhood educational programs: an Abecedarian project follow-up. *Developmental Psychology*, *48*(4), 1033–1043.
- Caniato, N., Alvarenga, M., Stich, M., Jansen, H., & Baube, B. (2010). Kindergarten attendance may reduce developmental impairments in children: results from the Bavarian Pre-School Morbidity Survey. *Scandinavian Journal of Public Health*, *38*, 580–586.
- Cleveland, G., & Forer, B. (2010). *Child care use and child development in immigrant, lone mother, rural and official language minority families in Canada*. Quebec: Policy Research Directorate Human Resources and Skills Development Canada.
- Coley, R. L., Lombardi, C. M., & Sims, J. (2015). Long-term implications of early education and care programs for Australian children. *Journal of Educational Psychology*, *107*(1), 284–299.
- Commission, Productivity. (2014). *Child care and early childhood learning draft report*. Canberra: Commonwealth of Australia.
- Duncan, G., & Early Child Care Research Network, N. I. C. H. D. (2003). Modelling the impacts of child quality on children's preschool cognitive development. *Child Development*, *74*, 1454–1475.
- Duncan, G. J., & Gibson-Davis, C. M. (2006). Connecting child care quality to child outcomes: drawing policy lessons from non-experimental data. *Evaluation Review*, *30*(5), 611–630. doi:10.1177/0193841X06291530.
- Gormley, W., Phillips, D., & Dawson, B. (2005). The effects of universal pre-k on cognitive development. *Developmental Psychology*, *41*, 872–884.
- Heckman, J., & Masterov, D. (2006). *The productivity argument for investing in young children*. Minnesota: Centre for Early Education and Development.
- Howes, C., Burchinal, M., Pianta, R., Bryant, D., Early, D., Clifford, R., et al. (2008). Ready to learn? Children's pre-academic achievement in pre-kindergarten programs. *Early Childhood Research Quarterly*, *23*, 27–50.
- Jensen, B. (2013). *VIDA: Knowledge-based efforts for socially disadvantaged children in day care*. Tuborgvej: VIDA project, Aarhus University.
- Leseman, P. (2002). *Early childhood education and care for children from low-income or minority backgrounds*. Oslo: OECD.
- Li, Y., Ying, L., & Huntsinger, C. (2014). Does preschool education predict children's academic and behavioural outcomes in China? *Early Childhood Development and Care*. doi:10.1080/03004430.2014.910201.
- Loeb, S., Bridges, M., Bassok, D., Fuller, B., & Rumberger, R. (2007). How much is too much? The influence of preschool centres on children's social and cognitive development. *Economics of Educational Review*, *26*, 52–66.
- Loeb, S., Fuller, B., Kagan, S. L., & Carrol, B. (2004). Child care in poor communities: early learning effects of type, quality, and stability. *Child Development*, *75*, 47–65.
- Magnuson, K., Ruhm, C., & Waldfogel, J. (2004). Inequality in preschool education and school readiness. *American Educational Research Journal*, *41*, 115–157.
- McCartney, K., Burchinal, M., Clarke-Stewart, A., Bub, K., Owen, M., & Belsky, J. (2010). Testing a series of causal propositions relating time in child care to children's externalising behaviour. *Developmental Psychology*, *46*(1), 1–17.
- Miles, M., & Huberman, A. (1994). *Qualitative data analysis: an expanded source book*. London: Sage.
- Moss, P. (2012). Access to and use of early childhood education and care services: an International Overview. In: J. Baxter, & K. Hand (Eds.), *Access to early childhood education in Australia. Research Report 24, 2013. Appendix A* (pp. A1–A14). Melbourne: Australian Institute of Family Studies (AIFS).
- Niklas, F. (2015). Die familiäre Lernumwelt und ihre Bedeutung für die kindliche Kompetenzentwicklung [The learning environment provided by the family and its impact on the development of child competencies]. *Psychologie in Erziehung und Unterricht*, *62*, 106–120. doi:10.2378/peu2015.art11d.

- NSCDC (National Scientific Council on the Developing Child) 2008. *The timing and quality of early experiences combine to shape brain architecture. Working Paper 5*. Cambridge: NSDC, Harvard University.
- Pilarz, A., & Hill, H. (2014). Unstable multiple care arrangements and young children's behaviour. *Early Childhood Research Quarterly*, 29(4), 471–483.
- Siraj-Blatchford, I., Mayo, A., Melhuish, E., Taggart, B., Sammons, P., & Sylva, K. (2010). *Performing against the odds: developmental trajectories of children in the EPPSE 3-16 study*. London: Department of Education.
- Spiess, C., Buchel, F., & Wagner, G. (2003). Children's school placement in Germany: does Kindergarten attendance matter? *Early Childhood Research Quarterly*, 18, 255–270.
- Sylva, K., Melhuish, E., Sammons, P., Siraj-Blatchford, I., & Taggart, B. (2004). *The Effective Provision of Pre-School Education Project: Findings from the early primary years*. London: Institute of Education.
- Taylor, C., Ishimine, K., Cloney, D., Cleveland, G., & Thorpe, K. (2013). The quality of early childhood education and care services in Australia. *Australasian Journal of Early Childhood*, 38(2), 13–21.
- Vandell, L., Belsky, J., Burchinal, M., Steinberg, L., & Vandergrift, N. (2010). 'Do effects of early childhood care extend to age 15 years? Research from the NICHD study of early child care and youth development. *Child Development*, 81(5), 737–756.
- Warren, D., & Haisken-DeNew, J. (2013). *Early bird catches the worm: The causal impact of pre-school participation and teacher qualifications on Year 3 National NAPLAN Cognitive Tests*. Melbourne: Melbourne Institute of Applied Economic and Social Research (MIAESR).
- Zaslow, M., Anderson, R., Redd, Z., Wesel, J., Tarullo, L. & Burchinal, M. (2010). *Quality, dosage, thresholds and features in early childhood settings: A review of the literature*. OPRE 2011-5. Washington, DC: Office of Planning, Research and Evaluation, Administration for Children and Families, U.S > Department of Human Services.

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