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debate

The evidence base for early childhood education and care programme investment: what we know, what we don't know

Linda A White, lwhite@chass.utoronto.ca, University of Toronto, Canada;
Susan Prentice, susan.prentice@umanitoba.ca,
University of Manitoba, Canada;
Michal Perlman, michal.perlman@utoronto.ca, University of Toronto, Canada

An expanding body of research demonstrates that high quality early childhood education and care (ECEC) programmes generate positive outcomes for children; in response, policy makers in a number of countries are making significant programme investments. No research consensus, however, has emerged around the specific types of policy intervention that are most effective. Much remains to be clarified in terms of specific policy interventions that flow from the evidence base. To respond to these important gaps in ECEC knowledge, we advance a call for a research agenda that will systematically examine the effects of early years policy instruments and settings.

key words early childhood education and care • evidence base • policy interventions • full-day kindergarten

Introduction

A remarkable expansion in early childhood education and care (ECEC) policies is occurring in many jurisdictions. Government investment in and the number of children attending ECEC programmes have exploded in the liberal welfare states of Australia, Canada, New Zealand, the USA and the UK (US Census Bureau, 2012; Waldfogel, 2010; White, 2012). An expanding research corpus demonstrates that high quality ECEC programmes can improve children's well-being, which we conceptualise broadly to include cognitive, social/emotional and physical development. These effects appear to be strongest for children who come from disadvantaged backgrounds including low family incomes, or having very young, single and poorly educated parents.[1] Research finds a positive relation between extensive ECEC programmes and parental labour force participation, education and training (Baker et al, 2008). Overall, the case for early years interventions is strong, yet no research consensus has emerged around the *specific types* of policies that are most effective. Thus, while the goal of early years policies and programmes appears well supported by research, the literature provides little guidance on specific instruments and settings.

This article examines and assesses the diverse evidence base used to justify early years interventions and to promote early years policy changes. From the perspective

of evidence-based policy making, we find that much remains to be clarified in the literature in terms of specific policy interventions that flow from the evidence base. Questions remain as to the type of policy intervention (child care centre, school-based kindergarten or pre-kindergarten, family child care, other more broad-ranging early childhood development programmes such as Head Start); whether policy should emphasis quality versus quantity/access; whether delivery agents ought to be public, private not-for-profit, or private for-profit; whether programmes are best organised on a universal basis or should be targeted to at-risk groups; and finally, what questions remain about the optimum ECEC 'dosage' for young children (namely, is child well-being enhanced in full or part-day programmes, kindergarten alone or with other ECEC services?).

A full understanding of these various interventions requires a recognition that they exist within a specific context. Since it is not possible to describe the context of all of the examples we provide in this review article, we draw mainly on US literature and research from comparator liberal welfare states. We also describe the Canadian context in greater detail, as it provides an interesting example of a federation where ECEC policy is highly decentralised, resulting in significant heterogeneity in terms of policies and programmes that are available within a single country. For example, some provinces provide publicly funded and delivered full-day kindergarten for all five-year-old children, while others do not. Ontario provides two years of full-day kindergarten delivered in public schools while the other provinces provide only one year of kindergarten and/or only part-day. The amount and cost of child care available varies considerably by province. Finally, little research is conducted on ECEC policy and programmes within Canada, leaving researchers to draw on work that comes from other jurisdictions, despite differences in these contexts. To respond to these important gaps in ECEC knowledge, we advance a call for a research agenda to examine systematically the effects of policy instruments and settings in early years programmes.

Background

Over the past few decades, the formerly separate concepts of child care and early childhood education have blended into a single notion of early childhood education and care.[2] This shift results both from conceptual work, as well as international changes in the types of programmes available to children and families. A plethora of programmes fall under the ECEC rubric, however, with real distinctions between different types of programmes (see OECD, 2006, chapters 2 and 3) that can range from part-time custodial care of children to highly enriched, education-focused full-time programmes.

Starting in the 1960s, early child development (ECD) research began to challenge the then widely held view that babies and young children only really develop the capacity to learn around age six or seven, finding that children can learn more and at earlier ages (that is, before the age of compulsory school). Neuro-scientific research showed that children have critical periods early in their development. Because of these critical periods, the experiences of early childhood may have a profound impact on the overall health and well-being of individuals throughout their lifetime. The new view proposes that neural development is not fixed but rather is adaptive and so is modulated by early experiences. As a result of neural plasticity, achievement gaps in

development can occur well before children enter kindergarten or grade one. Negative early experiences, including exposure to adverse childhood experiences such as 'abuse, neglect, chronic poverty, family dysfunction, chronic illness, family addiction and/or mental illness' can lead in later life to 'poor mental health and unhealthy behaviours, such as addiction' (Boivin et al, 2012, 5). Early and prolonged activation of stress response systems, without supportive relationships to buffer damaging stress, can lead to permanent changes in neurological structures and hormones, permanently affecting children's brains (reporting on Boivin et al, 2012; Shonkoff et al, 2012). Not coincidentally, such research occurred at a time of rapid changes to family practices, and rapidly rising rates of maternal employment.

Beginning in the 1970s, longitudinal experimental studies in the United States demonstrated that specific early years interventions could overcome young children's gaps in cognitive and non-cognitive abilities. The three most widely cited are the Perry High Scope study (Schweinhart et al, 2005); the Carolina Abecedarian study (Ramey et al, 2000); and the Chicago Child-Parent Centers study (Reynolds et al, 2011; Temple and Reynolds, 2007). Taken together, they demonstrated that high quality early interventions had positive effects on vulnerable children's cognitive and non-cognitive measures, including short-term gains in IQ scores, better performance in school, higher high school completion rates and, in later years, higher incomes earned, fewer arrests, and higher rates of home ownership, higher rates of ownership of a second car, lower use of welfare and other social assistance, longer marriages, and fewer births outside marriage.

Amongst evidence-based policy-making experts, longitudinal experimental studies such as these three are the 'gold standard' in research. As a result, their findings carry great weight in the academic and policy community. However, their sample sizes were very small, they served very disadvantaged children and they offered supplementary services such as weekly home visits that went far beyond what is offered in 'run of the mill' child care or full-day kindergarten programmes. More recent larger and non-experimental cohort studies from the introduction of pre-school programmes in New Jersey, Georgia, New Mexico, and Oklahoma (Barnett et al, 2013; Bartik et al, 2012; Fitzpatrick, 2008; Frede et al, 2007; Gormley et al, 2005; Hustedt et al, 2010; Weiland and Yoshikawa, 2013) have found good programme effects, including better preparing children for school and increasing their chances of academic and economic success. These results hold for certain disadvantaged populations and, in the case of Oklahoma, for the broader population as well (Wat, 2010).[3] These American studies prioritise cognitive measures of school readiness, not a full scan of children's social and emotional development; in fact, Figlio and Roth (2009), Gormley et al (2011), and Magnuson et al (2007) report mixed findings on the impact of these programmes on socio-emotional and behavioural factors, although notably Magnuson et al (2007) found no adverse effects for programmes located in public schools.

Research from other countries has also found generally positive results from high quality early childhood interventions. In the UK, for example, researchers involved in the longitudinal Effective Provision of Pre-School Education Study (EPPE/EPPSE) with over 3000 children, found that children's cognitive and behavioural outcomes improved significantly if they attended a high quality pre-school, and that the effects were especially significant for children with poor home learning environments (Sylva et al, 2011). Bennett (2008) documented the educational benefits of early years programmes in Australia, France, Ireland, and New Zealand. In cross-national

assessments of student academic achievement at age 15, the OECD (2011) found a statistically significant relationship between children who attended a pre-school and their educational performance as teenagers on Programme for International Student Assessment (PISA) tests, even after controlling for socioeconomic background (OECD, 2011).[4]

Broader psychological effects beyond cognitive performance[5] such as on motivation, self-esteem, and self-discipline that help in high school completion, college attendance, and job retention have also been reported. Dynarski et al (2011) found that early childhood interventions even have positive effects on university attendance and degree completion. These programmes, researchers argue, help remove educational gaps based on class, income, and other vulnerabilities including race and ethnicity (Bassok et al, 2008; Fitzpatrick, 2008; Magnuson et al, 2007).

Economic research also began to quantify the effectiveness of ECEC spending. The US-based longitudinal studies generated a number of analyses that calculated rates of return on investment (Cunha and Heckman, 2007; Heckman, 2006; Heckman and Masterov, 2007; Heckman et al, 2010; Kilburn and Karoly, 2008; Lynch, 2004; 2007). These cost-benefit analyses consider the financial impact of prevention and early intervention against the costs of subsequent spending such as labour market training, social assistance, and criminal prosecutions, among other outcomes. Such studies, including re-analyses of early intervention studies (Heckman et al, 2010), find that early years investments yield major direct returns to society in terms of decreased costs in health care, social service use and delinquency.[6]

Other research tracks the economic effects of public ECEC investment on the caregiving workforce and parental employment, labour market gains and stimulation of maternal employment (Baker and Milligan, 2008; Lefebvre and Merrigan, 2008; Fairholm, 2010). Economic analyses of Quebec's 'natural experiment' have shown that the tax-transfer return the federal and Quebec governments receive from the programme 'significantly exceed' its costs (Fortin et al, 2012). Those studies of the tax gains from maternal employment are a good start in quantifying mothers' contribution to the paid labour market, but no study has developed a way to measure the gender equity benefits generated by ECEC programmes. Other economic research focuses on the functional requirements of investing in human capital development in an increasingly globalised and competitive economy.[7] Short-term economic returns from ECEC have also been calculated in studies drawing on input-output or multiplier analysis.[8]

As some researchers have pointed out, however (Baker, 2011; Penn and Lloyd, 2007; Prentice, 2007), generalising policy recommendations from small-scale specific studies is problematic. From a scientific perspective, it is difficult to claim we know 'for sure' that specific early years interventions will achieve all the claimed social and economic outcomes. Much of the research is US-based, and focused on overcoming deficits for disadvantaged populations, a cause of some controversy given the population demographics of the children studied. Moreover, as Lefebvre and Merrigan (2003, 12) point out, any interventions to improve child well-being are made in a familial and social context that includes the financial resources available to a family; time constraints; the parents' own human capital, psychological stability, and so on; the child's genetic endowment; government services available to families; and more.

Specific policy interventions

We use the term policy interventions to refer to laws, regulations, and other formal government actions. We reserve programmatic interventions to refer to actual services. While these two approaches to intervention are distinct, they are closely entwined. A scan of the research provides evidence of positive effects of some early years programmes, but less guidance as to the best broader policy interventions. Questions remain as to the type of intervention (child care centre, school-based kindergarten or pre-kindergarten, family child care, other early intervention programmes such as Head Start); the emphasis (quality versus quantity/access); delivery agent (public or private); universal or targeted to at-risk groups; and 'dosage' (kindergarten alone or pre-kindergarten as well; full-day or half-day programmes) that best support children's development. We briefly review the research evidence informing these questions.

Child care versus pre-school versus kindergarten?

In the USA, researchers often lump together child care, pre-school and Head Start programmes under the label 'pre-kindergarten' or 'pre-school' – even though these programmes vary in fundamental ways, such as their duration (for example, full versus part-time), availability (for example, targeted or universal), goals (caring for children while their parents work versus programmes that are intended to support children's development), and delivery agents (schools, centres or family homes) – along with very different levels of quality (Rigby et al, 2007; Sosinsky et al, 2007). In the USA, expansion of pre-kindergarten seems to be driven by a desire to improve children's school success (Bennett, 2005; Jensen, 2009). In some European countries, in contrast, 'pre-school' as a mechanism for school readiness does not exist. Rather, European governments tend to approach children's services systematically, with a focus on the whole child (Bennett, 2005; OECD, 2006, chapter 3). Thus, grouping these different programmes may not be appropriate. Moreover, inconsistencies in the use of terminology to describe heterogeneous ECEC programmes that serve diverse populations across countries further contributes to confusion in this area, making it difficult to draw conclusions about what works and for whom. Several examples of this are provided below.

Head Start programmes, for example, have been found to improve health outcomes and improve education outcomes in programmes that are relatively well-resourced (Currie and Neidell, 2007; Gormley et al, 2010). However, overall findings about longer lasting outcomes for children attending Head Start programmes are discouraging (Armor and Sousa, 2014). Other research reports that child care programmes (distinct from kindergarten or pre-school programmes) have positive cognitive effects. As the OECD notes in a review of the research evidence, 'the earlier a child entered centre or family day care, the stronger the positive effect on academic achievement at age 13' (2006, 253). Havnes and Mogstad's (2009) study of the introduction in 1976 of subsidised, universally accessible child care in Norway found that the programme had strong positive effects on children's later educational achievement and also reduced welfare dependency. They concluded the 'effect on education stems from children with low educated mothers, whereas most of the effect on labour market attachment and earnings relates to girls', suggesting that 'access to subsidised child care levels the playing field by increasing intergenerational mobility and closing the gender

wage gap' (Havnes and Mogstad, 2009, 3). In Quebec, Geoffroy et al (2010) in a longitudinal study of about 1,800 children showed that children from disadvantaged backgrounds who participated in formal child care earned higher scores on academic readiness and achievement tests at ages six and seven than did children cared for by a relative or nanny. In their longitudinal study, Peters et al (2010) found long-term positive outcomes in terms of school and social functioning among children from economically disadvantaged areas of Ontario who participated in a community-based, comprehensive, but highly heterogeneous early years programme (Better Beginnings, Better Futures).

One final example of heterogeneity in what is studied and how it is labelled is that Canadian Junior (and sometimes Senior) Kindergarten often overlap with what is referred to as pre-kindergarten in the USA. As a result of inconsistent and imprecise terminology, it is difficult to determine from the evidence whether research really prescribes full-day, school-based early childhood education *per se* or rather high quality, developmentally appropriate, enriched small group experiences more generally (Montie et al, 2006).[9]

Good quality or good quantity / access?

One crucial factor regularly overlooked by policy makers is that there is often an inverse relationship between quality and accessibility. The three most influential US studies included very specific treatments of very high quality (such as excellent child/staff ratios with trained teachers) that are not always replicated in other early years programmes (Baker, 2011). The same developmental benefits for children are unlikely to result from lower quality programmes. Yet, the sobering reality is that children in Canada and many other liberal market economies are in programmes of poor quality, characterised by weak regulation (Goelman et al, 2001). When reviewing the largely US-based evaluations of child-care programmes and developmental outcomes, policy makers need to take into account that in the USA, 'about 90% of child-care services are privately operated centres or family child-care homes, and more than half of these operate for profit' (Neuman, 2005, 137). Many American child care centres operate with no federal regulations regarding quality, and with great variation in state regulations. Faith-based service providers in some states are not subject to regulation and the same is true for some part-day and family child-care providers (Kagan and Rigby, 2003, cited by Neuman, 2005, 137). Children in the USA also tend to spend long hours in programmes from a very young age because of the absence of well-compensated or paid parental leave (Capizzano and Adams, 2000).

While higher parent fees do not always equate with better quality, relationships have been reported between higher staff wages and higher quality (Scarr et al, 1994), as well as better educated staff (who are generally also better paid) providing higher quality care (Fukkink and Lont, 2007). To ensure wider access to programmes, quality is sometimes sacrificed to increase quantity. Recent research on Quebec's $7-per-day child-care policy has found the province's efforts to expand access to affordable child care led to the sacrifice of quality (Drouin et al, 2004; Japel et al, 2005; Japel, 2008). Indeed, the Baker et al (2008) study that found negative behavioural effects amongst the general cohort of children in Quebec after the introduction of $5-per-day child care could have simply been an artefact of the fact that much of the care in Quebec is not of high quality. Although the positive early childhood development benefits

for children are predicated on very high quality programmes, many initiatives that roll out mass services fail to replicate these conditions.

What *is* emphasised in the research is that quality matters to positive developmental outcomes (Belsky et al, 2007; Love et al, 2003; Sosinsky et al, 2007; Sylva et al, 2011). Research demonstrates that low quality programmes may lead to negative developmental outcomes (Herbst and Tekin, 2010); conversely, high quality programmes benefit children developmentally (Peisner-Feinberg et al, 2001; Japel, 2008).

Public or private delivery agent?

Quality differences are seen across private for-profit, private not-for-profit, and public services (Sosinsky et al, 2007). While some for-profit programmes provide good quality care, overall, public and not-for profit services tend to earn better quality scores (Cleveland and Krahinsky, 2009) and systemic differences between for-profit and not-for-profit child-care programmes have been found (Mitchell, 2002; Morris and Helburn, 2000; Sosinsky et al, 2007). Pre-school services in a number of US states, the UK and Australia are largely contracted to for-profit and community-based services and are not delivered in schools (White and Friendly, 2012). Those services have been found to be of varying quality. Magnuson et al (2007) found, however, that some of the negative behavioural effects of full-day programmes on young children (Baker et al, 2008; Loeb et al, 2007) did not manifest in children in pre-schools located in public schools.

Universal or targeted?

No consensus exists either as to whether the research on positive cognitive and behavioural benefits prescribes early learning experiences for all children, or whether the benefits are experienced mainly by disadvantaged children. It is intriguing that policy makers draw on the same evidence base in making completely different recommendations. For example, in Canada the evidence has been used to argue for universal Junior and Senior, full-day kindergarten (see the 2009 Pascal report for an example), while in the USA researchers have recently called for targeted intervention through the Strong Start for America's Children Act (HR 3461). Doherty (2007) recommends a universal model of programme delivery, noting that income levels alone do not predict whether children are at risk. McLaren and McIntyre (2013) propose that universal care is essential to moving beyond the remedial approach of mitigating child vulnerability.

In contrast, according to Baker (2011), the evidence base for targeted child care is stronger (given the power of randomised experiments), sizeable in quantity, and with generally sustained positive effects; the evidence base for universal child-care, by contrast, is smaller, methodologically weak, and mixed in its findings. Baker (2011) uses a national Canadian data set to argue that while a substantial proportion of children who are not from low socioeconomic status (SES) backgrounds exhibit vulnerabilities at school entry, over time children from more affluent environments appear to get the support they need to overcome these vulnerabilities. This might suggest that interventions should target those children whose challenges tend to remain more stable (that is, children of low socioeconomic status). However, extending this logic

to older children might lead to the unpalatable conclusion that public schooling should only be provided to children from low SES backgrounds, as higher SES parents might find a way to provide their children with a good education even if it were not publicly funded. It is unlikely that such an approach would gain traction, leaving us to wonder why it is considered in the context of ECEC. Doherty (2007) and McLaren and McIntyre (2013) have argued that targeted and universal child care differ fundamentally in key respects. The logic of the intervention varies: universal child-care supports all children and families, whereas targeted child care, through its focus on vulnerable groups, is remedial in nature.

Number of years of kindergarten / preschool?

The OECD (2011) PISA is one of the rare studies directly addressing the number of years of early learning that are beneficial. It finds that children in many OECD countries do better on cross-national educational assessments at age 15 if they have attended more than one year of pre-primary school. The OECD (2011, 3) reports that overall, 'the relationship between attending pre-primary school and better student performance at age 15 is strongest in school systems that offer pre-primary education to a larger proportion of the student population, that do so over a longer period of time, that have a smaller pupil-to-teacher ratios in pre-primary school and that invest more per child at the pre-primary level of education'.

Domitrovich et al (2013) also find in their examination of a public pre-school programme benefitting primarily low-income children in Harrisburg, Pennsylvania, that a second year of pre-school led to improvements in children's early literacy and numeracy skills. However, this is just one study carried out in a specific location. As Yoshikawa et al (2013, 5) highlight in their review of research evidence, no studies have yet been done that randomly assign students to one year or more years of pre-school. Some studies cited in Yoshikawa et al (2013, 18) find less of an impact of additional years of pre-school, with some speculation that the diminishing effects may be related to children being exposed to the same curriculum. Clearly, much more research into treatment effects on various populations is needed.

Full day or half-day?

Finally, the evidence is not clear as to the benefits of length of treatment per day; that is, full-day versus half-day programmes. Nawrotzki et al (2004, 163) note the largely political decisions that originally drove the choice regarding programme length. In the USA, public school boards began to add kindergarten programmes in the early twentieth century, usually on a half-day basis, to accommodate large numbers of children. The drive for full-day programmes by the 1980s in the USA coincided with mothers' increased employment (Nawrotzki et al, 2004, 164).

Often the research basis to justify the length of programme day is not specifically addressed in the literature, and is rarely explicitly scrutinised when observing developmental outcomes. Wong et al's (2008) five-state review of pre-school programmes, for example, includes two states with mandatory full-day kindergarten (South Carolina and West Virginia), one state (Oklahoma) where full-day kindergarten will only become mandatory by 2013–2014, and two states (Michigan and New Jersey) where kindergarten attendance is voluntary and offered either on a part-day or full-day

basis (Barnett et al, 2012; Children's Defense Fund, 2013; Education Commission of the States, 2013). State analyses as to effectiveness have included both half-day programmes (California, Georgia, New Mexico, Virginia) and full-day programmes (Arkansas, Louisiana, New Jersey (for disadvantaged children), Tennessee) (Barnett et al, 2013; Huang et al, 2012; Hustedt et al, 2010; Jung et al, 2013; Lipsey et al, 2011; Peisner-Feinberg, 2013; Wat, 2010). Of the three major US longitudinal studies, only one – the Carolina Abecedarian study – was a full-day programme. The Perry Pre-school and Chicago programmes, as well as Head Start, were part-day programmes (Jepsen et al, 2009, ii). Thus, the controlled experiment research base provides little direct guidance on the appropriate 'dose' of ECEC service that will maximise children's developmental gains, and reveals that the evidence base for the wholesale adoption of the full-day, school-based kindergarten model is not yet conclusive.

Longitudinal research has found mixed results regarding the benefits of full-day versus half-day programmes. Chang and Singh (2008), in their analysis of US kindergarten performance, report more positive results on reading and maths in first grade for those children in full-day kindergarten. Gullo (2000) also found greater benefits from full-day programmes based on a comparison of second-graders in a Midwestern school district, half of whom had been in full-day and half of whom had been in part-day kindergarten. Lee et al (2006), Schroeder (2007), and Zvoch et al (2008) all report positive results of full-day kindergarten.

Cannon et al (2006, 299), in contrast, determined that the initial benefits observed largely disappear by third grade. According to DeCicca (2005, 67), full-day programmes have positive impacts on academic achievement, but the gains are short-lived, particularly for minority children. Sylva et al (2010, 218) found that there was little difference in the performance of children in half-day or full-day programmes in the longitudinal EPPE study in the UK. Early results of the study of full-day early learning in the Peel region of Ontario found positive effects on children's learning after expansion to full-day (Pelletier, 2012), but programme implementation is too recent to observe effects over time.

Perhaps the strongest evidence comes from a meta-analysis by Cooper et al (2010), which found an immediate positive association between length of the pre-school day and academic achievement that faded away by grade three. Only one study in this 40-study meta-analysis (Elicker and Mathur, 1997) involved randomly assigning children to full- versus part-day programmes. Since improving child outcomes is a central justification for investing in full-day kindergarten, it is troubling to see how weak the evidence is in support of full-day kindergarten as an intervention for improving such outcomes.

Conclusion

This overview lays out a paradox for proponents of evidence-based policy making, with respect to both policy making as well as research. Whereas in many domains, researchers struggle to persuade decision makers that their evidence merits public policy uptake, the ECEC field appears to invert the relationship: programme and policy changes are occurring, despite an incomplete and sometimes inconclusive evidence base. As we have noted, in many liberal welfare states, including many US states and Canadian provinces, significant ECEC initiatives are actively under way. These initiatives regularly claim to be harnessing the child gains and social returns

documented by research. Yet a closer reading of the evidence base reveals that a number of key questions remain outstanding.

That beneficial child development gains, as well as positive social and economic returns, can be generated through ECEC services seems indisputable. Despite this confidence, it is important to ensure that policy and programmes maximise the possibilities for children. Furthermore, there is mounting evidence that some impacts of ECEC tend to diminish over time. This suggests that simply delivering a year or two of ECEC programmes is likely not to be the 'silver bullet' hoped for. Programmes that involve longer term support or 'boosters' may be needed to support child development and to reduce long term achievement gaps between different populations of children. In this respect, it is troubling that there is so little concrete evidence about the key variables of type of care, length of care, delivery agent, 'dosage' and more.

This overview further highlights a research paradox. While it is widely recognised that research is essential for moving the ECEC field forward, the research available is woefully limited, leaving many of the key questions discussed in this paper unanswered in many countries, the USA and Canada in particular (Cleveland et al, 2003; ECDC, 2014). The OECD has stressed the importance of information collection, policy making, research, monitoring and evaluation in the early childhood field. Two of the eight policy lessons for effective ECEC policy developed through its first multi-country thematic review (OECD, 2001) address research. Three years later the OECD (2006) reiterated the importance of research, observing that independent monitoring and evaluation agencies, a research council, and a monitoring and/or statistical unit were among the preconditions for ensuring quality ECEC services. Pointedly, Bennett (2007, 17) has observed that 'there is a need in many countries to have a national research council or research association to organise early childhood research, and improve links between research, policy and practice'. Many countries lack the independent agencies, the research councils, and the national research associations urged by the OECD. Such lack of investment in research is puzzling as, without a strong evidence base, it is obviously not possible to make informed policy decisions.

Like many others (for example, Cooper et al, 2010), we highlight the need for random control trials (RCTs) to address some of the key outstanding research questions posed in this paper. While RCTs are not a panacea that will solve all of the limitations in the literature identified in this paper (for example, they can be based on samples of limited generalisability and test programmes that are not easily scalable), observational studies alone will leave us no better off than we are today. The ethical issues of who received what treatment need to be considered cautiously as use of RCTs increases in the field of ECEC. The evaluation of new policy initiatives that need to be rolled out due to capacity constraints, or where resources are limited so that not all eligible participants can receive the service, provide a unique opportunity to carry out such research. For example, in Canada, the Ontario Ministry of Education could have built a random control trial into its five-year rollout of the province's full-day kindergarten programme (Ontario Ministry of Education, 2014). Regrettably, this did not happen over the implementation period, making it much harder to assess what, if any, impact it has on children.

In addition to RCTs, we need large samples of children studied over long periods of time, as longitudinal data allow the use of a person's own earlier score as a control for the impact of exposure to different environmental influences. One way to make such research feasible is to use administrative data to test key research questions. However,

at the moment in many places, including Ontario, there is no way to track individual children in order to test the interplay between their family characteristics, access to services and well-being (see ECDC, 2014 for a discussion of this issue in the USA). Here we call on government to find solutions to the very legitimate concerns about privacy in order to facilitate such research.

In conclusion, there are substantial gaps in what we know about ECEC programme investment. Strengthening the ECEC research infrastructure and its methodologies will go a long way to ensure we have the evidence we need to wisely spend public resources in support of children and families.

Notes

[1] Studies that have reviewed or compiled the research on aspects of early child development, early childhood education, and child care include Almond and Currie (2010); Bennett (2008); Bowman et al (2001); Camilli et al (2010); Goelman et al (2008); OECD (2006, especially chapter 9 and Annex D); Pascal (2009a; 2009b); Ruhm and Waldfogel (2011); Shonkoff and Phillips (2000); and Waldfogel (2007).

[2] The term 'early childhood education and care' began to appear in the literature in the mid- to late-1990s and was popularised by the OECD *Starting Strong* studies (OECD 2001; 2006).

[3] Magnuson et al (2007), Cascio (2009), and Wong et al (2008) all find positive effects in their multi-state analyses as well, although with variation in their findings based on population (disadvantaged or not). Camilli et al's (2010) meta-analysis confirms positive effects of preschool education, although with some diminishment (although not disappearance) of effects over time.

[4] A similar relationship between a country's public expenditures on public pre-school and fourth grade maths and science are observed via TIMSS (Trends in International Mathematics and Science Study) assessments. See Waldfogel and Zhai (2008).

[5] Some studies have found 'fade out' effects of early interventions such as Head Start on cognitive measures such as test scores in later years (Lowenstein, 2011).

[6] For a review of findings of a number of interventions in the USA see Prentice (2007) and Reynolds et al (2010).

[7] For example, Esping-Andersen (2002), although see Green (2007) for a critique of the redistributive potential of human capital development policies and programmes.

[8] Input-output, or 'multiplier' studies, have been conducted in the USA and Canada. For an American overview, see Warner and Liu (2006). For a Canadian summary, see Prentice (2007).

[9] Another big debate outside the scope of our review is the quality of centre-based versus home-based programmes. See, for example, Forry et al (2013).

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