University of South Australia

Rapid review of the literature and results of an academic pulse survey to determine the evidence behind pre-school for 3-year-old children.

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ABBREVIATIONS

Australian Early Development Census	AEDC
Child-Parent Centres	CPC
Early childhood education and care	ECEC
Early Childhood Environment Rating Scale-Extension	ECERS-E
Early Childhood Environment Rating Scale- Revised	ECERS-R
Effective Provision of Preschool Education	EPPE
Executive Function	EF
Fostering Effective Early Learning	FEEL
Head Start Impact Study	HSIS
Longitudinal Study of Australian Children	LSAC
National Assessment Program- Literacy and Numeracy	NAPLAN
Out of school hours care	OSHC
People's Democratic Republic	PDR
Professional Development	PD
Randomised Control Trial	RCT
Socioeconomic status	SES
Self-Regulation	SR

INTRODUCTION

This report has been commissioned by the Royal Commission into Early Childhood Education and Care (ECEC) in South Australia. The Commission, established on 16 October 2022, is an opportunity to propose new solutions and provide advice to the government on delivering a high-quality early years system that is fit for the children of South Australia. Broadly, the Royal Commission is inquiring into:

- The extent to which South Australian families are supported in the first 1000 days of a child's life, focused on opportunities to further leverage early childhood education and care to enable equitable and improved outcomes for South Australian children;
- How universal quality preschool programs for 3- and 4-year-old children can be delivered in South Australia, including addressing considerations of accessibility, affordability, quality and how to achieve universality for both age cohorts. Consideration of universal 3-year-old preschool should be undertaken with a view to achieving this, commencing in 2026;
- How all families can have access to out of school hours care (OSHC) at both preschool and primary school ages, including considerations of accessibility in all parts of the state, affordability, and quality in public and private settings.

In conducting its inquiry, the Royal Commission has been tasked to hear the voices of parents and caregivers from diverse backgrounds, experts in early childhood development, service providers in the first 1000 days, leaders of early childhood education and care services, relevant unions, and providers of OSHC.

Within this broader remit, the University of South Australia has been commissioned to (A) undertake a rapid literature review to help inform the Commission's knowledge of the existing scientific literature with a tight focus on the impact of 3-year-old preschool on developmental and learning outcomes, and (B) to conduct a survey of academic experts in the field to gather insights into what is established (known and not known) regarding ECEC implementation considerations to support child developmental outcomes. As such, this report will provide much of the evidence from the academic sector.

As background, the scientific literature into the importance of early child development for later academic success, health and wellbeing is extensive. Indeed, human development economists view early childhood as the most cost-effective time in life to invest in social services for future economic returns. As such, countries around the world are increasingly investing in ECEC. The intent behind such government investment is twofold; it not only serves to support early child development, but also to facilitate increased workforce participation of young parents. Interestingly, although the evidence for the latter is strong (i.e., increased workforce participation) (European Commission 2022), the strength of the evidence for the former (enhancing child development) is not so clear cut, especially when it comes to preschool provision for 3-year-old children.

Early childhood is a period of rapid growth and development, with the average child at 4 years of age showing vastly different development than a child at 3 years (note Appendix 1: Developmental Milestones). Further, children during these ages are characterised by a wide spectrum of variation in development. Consequently, the needs of children at different ages and stages during these years change as they grow from being highly dependent on adults to becoming active participants.

Understanding and responding to these differences is essential to create optimal development and learning opportunities. Many international and national ECEC services work with mixed age groupings, requiring educators and carers to offer flexible spaces, differentiated experiences, and a different mix of pedagogical approaches. Our review has aimed to focus specifically on ECEC for 3-year-old children, however understanding that many ECEC services are multi-age spanning, we also draw on the broader literature.

Much of the attention in preschool by policy makers has been driven by experimental evidence from two key interventions delivered in the 1960s and 1970s in the USA. Known as the Perry Preschool Program and the Abecedarian Program, the impact of these two interventions have been studied in depth, with children followed into adulthood, allowing for calculation of long-term returns as a result of the initial investment. Amongst other positive long-term outcomes, the children randomised to participate in these programs, showed improved academic outcomes in school, better health and wellbeing, lower levels of criminal activity and increased earnings compared to the children who did not participate. When compared to other social investments, early childhood interventions provided the strongest returns as evidenced by these studies. However, it is important to place these studies into context. These studies were small and undertaken decades ago in selected disadvantaged neighbourhoods, and despite the hope, no larger or more recent studies in western countries have been able to replicate the magnitude of impacts found.

More recent quasi-experimental evidence has been garnered through evaluations of Head Start in the United States. The results from these various studies have been inconsistent and somewhat disappointing, however early Head Start results were often based on small sample sizes, a lack of full randomisation and sample attrition (Garces, Thomas et al. 2002). Discordant findings across studies have been postulated to be the result of variations in study design, outcome measures, reference groups and control variables, thus requiring further research to clarify the nature of the effects (Molloy, Quinn et al. 2019, Lee, Nakamura et al. 2022). These issues highlight the difficulties associated with research in the field and the complexities policy makers face when aiming to interpret research findings.

This report provides the Commission with an up-to-date review of the most recent literature and surveys active eminent academics from across the world to determine their current views on the status of the evidence. As such, this report attempts to summarise what is known and not known and identify where further research is needed. We hope that this report will help to guide the Commission as to where policy recommendations can be made with confidence and where caution may be warranted. Further, we highlight South Australia's unique opportunity to contribute important evidence through quality monitoring and evaluation of any changes in future service delivery.

LITERATURE REVIEW

The aim of the literature review was to extract high quality research evidence behind the provision of ECEC to 3-year-old children with a focus on preschool provision. Specifically, we were asked to evidence the quantifiable impact of ECEC on child development and early skill formation, with a focus on the:

- evidence in relation to 3-year-old ECEC (e.g., optimum dosage, modality), but also
- including evidence about 4-year-old ECEC (e.g., optimum dosage etc.) where relevant.

Within science there is a hierarchy of evidence with some studies being of higher quality than others. Initially we aimed to limit our review to meta-analyses, systematic reviews or randomised controlled trials (RCT), however due to the limited number of such studies in the field for 3-year-old children specifically, we ended up additionally including general reviews and lower quality studies to provide a broader overview.

Throughout the report we have specifically noted the quality of the source according to the hierarchy of evidence for policy as depicted in Figure 1 below. Further, although there are many types of evaluations, here, we concentrated our attention to outcome evaluations (refer to Figure 2).

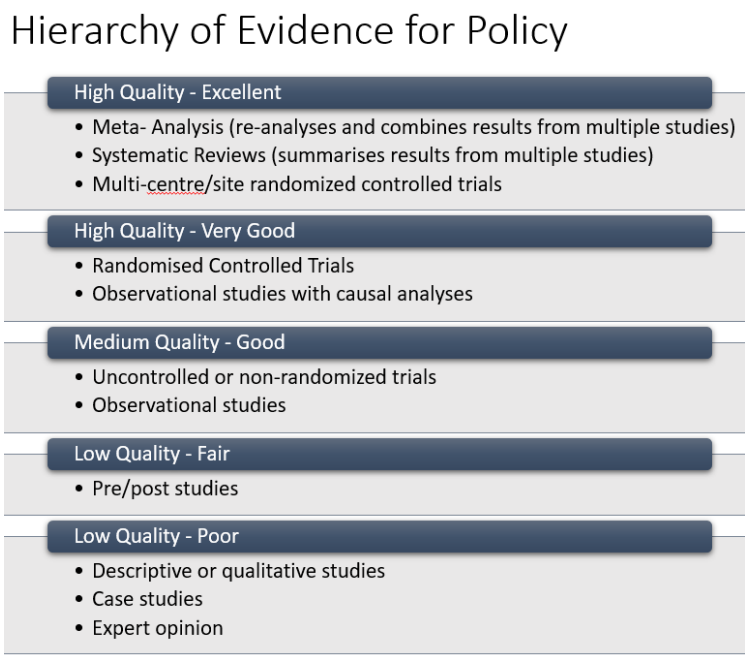

Figure 1: Hierarchy of Evidence for Policy

Evidence from randomised control trials (RCT) began as being classified as high-quality and observational studies as medium to low-quality evidence with quality downgraded as a result of limitations in study design or implementation, imprecision of estimates (wide confidence intervals), variability in results, indirectness of evidence, or publication bias. Quality was upgraded because of a very large magnitude of effect, a dose-response gradient, and if all plausible biases were taken into account. Qualitative research was excluded from the literature review due to both time constraints and a desire to limit the review to quantifiable evidence of impact on child development outcomes.

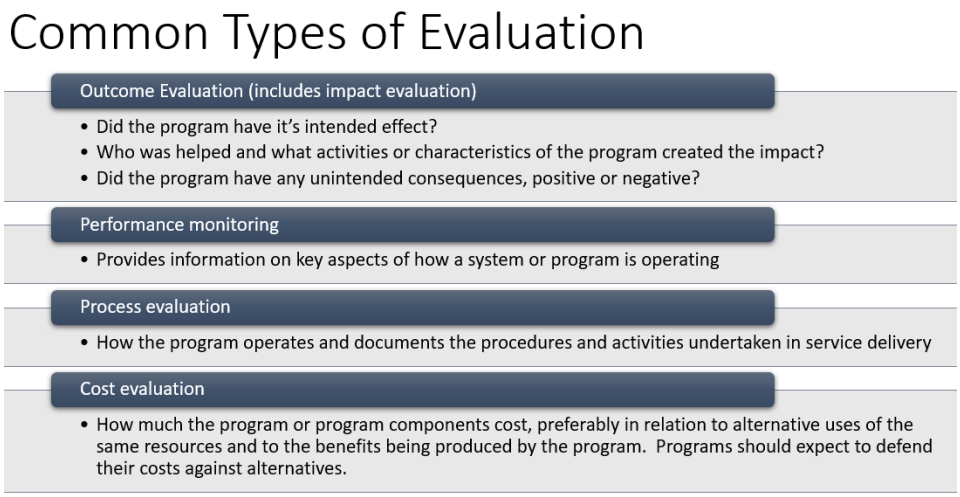

Figure 2: Common Types of Evaluation

As mentioned above, we initially restricted our literature review to high-quality evidence, however ended up broadening the inclusion criteria. As such we essentially undertook two separate reviews. The first we have called Part A which was restricted to the high-quality evidence specifically for 3-year-old children, and then Part B included wider parameters in terms of age and evidence quality. Within each of the topic sections in Part B, we give an overview of the literature and then provide a brief overview of the evidence where we draw on literature from both Part A and Part B.

PART A: HIGH QUALITY LITERATURE REVIEW STRATEGY

The literature review was formulated using PICO: Population, Intervention, Context, Outcome (Tufanaru, Munn et al. 2020), i.e. What interventions (I) across the range of early childhood settings (C) have been shown to be effective (O) for 3-year-old children (P). The search was conducted using variations of the following search terms shown in Table 1 below:

Table 1: Search Term Strategy and Parameters for Literature Reviews Part A and B

Search Term Strategy
Child* OR toddler OR boy OR girl AND 3-year-old OR three year old AND kindergarten*OR preschool* OR childcare OR playgroup* OR ECE OR "early childhood education*" AND learning OR development OR well-being OR education* AND outcome* OR development* AND intervention* OR program* OR approach*
Search Parameters
Target population: Children aged 2-3 years Geographical contexts: International Context: interventions in any setting including health, welfare and education, Language: published in English Part A was limited to Randomized Control Trials, Systematic Reviews or Meta-analyses

Additional inclusion/exclusion criteria were applied as follows:

- limit to typically developing children,
- published in last 10 years to ensure currency of research/practice and
- interventions focused on teacher improvements excluded.

The literature review was conducted between the 24th of October and 27th of November 2022, and searched common databases including Pubmed, ERIC, Cochrane, Campbell, Scopus, Google Scholar and the World Bank (Table 2). Full details of the searches conducted, and the subsequent results, are provided in APPENDIX 2: SEARCH CRITERIA.

Table 2, Summary results from database searches

Database	Results	Full text read
PubMed	431	71
Eric	53	5
Cochrane	1051	0
Scopus	582	36
Google Scholar	1061	5
Campbell	1	0
World Bank	3	2
Total (after removal of duplicates)	3182	119

A targeted search of the grey literature was also conducted which included the Chicago School of Economics, UN Library databases, GPE library, ECDtf list server. Based on the above search criteria, 119 full-text articles were obtained which were read. Following this, a further 106 papers did not meet the inclusion/exclusion criteria, leaving in 13 papers**,** details of which are summarised in APPENDIX 3. SUMMARY OF STUDIES FOUND BASED ON SEARCH CRITERIA.

Lastly, participants in the academic survey (Part C) were asked to contribute any references to papers or reports that they thought would be useful to consider within this review.

In summary, these searches provided evidence for a range of studies that had been conducted for 3-year-old children, usually in an early learning centre. Outcomes of interest from both search approaches related to the main themes: healthy lifestyle interventions (8 papers), school readiness (1 paper), socioemotional development (1 paper), childcare characteristics (1 paper), access (1 paper), and implementation modality (1 paper). For each section below we have differentiated between those high-quality research design papers that came up through our search criteria.

PART A: HIGH QUALITY LITERATURE SURVEY RESULTS

Thirteen papers were identified based upon our literature search (Appendix 3).

The highest quality papers pertained to a healthy lifestyle with eight randomised control trials (RCTs). These articles included programs that aimed to increase the amount of physical activity (Morgan, Grounds et al., 2022; Toussaint, Streppel et al. 2020; and Okely, Stanley et al. 2020), and healthy eating (Fernandez-Rao, Hurley et al. 2014, Iaia, Pasini et al. 2017, Nekitsing, Blundell-Birtill et al. 2019). A couple of papers also combined healthy eating and physical activity interventions and measured the impact on children's lifestyle (Alhassan, St Laurent et al. 2019, Toussaint, Streppel et al. 2021).

A single RCT related to the impact of ECEC on school readiness (Cuder, Vidoz et al. 2022). Their paper explored the impact of numerical training on 3.5-year-old children's mathematical ability. They demonstrated a significant improvement in maths ability for those who engaged in the training.

One RCT related to the topic of socioemotional skills (Solomon, Plamondon et al. 2018). The authors reported that their teacher directed play-based activities to promote self-regulation in Canadian children positively and significantly impacted children with high levels of hyperactivity/inattention.

One paper concerned the characteristics of childcare settings. Landry, Zucker et al. (2014) used a RCT and noted that a responsive early childhood curriculum positively impacted the children's social competence, behaviour and self-regulation.

One high-quality paper was reported on the impacts of an intervention in terms of access to ECEC. Price, Mudiyanselage et al. (2022) RCT was conducted in an Australian context and observed the Impact of Nurse Home Visiting on the Use, Dose and Quality of Formal Childcare. Those parents in the intervention reported using ECEC to support their children's social development more frequently than the control group.

One paper on implementation modality was found. A study by Brinkman, Lam et al. (2022) used a RCT to examine the impacts of different intervention modalities for 2 year old children on child outcomes. No singular modality was deemed superior, however low-cost, well-designed implementations tended to be as successful as their more expensive counterpart. Overall, literature on modality testing is very limited.

PART B: BROADER LITERATURE REVIEW

In view of the limited number of papers yielded by our literature search which served to answer our research question, and considering the time constraints of our project, we conducted a rapid literature search incorporating snowballing with two objectives:

1. to provide a wider context of the important themes of relevance to 3-year-old preschool/care
2. highlight recent papers (last 5 years)[1] providing high quality evidence (RCT, systematic reviews, meta-analyses) regarding these themes summarised within 'the recent evidence'.

In the following section, we therefore provide a discussion of the major themes relevant to the evidence pertaining to provision of ECEC programs to 3-year-old children, of which the majority relates to research based broadly on preschool children (rather than for 3-year-old children specifically), as many studies aggregate data from children across the preschool age ranges (Warren, O'Connor et al. 2016) .

We will initially discuss research from the Australian context specifically, focusing on four reports that are highly relevant to our research question, before moving to a broader discussion of the research from international contexts.

PART B BROAD LITERATURE REVIEW RESULTS

Within this broad literature review, we first precis literature and data from Australian reports and studies. We do this to introduce the state of the existing scientific evidence available within our own country prior to the full literature review where we draw on international research. This international research section is broken down into the following headings Universal Service Provision, Targeted Service Provision, Disadvantage, Access, Quality, Participation, and Implementation Modality.

LITERATURE REVIEWS/REPORTS CONDUCTED BY AUSTRALIAN AUTHORS

In the recent years there have been four key reports reviewing preschool in Australia that are relevant to our own review:

(1) an Australian Institute of Health and Welfare (2015) report reviewed the relationship between ECEC attendance and child development outcomes in terms of quality and quantity.
(2) Fox and Geddes (2016) authored a report for the Mitchell Institute in 2016 aiming to consider the appropriateness and feasibility of designing and delivering a preschool program for all 3-year-old children within Australia's existing early education and care system;
(3) In 2016 the Australian Institute of Family Studies published a report by Warren, O'Connor, Smart and Edwards (2016) titled *A Critical Review of the Early Childhood Literature;* and
(4) more recently a report titled *Restacking the Odds, Early Childhood Education and Care* by Molloy, Quinn et al. (2019) provides an evidence-based review of indicators to assess quality,

[1] We emphasised papers from the last 5 years, due to the comprehensive review of the wider literature and evidence provided in Molloy, C., P. Quinn, C. Harrop, N. Perini and S. Goldfeld (2019). Early childhood education and care: An evidence based review of indicators to assess quality, quantity and particpation.

quantity and participation. This report reflects the current key policy level decisions to consider in any scale up of services. Here we provide a precis of each of these four reports.

The Australian Institute of Health and Welfare (2015) conducted a literature review on the elements of ECEC in terms of quality and quantity that contribute to best practice and improved child outcomes. The evidence was divided into terms of age: 0 to 3 years, and 3 years to school age. Included studies were published prior to 2016, involved any out-of-home model of ECEC, and provided evidence regarding program participation and developmental outcomes. Conclusions included that there was clear evidence on the importance of quality of ECEC, although the relative contribution of the different elements is unclear. Further research is required on the optimal intensity and duration of ECEC, although some research suggests that two-years of part-time ECEC attendance is most beneficial.

Fox and Geddes (2016) proposed that implementing "access to a universal preschool program can be an affordable, achievable, and effective way to achieve greater and more equitable outcomes for Australian children" (page 5). They suggested that within an Australian context, access to high-quality programs for the right amount of time will benefit all children, especially those who are the most disadvantaged. The authors suggested that providing two years of preschool (beginning at age 3) is currently an under-utilised opportunity to increase Australia's educational performance and long-term productivity. They recommended a minimum engagement of 15 hours for all children, with consideration of longer hours for highly vulnerable children. Employing highly skilled educators that deliver a learning program that is developmentally appropriate for 3-year-olds, is also crucial.

They summarised the research stating that:

- Engaging with ECEC for two years instead of one is beneficial for many children
- Disadvantaged children benefit the most from ECEC
- Low and medium-quality programs deliver very little short-or long-term impacts.
- Preschool improves cognitive, social, and emotional outcomes

Warren, O'Connor et al. (2016) provided an overarching summary of the current literature on early childhood literature in Australia and the current paradigm in the Australian context. Literature on the Australian context is highly limited, therefore international studies with high relevance and impact were chosen, with discussion of the implications on how they may influence the Australian context.

Within the Australian context, key issues discussed on the implementation of preschool, included the lack of uniformity of service across jurisdictions, the differing quality dependent on community and location (in particular, quality childcare service in rural areas can be near non-existent), the different implementation modalities including privately funded and government funded services, and finally, the increased attention on implementing a standardised framework (the National Quality Framework). Studies highlighting the benefits of ECEC in Australia are minimal, with only one notable longitudinal study, the Longitudinal Study of Australian Children, (LSAC). Within LSAC, association between preschool attendance and formal schooling outcomes as assessed through the National Assessment Program- Literacy and Numeracy (NAPLAN) at year 3 were found, in particular for those who were enrolled in high quality preschool programs with qualified teachers. However, analysis of the B cohort found limited evidence of benefit in school readiness when further risk factors were controlled for, suggesting that selection bias was strong. Of note, LSAC had little analysis of 3-year-old children thus conclusions could not be made for that age group.

The international selection of studies was predominantly from western societies, these included:

- Effective Provision of Preschool Education, United Kingdom

- Effective Preschool Provision in Northern Ireland
- Highscope Perry Preschool Study, USA
- Head Start Impact Study, USA
- The expansion of French preschool program
- The expansion of Norway preschool program
- Child-Parent Centre (CPC) Education Program, USA

Of these, a majority were conducted in the 1960's to 1970's which highly limits the generalisability to modern teaching practices and the current paradigm. Most of these studies also did not have 3-year-old preschool as a focus but included 3-year-old children in the target age range. Generally, the authors found that there was evidence for longitudinal benefit, however this was dependent on program quality, including dosage (recommending >30 hours per week), teacher qualifications, and student engagement. They also noted that parental practice was likely to play a big role in successful child development and this was inadequately adjusted for in many of these studies. Benefit was largely found for disadvantaged populations, with children from these backgrounds demonstrating more benefit from targeted programs. Universal programs were still found to be beneficial but generally less successful and more susceptible to fade-out in later years. Continued high quality schooling was highlighted as an important factor for sustained success. The authors noted that generalisability in the Australian context was limited, however the successful implementations all shared similar patterns of providing quality childcare.

More recently, Molloy, Quinn et al. (2019) conducted a comprehensive evidenced-based review of the indicators for assessment of early childhood education and care in terms of quality, quantity and participation. The review was organised around five key themes, of which early childhood education and care, and parenting programs were relevant to the current review, with a focus on interventions that were longitudinal, evidenced-based, ecological and had the potential to be targeted at the most disadvantaged children. The evidence for each theme was assessed in terms of quality (the effective delivery of interventions which are based on robust evidence and leading to positive outcomes), participation (are the interventions available to the targeted children and is participation at appropriate dosage levels?), and quantity (assessment of the availability of services to the targeted population). The report aimed to identify gaps in early childhood service provision in Australia, as a basis for a project testing preliminary indicators to guide the Restacking the Odds project, through examining the evidence behind 4 key questions:

1. Identifying the standards/quality elements which provide the greatest effect on child cognitive and non-cognitive outcomes;
2. Determining the optimal universal starting age, dosage and attendance duration to optimise cognitive and non-cognitive outcomes;
3. The optimal quantity for community ECEC;
4. Are the findings from the previous questions applicable to targeted provision for children from disadvantaged backgrounds?

The Restacking the Odds project aims to provide best-practice benchmark frameworks to reduce early childhood inequities and developmental outcomes.

The importance of quality in terms of the evidence linked to improved outcomes was highlighted. Best practice involved programs for 3–5-year-old children with an emphasis on the development of skills in literacy, numeracy, science and the environment, supported through a range of cultural and

theoretical approaches, as evidenced by projects such as EPPE. National and international quality rating systems (Classroom Assessment Scoring System PreK, and Early Childhood Environment Rating Scale- Revised (ECERS-R) provide an important standard for ensuring efficacious service development and provision.

Quality was assessed using the NQS, as defined by the Australian Children's Education and Care Quality Authority (ACECQA) and graded for effectiveness and overall ranking into one of 5 categories (supported, promising, mixed, not adequately addressed and not supported) (Table 3). Whist evidence in terms of systematic reviews, meta-analyses and large international trials was lacking for the direct impact of the environment-related factors on child cognitive and socioemotional outcomes, it was supportive of an impact from the three teaching related factors.

Table 3: Summary of the overall evidence for the 7 quality areas of the ACECQA framework (reproduced from Molloy, Quinn et al. (2019))

Quality Area	Cognitive & Academic	Social-Emotional
Teaching-related factors		
QA1- Educational program & practice	Supported	Supported
QA4- Staffing arrangements	Supported	Supported
QA5- Relationships with children	Supported	Supported
Environment-related factors		
QA2-Children's health & safety	Not adequately addressed in target evidence-based	Not adequately addressed in target evidence-based
QA3- Physical environment	Promising	Not adequately addressed in target evidence-based
QA6- Collaborative partnerships with families and communities	Promising	Promising
QA&- Leadership and service management	Promising	Not adequately addressed in target evidence-based

The evidence base for participation indicators in terms of starting age, program duration and program intensity, pertaining to 3-year-old children which form the focus of our study, are provided in

Table 4 and Table 5. Summary findings included that evidence varied across domains, with the strongest being for cognitive domains, for part-time programs of 2-3 years duration, with higher program dose and duration being linked to potential adverse socioemotional outcomes.

Table 4: Summary of the overall evidence for participation in universal care for 3-year-old children in terms of age, program duration and program dose (adapted from Molloy, Quinn et al. (2019))

Universal	Cognitive & Language	Academic	Social-Emotional
Starting Age			
2-3 years	Supported	Promising	Mixed
3-4 years	Promising	Promising	Not adequately addressed in target evidence-based
Program Duration			
1-2 years	Promising	Supported	Not adequately addressed in target evidence-based
2-3 years	Supported	Supported	Not supported
More than 3 years	Supported	Supported	Not supported
Program dose			
Part time	Supported	Supported	Not adequately addressed in target evidence-based
Full time (>15 hours)	Mixed	Not adequately addressed in target evidence-based	Not supported

Table 5: Summary of the overall evidence for participation in targeted care for 3-year-old children in terms of age, program duration and program dose (adapted from Molloy, Quinn et al. (2019))

Targeted	Cognitive & Language	Academic	Social-Emotional
Starting Age			
2-3 years	Not adequately addressed in target evidence-based	Supported	Not supported
3-4 years	Supported	Supported	Supported
Program Duration			
1-2 years	Supported	Supported	Supported
2-3 years	Not adequately addressed in target evidence-based	Not adequately addressed in target evidence-based	Not adequately addressed in target evidence-based
More than 3 years	Supported	Supported	Supported
Program dose			
Part time	Supported	Supported	Supported
Full time (>15 hours)	Supported	Supported	Supported

Targeted evidence mostly drew on US programs dating to the 1960s and 1970s, raising questions of applicability to Australian contexts, but suggested that the greatest benefit was for at-risk children starting full time (>15 hours per week) ECEC prior to 2 years of age.

RELEVANT AUSTRALIAN RESEARCH RESULTS

Evidence of the impacts of early childhood education for 3-year-old children in Australian contexts is mixed and based on the limited number of studies, partly due to the relative lack of longitudinal datasets in Australia. Relevant studies dating prior to 2017 have been summarised by Warren, O'Connor et al. (2016). In a study from 2000, Raban-Bisby (2000), using data from the Preschool Literacy Project (PLP) which ran for three years in Victorian Preschools, found that participating children had higher scores in reading, writing and oral language skills at the end of their first year of primary school compared with their peers who did not participate in the PLP program. This advantage was found to persist at the end of the second year of primary school. Positive cognitive outcomes were also detected in a study by Boardman (2005), looking at whether literacy and numeracy outcomes in the first year of formal schooling varied according to whether children attended half or full-day kindergarten. Attendance at a full day program was associated with significantly higher reading, maths and overall scores. An advantage was also noted by Bowes and Wales (2009) for children in a range of care settings in New South Wales, where longer hours in informal care were associated with improved social behaviour, although more early hours in formal care showed negative cognitive outcomes.

A study by Warren and Haisken-DeNew (2013), using data from LSAC to examine the impact of preschool attendance of 4-and 5-year-old children on NAPLAN scores in Year 3, found that attendance at preschool was associated with an 10-15 point improvement in NAPLAN scores overall, particularly across the domains of Reading, Spelling and Numeracy. A relationship with preschool teacher qualifications was also noted, with the highest NAPLAN scores apparent for children who attended a preschool class where the teacher had diploma or degree qualifications. The authors furthermore explored causality by estimating the average treatment effect on treated (ATT) and average treatment effect on the untreated (ATU) with the latter being the estimated benefits if these children had attended ECEC. Whilst the ATT was significant only for Reading, Spelling and Numeracy in NAPLAN scores, for the children who did not attend (ATU), the treatment effect was significant and slightly greater across all domains, suggesting that these children would have benefited from preschool attendance.

Mixed evidence of cognitive outcomes was detected by Harrison, Ungerer et al. (2009) in a study using LSAC data. Four- and five-year-old children who participated in an early learning or preschool program had better language scores than non-attenders, although ECEC attendance, particularly for more than 30 hours per week, was associated with poorer vocabulary outcomes. Longer term outcomes were also examined using LSAC data in terms of cognitive and socioemotional outcomes, with stronger cognitive skills at preschool persisting through to middle childhood (Claessens 2009). Quality of the child:carer relationship was also noted to be more predictive of developmental outcomes at 4-5 and 6-7 years of age than qualification of the carer (Gialamas, Mittinty et al. 2014).

INTERNATIONAL RESEARCH

Seven main topic areas were highlighted by our review: Universal Service Provision, Targeted Service Provision, Disadvantage, Access, Quality, Participation, and Implementation Modality. For each of these sections we provide an overall context taken from the broader literature and then a section specific to the recent high-quality recent evidence generated through the literature review and free text survey responses.

UNIVERSAL SERVICE PROVISION

The Context

Exposure to ECEC is widely recognised for its positive role in enhancing school readiness (Pianta, Barnett et al. 2009, Duncan and Magnuson 2013, Phillips, Lipsey et al. 2017), with much of this grounded in evidence from model targeted programs from the 1960s and 1970s including Abecedarian and the Perry Preschool Study. In recognition of the importance of early childhood for development and the opportunity to ameliorate the effects of a range of biological and socio-economic impacts, universal childcare programs have been formalised through policy across a range of countries including France, Norway, the UK, Germany, countries from the Nordic region, Australia and some states of the USA (Cornelissen, Dustmann et al. 2018).

Indeed, various studies based on longitudinal cohort design have demonstrated at least short-term improvements in cognitive and non-cognitive outcomes from universal care (Siraj-Blatchford, Taggart et al. 2008, Administration for Children and Families 2012), with some evidence of these benefits being sustained into adolescence and early adulthood (Berlinski, Galiani et al. 2008, Leow, Wen et al. 2015, Ulferts and Anders 2016, Cornelissen, Dustmann et al. 2018). More commonly, however, longitudinal cross-sectional or cohort studies of large-scale programs have resulted in only small effect sizes and can demonstrate fade-out (Schweinhart, Montie et al. 2005, Frede, Jung et al. 2007, Barnett 2011, Puma, Bell et al. 2012). Other studies have found that initial gains from program participation tend to be modest and converge within the first few years of primary education, with the performance of children who did not attend ECEC programs (Duncan and Magnuson 2013, Bailey, Duncan et al. 2017, Abenavoli 2019, Barnett and Jung 2021). Experimental evaluation of universal programs is inherently difficult without the ability to evaluate a staggered approach to implementation and, as such, it is not surprising that there is mixed evidence regarding the benefits of universal programs. Furthermore, inconsistencies in study methodology, within study impacts of factors such as differential attrition, noncompliance and counterfactuals, and variation in the degree to which post preschool education supports the gains made during the preschool period can contribute to the apparent fade-out effects (Meloy, Gardner et al. 2019).

A recent review by Meloy, Gardner et al. (2019) sought to assess the impact of a range of universal and targeted programs in the US to clarify inconsistencies in the evidence. It demonstrated strong evidence for improved outcomes in cognitive outcomes following participation in high-quality ECEC programs. Positive improvements were noted in literacy (17 out of 18 studies) and numeracy (14 out of 16 studies) outcomes, but less commonly for language outcomes (8 out of 15 studies). The authors

suggest that the relative ease of measuring early literacy and numeracy as opposed to language skills, and greater influence of factors external to the ECEC program such as the home environment in language development, are likely to account for these results. When looking at persistence of positive effects from ECEC attendance into the primary years, however, the evidence was more variable. Whilst 6 out of 10 studies demonstrated a reduction in grade retention, there was less evidence supporting persistence of academic gains with only half of the studies showing persistence of literacy gains, and 3 of 7 showing continuing benefits in language skills. Evidence was stronger for numeracy skills with 10 of 13 studies showing persisting benefits in mathematics.

Recent Evidence

Understanding of the mechanisms behind these apparently contradictory findings has prompted further, more recent, studies into the potential determinants of long-term effects in large-scale studies. A meta-analysis of 30 studies examined the evidence for whether universal childcare in terms of a range of cognitive and non-cognitive outcomes demonstrates a relationship to economic and educational outcomes in adulthood (van Huizen and Plantenga 2018). The evidence supports high quality programs as the most critical factor for positive outcomes, with the greatest benefits seen for children from lower socio-economic backgrounds. The review provided some support for the benefit of participation in higher intensity programs and public over private programs, with starting age being relatively unimportant. A recent systematic review (Dietrichson, Lykke Kristiansen et al. 2020), sought to examine the long-term effects (third grade to adulthood) of universal ECEC attendance for children 0-6 years. Various models of care were included such as parental, family, and private care, in relation to outcomes including educational attainment and economic and employment gains. Twenty-six papers met the inclusion criteria, although no randomised control trials were identified in the review. Moderate beneficial effects were found for various long-term outcomes including educational attainment (school progression, years of schooling, tertiary degree completion), income and employment status. Mixed results were noted for shorter-term outcomes of health and well-being, and behaviour with variation between and within studies, few statistically significant results, and evidence of both positive and negative effects. Mixed results were also noted for short-term cognitive outcomes (standardised tests of science, maths and literacy) with positive and negative effects observed across studies. Children from lower SES backgrounds benefited more from universal programs than their higher SES peers (discussed below). Few studies were found comparing different types of preschool programs against long term outcomes and these did not permit any conclusions, thus further robust research is required in this area. Differences in outcomes was most likely due to variation in quality between studies in terms of the universal preschool program and the counterfactual program of care.

A recent quasi-experimental study by Barnett and Jung (2021) looked at long-term effects from the third to tenth grade as a result of the Abbott preschool program. Initial positive gains in language, literacy, numeracy and science were found to persist into grade 3 based on state-wide testing. Adolescents who had participated in ECEC were found to have less grade retention by Grade 10, compared with their peers who had not attended ECEC. Similarly, Pearman, Springer et al. (2020) conducted a quasi-experimental study of preschool children (N=806) in Tennessee transitioning through a universal pre-K program to school. Persistence of gains in numeracy and ELA to Grade 3 were dependent on high quality in the preschool environment in terms of both teacher skill and the centre.

Summary Findings

Data from meta-analyses, systematic reviews and quasi-experimental studies showed generally improved long term outcomes from attendance in a universal ECEC:

- beneficial effects were found for various long-term educational, income and employment outcomes;
- mixed results were noted for shorter-term cognitive and non-cognitive outcomes however various factors may be impacting on these results including methodological challenges, and lack of persisting educational supports into the primary years;
- universal programs that are high quality provide the greatest benefit;
- some support for higher intensity programs;
- children from lower SES backgrounds benefit more relative to their peers from universal programs;
- more research is needed comparing different program modalities as they relate to outcomes.

TARGETED SERVICE PROVISION

The Context

In comparison to universal care, evidence of the benefits of targeted programs in terms of long-term outcomes appears to be more consistent. Targeted programs are directed at children identified as likely to benefit from additional educational support, including communities with socio-economic disadvantage or children from minority communities. There is evidence of various positive long-term social, education and economic outcomes from programs such as Abecedarian, Head Start and the Perry Preschool Programs (Vandell, Belsky et al. 2010). Reported heterogeneity of effect size of these programs has nevertheless been reported. A 2013 meta-analysis of evaluations of Head Start, which included both RCT and quasi-experimental research designs, found a statistically significant overall effect size of 0.27 in the short term for cognitive and developmental outcomes (Shager, Schindler et al. 2013). Differences in research design factors and reports of effect size across papers was however noted to account for 41% of the variation between evaluation findings and 11% of the variation within evaluations. Similarly, a re-evaluation of the annual social rates of return for the Perry Preschool Program fell by 7-10% when compromises in the randomisation protocol were factored into the results (Heckman, Moon et al. 2010). Further data from the Children of the National Longitudinal Survey of Youth of 1979 for 2833 children from 3- to 5-years of age who participated in Head Start, demonstrated positive outcomes into early adolescence to adulthood (Baker, Gruber et al. 2008, Kottelenberg and Lehrer 2013, Carneiro and Ginja 2014, Baker, Gruber et al. 2019). Participation in the program was found to be associated with lasting positive effects including decreased behavioural problems, improved health outcomes, and decreased obesity rates amongst young male adolescents, lower depression and obesity rates in the mid-teen years, and decreased involvement in criminality in adulthood.

Targeted programs have been characterised by large economic investment and high structural and process quality elements such as small group sizes, high quality teaching, family engagement and ongoing support (Warren, O'Connor et al. 2016). There is some evidence from European contexts that the efficacy of targeted programs is improved through a multi-faceted approach in which there is, for example, involvement of parenting styles and the home environment (Ulferts and Anders 2016). Targeted programs tend to be more intensive and directed at populations with greater need, where there is the potential for greater gains for effective interventions (Warren et al 2016).

Disaggregated data from Head Start (Garces, Thomas et al. 2000, Deming 2009) allowed for assessment of the impacts of targeted care on 3-year-old children specifically. Sustained benefits were noted in terms of physical health, and parent report of positive parenting styles, social skills, and approaches to learning. By contrast, whilst language development improved initially for the intervention group, this had faded out based on assessments at the end of Grade 1. Similarly, although mathematics showed improvements by the end of the 3-year-old program year, parent report suggested a deterioration in skills by the end of kindergarten.

As with universal programs, the effects of fade-out have also been demonstrated for targeted programs including Head Start, EPPE and Perry Preschool, as children enter and progress through primary school (Schweinhart, Montie et al. 2005, Puma, Bell et al. 2012, Gibbs, Ludwig et al. 2013,

Kline and Walters 2016, Baker, Gruber et al. 2019). For example, early cognitive gains in literacy and numeracy for children in the Head Start program were found to have faded within 2 years of program participation (McKey, Condelli et al. 1985). In a RCT for the Head Start Impact Study (HSIS) involving 500 children, early small to moderate positive outcomes in some literacy and numeracy measures for 3- and 4-year-old children resulted in few statistically significant differences between the intervention and control groups by the end of Grade 1 (Puma, Bell et al. 2005). Proposed mechanisms underlying this included that initial positive outcomes from the preschool intervention lacked the strength to persist, or that subsequent education at the primary level failed to support and develop the earlier gains (Stipek 2018, Meloy, Gardner et al. 2019). Study design and the choice of comparison groups have also confounded interpretation of the results, with studies comparing outcomes of children attending preschool programs against non-attending but otherwise comparable children showing clear benefits in the former group (Meloy, Gardner et al. 2019).

Successful scaling up of intensive high-quality targeted programs has also proven elusive, due to a combination of factors including cost, lack of institutional commitment, and service fragmentation between ECEC and primary education (Reynolds, Hayakawa et al. 2017). Programs such as the Midwest Child-Parent Center Expansion has sought to address this through scale-up of high-quality preschool to 3rd grade program emphasising the principles of shared ownership, committed resources, and progress monitoring for improvement. Based on a quasi-experimental design, evaluation showed increased school readiness in terms of literacy and numeracy outcomes, particularly for full day attendance, compared against children attending business-as-usual childcare.

Recent Evidence

A systematic review (Lee, Kim et al. 2021) explored the treatment effect of participation in the Head Start program using HSIS data. Based on 28 studies, results demonstrated high heterogeneity in outcomes, although benefits across multiple outcomes were noted for various high-risk groups including children with lower baseline cognitive skills and poorer English language skills, children from minority backgrounds, and lower parental education levels. These effects decreased the level of disadvantage for these children compared with their peers. An emphasis in the studies was noted on cognitive and socioemotional outcomes, with less consideration of health and parenting effects. Average treatment effects were found to fade-out rapidly, although consistent long-term gains in terms of educational attainment, income potential, health status and lower rates of criminality were noted.

A recent RCT reviewed outcomes at Grade 3 for children (N=75) following participation in Educare, an ECEC program, compared with no participation (Horm, Jeon et al. 2022). Educare is based on Early Headstart/Headstart, but includes enhancements such as year-round, full day care taught by teachers with bachelor degrees, professional development (PD), ongoing evaluations and family support. The study found that medium to large effect sizes for academic outcomes persisting to Grade 3 for the intervention group, although executive function (EF) results were mixed, and no difference was found for social-emotional skills.

Summary Findings

Data from systematic reviews and longstanding RCTs showed generally improved outcomes from attendance in targeted ECEC for at-risk children:

- substantial evidence supports long term benefits (improved educational, economic and social outcomes in adulthood) from participation in targeted ECEC for at-risk children;
- evidence is strongest for cognitive gains from ECEC participation in high-quality programs;
- initial improvements in cognitive skills have tended to fade-out as children enter primary school, although recent data shows that following program enhancements around quality have yielded more persistent academic gains;
- Centre-based program provide evidence of improved outcomes when incorporated into multifaceted approaches which include parenting programs and home visits, teacher qualifications, and ongoing PD;
- The mixed results are at least partly explainable through factors including variation in evaluation methodology, intervention program quality across sites, and control group characteristics.

DISADVANTAGE

The Context

Various studies demonstrate that ECEC programs can have a significant and persisting impact on children from disadvantaged contexts above the gains observed for other children (Barnett 2011, Yoshikawa, Weiland et al. 2013, Stevens and English 2016). Participation for disadvantaged children can also provide a pivotal role in altering trajectories for children to break cycles of poverty, however these children are less to attend ECEC services (European Commission 2022). The importance and benefits of providing early childcare to children at-risk and from lower SE circumstances has been highlighted across numerous studies (Gormley and Gayer 2005, Havnes and Mogstad 2011, Kline and Walters 2016, Jenkins, Sabol et al. 2018). Head Start data demonstrated that the largest gaps in language outcomes from pre-Kindergarten to Grade 3 were apparent between children from low SES contexts and the control group. Data on cognitive outcomes for 3,571 children from the Head Start Impact Study found the greatest benefits amongst participants from disadvantaged contexts who would have otherwise attended another preschool program or no preschool program at all (Kline and Walters 2016).

Similar results have been noted in European contexts. Havnes and Mogstad (2011, 2015) examined adult outcomes using longitudinal linked cohort data for a sample of 3-to 6-year-old children following the large-scale expansion of subsided childcare in Norway. Higher educational outcomes and increased income in midlife were observed particularly for children with mothers of low education and low-income families respectively. Participating children from higher income families by contrast experienced a lower income by midlife, with the authors concluding less evidence for the benefits of providing subsidised childcare to middle- and higher-income families. Improvements in literacy at age 15 were also noted using a longitudinal linked cohort data following expansion of publicly subsidised high-quality childcare to 3-year-old children in Spain, primarily due to the improvements in scores of girls and children from disadvantaged backgrounds (Felfe, Nollenberger et al. 2015).

Research has shown that children from disadvantaged and minority backgrounds are less likely to attend childcare than children from advantaged backgrounds, but have larger treatment effects because of their worse outcome when not enrolled in childcare. Cornelissen, Dustmann et al. (2018) applied a marginal treatments effects framework to estimate the causal effect on school readiness outcomes for children following the expansion of a universal half day childcare program for 3-year-old children in Germany. Whilst late engagement with childcare resulted in minority children being 12 percentage points less likely to demonstrate school readiness compared to their peers, earlier childcare attendance virtually eliminated this gap. The research indicted however that the children who engage with childcare later were disproportionally from minority and disadvantaged backgrounds, although they were the most likely to derive the greatest benefit from earlier engagement. A further quasi-experimental study from the Netherlands (Leuven, Lindahl et al. 2010) found that additional months of ECEC for 4-year-old children improved language and numeracy scores for children from disadvantaged backgrounds by 6 and 5 percent of a standard deviation respectively at age 6 years, where no effect was noted for children from non-disadvantaged backgrounds.

Preschool programs at age 2 in France are preferentially targeted to at-risk children including those from lower SES and isolated communities, in contrast to the universal program offered to 3-year-old

children (Dumas and Lefranc 2010). Exposure to three years of preschool education was found to be more advantageous than two years, with grade repetitions decreasing by a further three percentage points at age 11 and 16 respectively, and secondary school completion increasing by four percentage points (Dumas and Lefranc 2010, Warren, O'Connor et al. 2016). Furthermore, analysis showed that the advantage from preschool differed across socio-economic strata, with children from higher SES contexts showing no advantage from preschool attendance in contrast to their peers from middle income and, more particularly, lower income contexts. Thus, preschool attendance in quality programs functioned as an important enabler to more disadvantaged children at a life stage with high potential to alter their future educational and social trajectories.

There is also evidence that children from other than the prevailing ethnic background are more likely to gain greater benefits from ECEC. A universal pre-K program directed at low-income children in Tulsa was analysed using a quasi-experimental design (Gormley and Gayer 2005). Hispanic children were found to have the greatest benefits in terms of cognitive, motor and language scores assessed at kindergarten, compared with their African-American peers, with no benefit found for white children. There is evidence that duration may be important for these children also, with potential to gain greater advantages from 2 years of exposure to kindergarten relative to their peers.

Using a difference-in-differences framework, Cascio and Schanzenbach (2014) detected substantial differences in outcomes based on SES of the children participating in a universal 4-year-old ECEC program in Georgia and Oklahoma in the US. Children from lower SES environments were found to have improved numeracy that persisted into 8th grade, whereas cognitive outcomes showed no impact for children from higher SES backgrounds. Proposed mechanisms for the change in scores for the former group included a changed status from non- attending to attending, increased engagement in early learning activities such as book sharing with their mothers, and greater likelihood of maternal employment.

To look at the relationship of disadvantage to time spent in preschool, a study by Arteaga, Humpage et al. (2014) used longitudinal data from 1539 children to investigate the effects of none, one or two years of participation in public preschool programs in low income neighbourhoods in Chicago, with 989 children attending a high-quality program targeted at low-income minority children. Assessed outcomes involved a range of cognitive and socioemotional outcomes. For children and adolescents these included literacy and numeracy at 8th grade, rates of special education placement by 12th grade, grade retention, record of child abuse or neglect or criminal justice involvement. Early adult outcomes (up to 24 years of age) included criminal justice involvement, educational attainment, health insurance coverage and socio-economic status. Results demonstrated an association between number of years of preschool attendance and long-term outcomes. Compared with those children who attended only one year, those that attended a two-year program had lower rates of reported criminal involvement, abuse or neglect and higher test scores. Of note, a second year of attendance did not impact on educational attainment, although positive effects on readiness for kindergarten were apparent. The effect size was also greatest and most statistically significant for children from households where the mother had failed to complete secondary school at the time the child participated in the 3-year-old program.

There is a relative lack of research into the impact of ECEC exposure on Indigenous children who may face various challenges in terms of reaching their educational and developmental potential. A longitudinal retrospective cohort study explored the relationship between ECEC type and

developmental outcomes at school entry based on data from the Australian Early Development Census (AEDC) (Falster, Hanly et al. 2021). Home-based care was associated with a higher chance of being vulnerable on at least one AEDC domain, however the magnitude of benefit of preschool attendance was shown to be relatively lower for Indigenous compared with non-Indigenous children. The latter provides evidence for the importance of enhancing ECEC programs specifically to address the needs of Indigenous children.

Recent Evidence

In their systematic review of the long-term effects of universal preschool on child outcomes for children 0-6 years of age, Dietrichson, Lykke Kristiansen et al. (2020) found that children from lower SES backgrounds who attended universal preschool programs showed improved outcomes in terms of test scores and grade, primary and secondary school progression, and employment/earnings, relative to their higher SES peers. No clear relationship was demonstrated for health/well-being and behavioural outcomes.

Goldfeld, Moreno-Betancur et al. (2021) study used an interventional effects experimental design based on linked LSAC data from 3651 children from lower SES backgrounds looking at the relationship between home reading at ages 2-5 years, preschool attendance at 4-5 years, and readings skills assessed through NAPLAN at 8-9 years of age. Both preschool attendance and home reading programs were shown to narrow the socioeconomic gap in reading skills for disadvantaged children by middle childhood.

A further systematic review (Lee, Kim et al. 2021) based on 28 evaluations of HSIS, found that outcomes varied across low-income subgroups. Thus, whilst positive effects were demonstrated for subgroups of children (lower baseline cognitive skills, girls, Spanish-speaking dual language learners (DLL), Hispanic and Black children, lower parental education levels, younger caregiver) results were mixed, with no clear pattern in outcomes from other low-income subgroups (children with special needs, lower SES backgrounds, single parent families, caregivers with depressive symptoms).

In a similar vein, a recent systematic review by Abenavoli (2019) examined the impact of sociodemographic and family risk factors (17 studies) on the persistence of ECEC outcomes. Stronger evidence of persisting impacts was noted for African American children compared with their white peers, and for children from lower SES backgrounds. Mixed results were noted based on 6 studies that considered child factors, such as those with special needs (mostly no impact), and high or low baseline skills. Certain subgroups of children therefore show persistence of positive outcomes more than others, although further research is needed to determine the relative influence of wider socio-economic and cultural influences on the degree of benefit of children's experiences of ECEC. The impact of counterfactual quality on persistence of gains (3 studies), provided somewhat mixed results, but with some indication that persistence of impacts may vary relative to counterfactual groups. Gains in early primary, for example, were more consistent when compared with non-attending children rather than those with other preschool experience.

A systematic review by Elek, Gubhaju et al. (2020), looked at 11 programs, evaluated through 12 experimental or quasi-experimental studies, in terms of their main characteristics, child outcomes and acceptability to their local community. The programs demonstrated positive but small impacts on outcomes. The need for the development and implementation of culturally sensitive and appropriate

programs with community engagement, evaluated through high quality experimental trials, was highlighted.

Summary Findings

Data from systematic reviews and longitudinal large-scale RCTs showed improved outcomes from attendance for disadvantaged children:

- Participation in ECEC for children from lower SES backgrounds is associated with improved short-term and long-term outcomes;
- Outcomes may differ across subgroups of children from lower SES backgrounds, with some groups (eg some minority groups, DLL) deriving greater benefits from ECEC;
- Children from lower SES backgrounds, although gaining more advantage overall from ECEC exposure, are less likely to participate than their higher SES peers;
- There is a need for further research into the development and evaluation of high-quality culturally sensitive ECEC programs for Indigenous children.

ACCESS

The Context

Access reflects the degree to which the community accesses available ECEC programs. Whether the community engages with ECEC support depends on several factors, including parental belief, family context, base availability of services and the broader socio-economic and resource context. The importance of access for ECEC participation has been highlighted by the 2019 European Union Council Recommendation on High-quality Early Childhood Education and Care Systems (European Commission 2022). Aside from quality, the inclusivity, accessibility, and affordability of ECEC comprise key themes to encourage participation through mechanisms including flexible opening hours, addressing territorial imbalances, cost and financial support, and the provision of online and offline information for families, and supportive infrastructure. Various factors have been highlighted in the literature as impacting on whether children access ECEC with a number of studies exploring Australian data.

A longitudinal study on child development followed 3- to 5-year-old Canadian children (N=151) (Roy-Vallières, Lachapelle et al. 2022), to track whether child engagement (defined as the quality of the child's involvement, focussed and sustained attention, and duration of quality interactions within the social and physical environment) changed over the two years the child participated in an ECEC program and what factors affected this change. The authors highlight that the SES of the child's family at age 5 was the only variable that predicted the transition from one engagement profile to the other. They demonstrated that children from more 'favourable' SES backgrounds were more likely to demonstrate high engagement by age 5 years. The authors propose that this could mean that child engagement is a distinct construct from ECEC quality, and that it operates according to characteristics that are more specific to children themselves.

Using LSAC data in a two-stage clustered sampling design from 3615 4- and 5-year old children, various factors were identified which were associated with decreased participation in preschool relative to homecare or long day-care (Wong, Harrison et al. 2014). These included the child having special health care needs, being from a language background other than English, being Aboriginal and/or Torres Strait Islander, in the lowest socio-economic quintile, the presence of maternal mental health conditions, or parental illicit drug or alcohol abuse. Furthermore, using a composite Disadvantage Index, increased number of risk factors for a given child was correlated with decreased preschool participation and increased exclusive parental care. The children at greatest risk were less likely to attend ECEC.

Over the last decade, the United Kingdom government has enacted policy aiming to close developmental gaps between higher and lower-income children by providing free part-time early education. Subsequently, using census data, researchers observed what factors contributed to 3-year-old children accessing the program (Campbell, Gambaro et al. 2018). The authors showed that one in five children did not access their free place from when they first became eligible, and the proportion of those not accessing education was much higher among children from families with persistently low incomes. They also showed that having English as an additional language, or being English-speaking and persistently poor, were both strong predictors of non-attendance. However, this effect was minimised when the authors looked at 'local' providers. When investigating these providers, the

results suggested that low-income households were more likely to place children in settings that had an increased flexibility, where they could enrol their child earlier than allowed in the universal system, and where the fees were lower for longer hours. Therefore, they propose that future iterations of the universal ECEC system should replicate the flexibility of these providers.

Similar trends are apparent in Australia. Although preschool attendance rates based on AEDC data from 2008 to 2014 show increasing uptake with time, with over 90% of children attending by 2014 (O'Connor, Gray et al. 2016, O'Connor, O'Connor et al. 2020), children from lower SES, Aboriginal and/or Torres Strait Islander and non-English speaking backgrounds are disproportionally less likely to attend. The importance of engaging with families from these communities to enhance childhood participation was stressed by the authors.

Furthermore, Beatson, Molloy et al. (2022) provide a comprehensive list of the barriers, facilitators, and strategies to improve participation in ECEC in an Australian context. The authors note that skilled staff, cultural inclusivity, information about the benefits of ECEC for families, knowing educators are professionally trained, ensuring that families feel educators understand their child(ren), and good communication about what is involved in the centre's services, are all facilitators to ECEC attendance. They note that direct and indirect costs of participation, parents not being aware of the benefits, families not knowing how to access services, and views about maternal roles and child readiness to attend are barriers to ECEC attendance.

Recent Evidence

In a RCT, Price and colleagues investigated whether nurse home visits affected the uptake of ECEC by children aged 2-3 years old within an Australian context (Price, Mudiyanselage et al. 2022). 772 pregnant Australian women experiencing adversity participated in the right@home initiative. For those in the intervention group, the initiative included an average of 23.2 home visits from nurses antenatally and 28% of visits were said to address childcare issues. Women in the control group received an average of 7.6 visits. During the visits issues such as dosage, access and quality of ECEC were discussed. The results highlight that following the intervention, more families used Long Day Care at 3 years (44%) than at 2 years (32%), while 13% used Formal Day Care at both ages. There was no statistical evidence that the intervention impacted the type or quality of ECEC used. Of parents who did engage with formal ECEC, more intervention parents reported using it for their child's social development, whereas control parents used it to assist with their work or study commitments or to have a break. The authors note that the uses of formal ECEC was comparable to national data and concluded the initiative did not impact the results.

Summary Findings

Data from census information, longitudinal data, and a RCT showed that children from disadvantaged backgrounds access ECEC less. Research suggests that:

- Flexibility in programs could result in more children accessing ECEC;
- Skilled staff, cultural inclusivity, understanding benefits, well-trained educators, and good communication are facilitators of access;
- Children with one risk-factor are less likely to access preschool, with participation rates decreasing with cumulative risk-factors;
- Direct and indirect costs, lacking awareness of the benefits, stereotypes about maternal roles and child readiness to attend are barriers to accessing ECEC.

QUALITY

The Context

Abundant evidence suggests that a critical factor in the efficacy of childcare is quality (Sylva, Melhuish et al. 2004, Australian Institute of Health and Welfare 2015, Fox and Geddes 2016, Warren, O'Connor et al. 2016, Ulferts, Wolf et al. 2019, Blanden, Del Bono et al. 2022, European Commission 2022). There is well established evidence for the positive impact on outcomes of a child's participation in high quality ECEC, including developmental gains and school readiness (Heckman 2006, Zaslow, Anderson et al. 2010, Duncan and Magnuson 2013, Yoshikawa, Weiland et al. 2013, Emerson, Fox et al. 2015, Zaslow, Anderson et al. 2016). This includes across middle- and low-income countries (Rao 2010, Pinto, Pessanha et al. 2013, McCoy, Waldman et al. 2018). Quality of preschool environments and experiences consist of structural and process elements (Melhuish and Gardiner 2019). Structural quality indicators include teacher-to-child ratios, teacher training and qualifications, cultural influences, and resource availability. Process quality embodies factors such as teacher-child interactions, the structure and organisation of class time, and teacher responses to the psychosocial needs of students including negative behaviours (Pianta, Howes et al. 2005). Higher quality ECEC is proposed to provide the foundations which, through ongoing support and investment, promote later skill development through 'self-productivity', in addition to recognising the need for, and facilitating, earlier intervention programs.

Research has been conducted on ECEC quality in terms of defining these characteristics and the relationship of structure and process to learning and developmental outcomes. This has predominantly occurred in high income countries such as the US (Peisner-Feinberg, Burchinal et al. 2001, Ansari and Pianta 2018) and include tools such as the widely applied Early Childhood Environment Rating Scale (ECERS), ECERS-Revised, and the Classroom Assessment Scoring System PreK. Factors such as methodological heterogeneity in research have resulted in mixed results and complicate comparisons of research findings (Brunsek, Perlman et al. 2017).

Participation in high quality ECEC programs, including Abecedarian, High Scope Perry Preschool and Child-Parent Centres, has been linked to multiple long-term outcomes of value to the individual and wider society including improved educational attainment, increased earning potential, and higher mental and physical well-being (Schweinhart, Barnes et al. 1993, Campbell and Ramey 1995, Reynolds, Temple et al. 2001, Campbell, Ramey et al. 2002, Heckman 2006, Reynolds, Temple et al. 2011, Stevens and English 2016, Reynolds, Richardson et al. 2021). Using studies based on longitudinal cohorts followed for over three decades, across differing community contexts, these programs have demonstrated some consistent elements in terms of quality. These include staff:child ratios lower than or equal to 2:17, a holistic developmental approach to education with strong foundations in literacy and numeracy, parental engagement, professional development and teacher qualifications, ongoing monitoring and program evaluation, and wider organisational support (Reynolds, Richardson et al. 2021). These program elements are challenging to scale up, due to factors such as economic and resource limitations, and the lack of these high-quality elements from numerous large-scale ECEC programs at least partially accounts for the variability in efficacy and outcomes across studies.

More recent longitudinal data also supports the role of high-quality care (Li, Farkas et al. 2013, Meloy, Gardner et al. 2019, Horm, Jeon et al. 2022). For example, children from lower SE backgrounds exposed to high-quality care demonstrate academic gains persisting into primary school (Horm, Jeon

et al. 2022). In the UK, the Effective Provision of Preschool Education (EPPE) program evaluated a longitudinal cohort of 3- to 7-year-old children (N=3171) who participated in a range of childcare models from the mid-1990s. The study investigated the impact on behavioural and cognitive developmental outcomes following attendance across of range of public and private early childhood settings including nursery schools, playgroups, and home care (Sylva, Melhuish et al. 2004). Program quality was assessed using the Early Childhood Environment Rating Scale-Revised (ECERS-R), based on 7 subscales (space and furnishing, personal care routines, language-reasoning, activities, interactions, parents and staff, and program structure), whilst environment was assessed using the Early Childhood Environment Rating Scale-Extension (ECERS-E), with subscales of literacy, mathematics, science and environment, and diversity practices (Sylva, Siraj-Blatchford et al. 2006). Findings demonstrated a relationship between attendance at a higher quality preschool for a longer duration, and educational outcomes for children across of a range of socio-economic contexts. The data revealed an association between higher program quality and more highly developed numeracy and literacy at school entry. When service quality and duration were accounted for simultaneously, high quality care for 2- to 3-year-old children was associated with on average a 3-month developmental advantage compared with a child who attended a low-quality setting, and an almost 5-month advantage compared with children attending a low-level setting for 1-2 years. In addition, although positive outcomes continued albeit in at a diminishing level by 7-11 years of age, these advantages were evident only for children who had attended medium to high quality settings (Taggart, Sammons et al. 2014). Higher literacy and numeracy outcomes also persisted at age 16 years for those children who attended longer and higher quality programs, and these children were also more likely to pursue tertiary study. This was contrasted with those children who had either remained in home only care prior to school entry or who had attended poor quality services. Higher quality services were also associated with improved outcomes for children across SE brackets, although importantly, the benefits persisted for children from lower socio-economic backgrounds in early to mid-adolescence in terms of various cognitive and behavioural outcomes.

Indeed, some evidence suggests that the impact of quality on outcomes differs according to the vulnerability of the child (Melhuish and Gardiner 2019). Thus, studies show that children with lower levels of self-regulation show greater benefits from exposure to high quality care and poorer outcomes with participation in lower quality care (Broekhuizen, Aken et al. 2015), whilst amongst children with behavioural problems from disadvantaged backgrounds exposed to high quality care, boys show greater benefits compared with girls (Votruba-Drzal, Coley et al. 2010). Similarly, Gialamas, Mittinty et al. (2015), using LSAC data on 2-3-year old children (N=980, 1187 depending on outcome), found that the effects of higher quality, as reflected in interactions with carers, were stronger in terms of cognitive and behavioural outcomes at school entry for children from lower SES backgrounds.

Nevertheless, there is a lack of clarity about which relative importance of program features towards high quality care and their differential impacts on outcomes (Burchinal, Kainz et al. 2009, Silburn, Nutton et al. 2011, Australian Institute of Health and Welfare 2015, Zaslow, Anderson et al. 2016). This is partly due to the emphasis on researching the structural aspects of care relative to process measures (La Paro, Thomason et al. 2012, Tonge, Jones et al. 2019). It is furthermore likely that the optimal elements for a given setting, community and child and likely to vary across settings. There is also a need for the development of interactional and pedagogical measures which can adequately assess the ECEC characteristics most likely to impact on child outcomes (Melhuish and Gardiner 2019).

Staff-child interactions appear to be a significant predictor of quality (Mathers, Sylva et al. 2007, Roberts, Mathers et al. 2010) and can be critical for the child's development whereby higher quality interactions are associated with improved outcomes (Burchinal, Howes et al. 2008, Gialamas, Sawyer et al. 2014, Perlman, Falenchuk et al. 2016). For instance, based on LSAC data on quality of childcare at age 2-3 years and outcomes at ages 4-5 years and 6-7 years, higher quality staff:child relationships were associated with later improved task attentiveness and emotional regulation. Consistency of study methodology and high quality measures to assess the relationship between staff:child interactions and child outcomes are however required, as evidenced by a systematic review and meta-analysis (Perlman, Falenchuk et al. 2016) in which the Classroom Assessment Scoring System (CLASS) measure demonstrated only small associations with children's outcomes .

Professional qualification of teachers is considered important in many ECEC policies, with prior studies demonstrating an association between higher teacher qualifications, program quality, and subsequent child outcomes (Early, Maxwell et al. 2007, Mashburn, Pianta et al. 2008, Ulferts and Anders 2016, Blanden, Hansen et al. 2017). Both teacher qualifications and PD have also been shown to be important for process quality (Melhuish, Quinn et al. 2006, Kammermeyer, Stuck et al. 2016). Other studies however have failed to demonstrate a strong association between higher professional qualifications/PD and improved child outcomes (Early, Maxwell et al. 2007, Mashburn, Pianta et al. 2008, Ulferts and Anders 2016, Blanden, Hansen et al. 2017, Blanden, Del Bono et al. 2022). In a meta-analysis of 22 European longitudinal studies (Ulferts and Anders 2016), evidence of direct overall association between structural quality and literacy and numeracy outcomes was lacking. Based on linked longitudinal data on ECEC attendance at 3 years of age and outcomes at 5 and 7 years of age, the small positive effects were observed only for children attending centres that received the highest inspection ratings, and these were unrelated to higher teacher quality (Blanden, Del Bono et al. 2022).

Inconsistent evidence also exists concerning staff:child ratios. Whilst data from programs such as Perry Preschool and Abecedarian prompted the notion that higher staff:child ratios relate to improved outcomes, through mechanisms such as increased frequency of teacher to student interactions and instruction, the evidence is mixed. Many studies however, including a systematic review, have demonstrated either small or no association between class size and child outcomes (Mashburn, Pianta et al. 2008, Burchinal, Zaslow et al. 2016, Perlman, Fletcher et al. 2017). Based on the meta-analysis of three studies examining ratios and the development of receptive language skills, the findings were not significant (Perlman, Fletcher et al. 2017). Similarly, the systematic review of 29 studies found little or no relationship between ratios and children's developmental outcomes. It is nevertheless recognised that support for staff including adequate renumeration and fair working conditions are important in attracting and retaining staff (European Commission 2022).

Positive outcomes from ECEC participation are however contingent on the provision of high-quality process services (Siraj, Kingston et al. 2016), although there is a relative dearth of strong evidence regarding the essential features to improve teacher practice through PD. Their review of the literature on evidence of preschool quality highlighted various elements required for PD and teacher practice: a) although structural factors are important in contributing to a quality ECEC experience, a focus is required on process quality in terms of PD to support teachers in delivering high quality staff:child interactions, and development and implementation of high quality curriculum; b) elements of process quality should be studied using validated and standardised tools; c) process quality improvements lead to demonstrable improvements in child outcomes; d) a thorough grounding in child development

enables ECEC teachers to address the educational, cultural and developmental needs of individual children; e) formal staff qualifications are required to facilitate the delivery of responsive high quality ECEC programs and pedagogy; f) the importance of high-quality interactions between staff, children and families; and g) continuing PD.

Meloy, Gardner et al. (2018), reviewing one universal[2] and five targeted[3] US ECEC programs in terms of the quality elements that contribute to the best child outcomes, concluded that there was no single best ECEC program, with programs that address the needs of the specific child population using best practice providing optimal outcomes. Consistent elements across the programs that contributed to high quality included full-day, multiyear programs, early learning standards that addressed the global development of the child, teacher PD and adequate remuneration, comprehensive service provision including the provision of family services, ongoing service quality improvement, and linkage of service quality and provision from infancy through into primary school. Lack of continuity of high-quality education in terms of curriculum, teacher expectations, services and supports, and unnecessary changes in structure from the preschool into school periods can undermine early gains and contribute to fade out through time (Stipek 2018). Primary school curriculum for example may duplicate ECEC learning, fail to build on earlier knowledge and skills, or continue to develop some developmental domains at the expense others.

Recent Evidence

Various recent studies have sought to further clarify the importance of different aspects of ECEC quality. A recent longitudinal study of 598 ECEC settings for 3- and 4- year old children from the UK found that that staff qualifications were predictive of quality across both private and state-funded ECEC settings, even in the presence of low staff:child ratios for the latter (Melhuish and Gardiner 2019). Other predictors of quality included the impact of higher staff qualifications on settings quality, PD in the form for a training plan in not-for-profit centres, and high staff:child ratios. This study also compared quality in ECEC settings prior to and following significant policy change in the UK, using data from two longitudinal data sets (EPPE and SEED). Substantial improvements in overall quality (assessed using ECERS-R) and curricular quality (assessed using ECERS-E), with concomitant increases in teaching and centre staff qualifications and PD, were noted for ECEC settings generally with an increase in the proportion of medium- and high-quality services.

A meta-analysis (20 papers) and systematic review (64 papers) (Brunsek, Perlman et al. 2020) recently examined the evidence for ECEC PD programs against a wide array of early childhood outcomes. The most common programs were those targeting school readiness, socioemotional functioning through interactions, and language/literacy. Significant but small positive effect sizes (0.07-0.26) were apparent in 10 of the 13 analyses, with positive associations found when there was a high level of relevance between teaching program and outcomes. Language and literacy programs, for example, had greater significant associations with children's expressive language and emergent literacy outcomes. The strongest associations were noted for programs focused on school readiness, language and literacy. Their systematic review, which included a wider PD content (motor functioning, healthy lifestyle and academic functioning), also indicated that associations were stronger when program

[2] Oklahoma's universal 4-year-old program

[3] The Child-Parent Centres, Michigan's Great Start Readiness Program, New Jersey's Abbott Preschool Program, North Carolina's Smart Start and NC Pre-K programs, and Washington State Early Childhood Education and Assistance Program.

content and outcomes were aligned. The study highlights the value of choosing appropriate PD programs to address targeted outcomes.

In a systematic review (Abenavoli 2019), evidence on the relationship of the quality of the subsequent school environment to persistence of positive outcomes from ECEC programs (8 studies) was found to be mixed. Whist some studies indicated that post ECEC exposure to low quality schooling was associated with fade-out, in other studies subsequent school quality did not moderate ECEC gains. The effect of interventions that continue into primary school was also explored through seven studies, with results indicating that carry-through provided some benefit (for example in terms of cognitive outcomes), although it is unclear if this effect persisted once the intervention ceases. Evidence of the effect of mechanisms through which positive gain persist was explored through 11 studies, showing that cognitive gains (four studies), socioemotional/behavioural gains (three studies) and social adjustment (two studies) mediated persistent outcomes.

A further systematic review (Lee, Kim et al. 2021) on the treatment effect heterogeneity in the HSIS, based on 28 studies, found mixed evidence regarding the impact of quality. Whilst full day programs, home visits and instruction in mother-tongue impacted positively on outcomes, teacher qualifications and low staff:child ratios showed no impact.

A three-armed cluster RCT in Sweden (Gerholm, Kallioinen et al. 2019) compared two pedagogical methods, socioemotional and material learning paradigm (SEMLA) and digitally implemented attention and math training paradigm (DIL), for 4–6-year-old children (N=431) across 18 preschools and 29 preschool units. Results found that the interventions had no measurable effect on a range of outcomes, including language and communication, EF, socioemotional skills, and early numeracy. A Danish cluster-randomised evaluation (Bleses, Højen et al. 2018) used a population representative sample of 5,436 3- to 6-year-old children from 154 day-care centres. It evaluated three variations of a language-literacy focused curriculum (LEAP) in terms literacy outcomes compared against business-as-usual day-care. The largest effect size was noted for the LEAP program where the sequence and scope of learning objectives had instructor input, as opposed to the business-as-usual or scripted group lessons. Higher exposure (participation in a greater percentage of the program lessons) was associated with better literacy outcomes. Effect sizes were not influenced by class group size or at-risk groups.

A recent quasi-experimental match group analysis of 433 children explored the efficacy of a program to scale up a high-quality program (Warren, O'Connor et al. 2016, Blanden, Del Bono et al. 2022). Children participating in Child-Parent Centres (CPC) had significantly better language and literacy outcomes in preschool and kindergarten compared with their peers who were attending the usual preschool and kindergarten programs. The CPC program resulted in overall composite effect sizes of 0.51 SD and 0.36 SD at the end of preschool and kindergarten respectively, equating to a developmental gain of approximately six months. It was noteworthy that, although by kindergarten the intervention children showed improved reading and fluency relative to the comparison group, no difference in outcomes was noted between those children that attended CPC for two years over one year.

A meta-analysis (Ulferts, Wolf et al. 2019) used data from 17 longitudinal studies involving European pre-schoolers (N=16,461). It examined global process quality (the quality of child interactions with staff, parents, peers, plus the quality of the material and spatial environment) and domain specific

process quality (extent and quality of promotion and stimulation of early learning across various domains) primarily in terms of language, literacy and numeracy outcomes up to 16 years of age. Small but persisting positive effect sizes were noted from global and domain-specific process quality of regular ECEC provision. Significantly larger effects derived from instruments that measured (a) global process quality with a focus on interactions and (b) domain-specific process quality by observation. Higher global quality was associated with small but persisting cognitive benefits throughout a child's schooling.

A meta-analysis (Joo, Magnuson et al. 2020), based on ECEC program evaluations conducted from 1960 to 2007, examined the effects of the gradual introduction of professional enhancement components on cognitive, pre-academic, socio-emotional, behavioural and health outcomes. Enhancement programs comprised parenting programs, skills-based curricula, and teacher PD. Impacts differed according to enhancement type, with the improvements across a range of outcomes including in school readiness resulting from parenting programs and skills-based curricula. Well-developed and supported parenting programs were associated with large positive outcomes in terms of child behaviour, health, and, to a lesser extent, socioemotional outcomes. Smaller improvements were noted in cognitive outcomes and overall development. Parenting programs were delivered across a range of modalities (e.g. group meetings, take-home instructional materials) and were typically of less than one year duration, but aimed to promote stimulating parent:child interactions through play and household routines and provided parental support of early learning. Skill-based curricula, particularly those focused on language and literacy, were also associated with large improvements in cognitive function, school readiness and overall outcomes. The evidence more strongly supported focused skills based rather than global curricula. Lastly, the evidence for PD programs did not support positive outcomes, with negative significant effects for pre-academic skills and no effect for cognitive or overall outcomes.

Similar patterns were noted from a small cluster RCT in Victoria involving exposure to a literacy PD program, Let's Read, in long day-care centres for children from 0-5 years of age in communities of high disadvantage (Elek, Gray et al. 2022). Data from 12 long day-care centres and 223 educators demonstrated improvements in educator and centre quality in terms of all literacy promoting practices and environments, including storytelling instruction, participation in learning, developing child:staff interactions and classroom organisation. The impact of targeted literacy and language interventions at preschool and early primary years has also been assessed through a restricted systematic review (Goldfeld, Beatson et al. 2022). Effects size varied across and within the 13 studies that concerned preschool interventions, with moderate to large positive effects generally related to oral language and vocabulary development. Although none of these studies were rated as high level based on strength of evidence assessments, they nevertheless suggest that targeted interventions at preschool can yield positive outcomes for cognitive domains.

An evaluation of the impacts of a high quality PD program, the Fostering Effective Early Learning (FEEL) study, in metropolitan and regional NSW was assessed through a cluster RCT and qualitative study by Siraj, Melhuish et al. (2018). The study involved using an evidence-based PD program, Leadership for Learning, aimed at improving the quality of ECEC staff:child interactions and curricula through increasing understanding of key concepts of early child development and learning including self-regulation, early language, communication and numeracy, and science and critical thinking. The program involved an initial intensive program, supplemented by fortnightly half-day workshops, and

online support. Quality outcomes were assessed using ECERS-E, the Sustained Shared Thinking and Emotional Well-Being (SSTEW) scale to assess interactional quality, plus measures of language, numeracy, and social-behavioural development. Several direct and indirect impacts were found based on pre- and post-treatment evaluations of the 38 intervention sites compared to the 45 business-as-usual sites. The intervention group demonstrated significant improvements in curricular quality and staff:child interactions, improved language and numeracy including a 23% improvement in number concepts, and socio-emotional outcomes including reduced internalising behaviours. The evaluation strongly supported the use of targeted evidence based ECEC PD programs.

Summary Findings

Data from meta-analyses, systematic reviews, and longstanding large-scale RCTs, show generally improved long term outcomes from attendance in a universal ECEC:

- Debate on the essential elements comprising high quality care;
- Mixed evidence on the importance of teacher qualifications: Teacher PD shows the strongest evidence when targeted at specific outcomes;
- Staff:child interactions: associated with increases in school readiness and improved outcomes in literacy and numeracy domains;
- Pedagogy: limited evidence of elements required for high quality ECEC; evidence that programs with teacher input show greater improvement in outcomes;
- Scale-up of high-quality programs: some evidence that this can be effective and result in developmental gains;
- Strong evidence for large positive child development effects from well-developed and supported parenting programs.

PARTICIPATION

Program participation is reflected in dosage (hours per week) and duration (months/years) (Molloy, Quinn et al. 2019), which varies according to whether a child attends ECEC at all, the amount of contact provided by the ECEC program, attendance rates, and the age at which care is commenced. Whether ECEC is beneficial or negative involves a complex interaction between dosage, duration and multiple additional factors relating to the child, type and quality of the care environment, and wider socioeconomic factors. Much prior research has not considered in detail the impact of variations in dosage and duration on developmental outcomes. The impact of attendance rates, for example, have tended to be overlooked in the research (Reynolds, Richardson et al. 2021).

Various studies have suggested that greater exposure to childcare impacts positively on outcomes (Berlinski, Galiani et al. 2008, Leow, Wen et al. 2015, Ulferts and Anders 2016, Cornelissen, Dustmann et al. 2018). A longer duration of preschool attendance was shown in the EPPE study to be associated with improved numeracy and literacy outcomes at the time of entry to school and at Year 2 (Taggart, Sylva et al. 2015). Commencement of preschool at 2 to 3 years of age for children was linked to better cognitive outcomes at the beginning of primary education, and enduring higher numeracy and literacy outcomes at the end of Year 1, although the effect persisted more for literacy than numeracy outcomes by the end of Year 2. Children from lower SES backgrounds demonstrated the highest levels of school readiness in they had been exposed to high quality ECEC through infancy and the preschool period (Li, Farkas et al. 2013). Similarly, Yazejian, Bryant et al. (2015) found that longer exposure of children from lower SES backgrounds to a high quality preschool program available from infancy to school entry was associated with greater improvements in receptive language skills compared with shorter attendance duration. Thus, there is evidence to suggest that persistent enrolment in a high-quality program throughout the infancy and early childhood periods may be especially beneficial for more at-risk children.

Zaslow, Anderson et al. (2016), using propensity score analyses of Head Start data, found that children with two as opposed to one year of Head Start had stronger vocabulary and literacy skills both immediately upon exit from Head Start and at the end of kindergarten. Fewer absences and more observed time spent on instruction were also associated with higher literacy and numeracy scores. In terms of thresholds of contact that may prove to be beneficial, based on data from the UK, France and the USA, 3-year-old children benefit from programs involving twenty or more hours per week (Lee, Zhai et al. 2014, Warren, O'Connor et al. 2016), whereas programs of a lower dosage may not promote significant gains, particularly as regards children from disadvantaged backgrounds. Other studies show similar benefits from a longer duration of exposure from ages 2 to 3 years (Sylva, Melhuish et al. 2004, Sammons, Sylva et al. 2012, Li, Lv et al. 2015)

Contrary to these findings however, other studies demonstrate a lack of benefit from increased exposure. For example, there was a lack of consistent positive impacts on outcomes at Grade 1 and Grade 2 for 3- to 4-year-old children attending ECEC for a longer duration as part of the longitudinal cohort study Effective Preschool Provision in Northern Ireland (EPPNI) (Melhuish, Belsky et al. 2008). Kuhlne and Oberfichtner (2017) used a quasi-experimental design involving fuzzy discontinuity data for children starting childcare at age 3 years in Germany to examine short- and medium-term outcomes up to age 15. A five-month difference in exposure to childcare failed to provide any impact

on a range of cognitive and non-cognitive outcomes. An observational study of children (N=1,364) examining the relationship between various forms of non-relative care between 0 to 4 years of age with outcomes at 15 years, indicated that increased hours in care were associated with increased risk taking and impulsivity by adolescence (Vandell, Belsky et al. 2010).

Some studies, such as those relating to subsidised childcare, also show negative effects. For example, Herbst and Tekin (2010), performing a sub-group analysis using US national data on 2,795 children from the Early Childhood Longitudinal study, found that universal childcare subsidy in the pre-K year was associated with lower literacy and numeracy scores and increased behavioural problems at the time of entry to kindergarten. Negative effects of longer childcare exposure appear to be particularly pertinent for non-cognitive development, including evidence of increased rates of anxiety and aggression, and may persist into the school years and adult life (Baker, Gruber et al. 2008, Kottelenberg and Lehrer 2013, Baker, Gruber et al. 2019).

There is also evidence of ECEC programs which demonstrate both short- and long-term positive impacts following lower dosages. The HighScope Perry Preschool Program targeted African American children with IQs in the lower 15% of the range in Michigan with 58 children allocated to the program and 65 allocated to no treatment (Schweinhart, Montie et al. 2005, Warren, O'Connor et al. 2016). The program ran for 8 months per year over two years and involved 2.5 hours per day for five days a week. Outcomes for the intervention participants included improved school engagement, significantly higher scores on standardised achievement and literacy tests into adolescence and early adulthood, and a range of economic and social benefits at 40 years of age. These outcomes demonstrate that programs with a relative low dosage (12.5 hours per week), can be associated with improved outcomes in the context of other factors including parenting interventions and high-quality pedagogy and program features, when provided to a cohort of at-risk children who might be more likely to benefit. In addition, studies comparing full- and part-time attendance have failed to demonstrate significant differences in school readiness (Sylva, Melhuish et al. 2004, Melhuish, Quinn et al. 2006, Sammons, Sylva et al. 2012).

There is also increasing interest in the concept and practice of ‘stacking’ early childhood services in which continuity of participation in complementary services may lead to enhanced child outcomes (Molloy, O'Connor et al. 2019). In an Australian retrospective longitudinal cohort study (Molloy, O'Connor et al. 2019), LSAC data on risk and exposure measures across service usage (antenatal care, nurse-home visits, ECEC, parenting programs and early years of school) for 0-5-year-old children was linked to NAPLAN reading scores at ages 8-9 years (N= 3790). Participation in more services was found to be associated with improved reading outcomes, with each additional service yielding a positive and cumulative benefit on reading scores. A RCT from the US evaluated 556 disadvantaged 4-5-year-old children who participated in either an enhanced classroom intervention (REDI Head Start), the intervention plus a home visiting program, or the usual Head Start intervention, on outcomes in Grade 2 (Bierman, Heinrichs et al. 2017). Whilst the enhanced intervention demonstrated sustained improvements in social-emotional skills at Grade 2, simultaneous participation in the classroom and home programs had the added benefit of enhanced cognitive outcomes. The research thus suggests the importance of complementary multiservice provision.

Recent Evidence

There is a relative lack of longitudinal research into the effects of exposure to high quality ECEC exposure from birth until the time of school entry, and impacts on outcomes into the primary years.

A meta-analysis of 22 longitudinal European studies (Cornelissen, Dustmann et al. 2018), examining characteristics of ECEC in relation to numeracy and literacy outcomes through primary and secondary school, found a relationship between ECEC quantity and literacy and numeracy outcomes. The study demonstrated substantial heterogeneity in the returns of preschool based on different attendance patterns and risk factors across children. Minority children displayed better school readiness if they enrolled in ECEC earlier and poorer school readiness when attending ECEC later compared to their majority peers, although minority children were less likely to enrol earlier. A further group of children with unobserved characteristics displayed a similar pattern of greater benefit but less likelihood of earlier enrolment in childcare, and evidence suggested that these children were from disadvantaged backgrounds. The impacts of duration on children from lower SE backgrounds has also been demonstrated in a RCT by Horm, Jeon et al. (2022), in which a longer duration of attendance started earlier showed the greatest and persistent benefits in cognitive outcomes into primary school.

A recent study from the US using a randomised block design (Atteberry, Bassok et al. 2019) compared participation for 226 children in either a full- or half-day pre-K program against various cognitive and noncognitive outcomes. Attendance in the full-day, 5 day a week program was associated with improved vocabulary skills (0.275 standard deviations) at the end of Pre-K, compared with children who attended the half-program. Statistically significant, but less robust, positive effects for cognition, literacy, maths, and physical development were also noted based on teacher report in district schools.

The impacts of dosage (duration, intensity, hours) of ECEC on persistence of a range of child outcomes was also assessed in the systematic review by Abenavoli (2019). Analysis was complicated by the variation in the operationalisation of dosage across studies. In terms of years attended, the impact of dosage on the persistence of outcomes was mixed. Attending a high-quality program for two years over one year, was associated with persistent positive outcomes to the end of kindergarten or into primary school in three studies. Results for three other studies either did not demonstrate a persistent positive impact or the results differed by outcome. When operationalised as contact hours per week, two studies demonstrated no impact of number hours per week, or attendance at half- or full day-programs, on persistence of positive outcomes. There was some evidence from one study that more intensive targeted skills-based curricula show greater efficacy in persistent outcomes versus less intensive versions of the same program. Variations in quality and content of the program are likely to explain at least some of the variance in results.

In a cross-sectional analysis, Baker, Gruber et al. (2019) researched long term outcomes in terms of noncognitive development, cognitive development, health, and crime for children enrolled in universal childcare between 0-4 years of age in Quebec using data from the National Longitudinal Study of Children and Youth (NLSCY) and Survey of Young Canadians (SYC). Negative effects for non-cognitive outcomes were found to persist at 5-9 years of age, with at-risk children being most likely to be affected. Negative effects in terms of health, mental health, and life satisfaction also persisted into adolescence based on self-report, particularly for boys, in addition to an association with higher rates of criminality relative to children who did not participate in early years programs. Of importance, short-term negative impacts appeared to be predictive of longer-term outcomes.

A recent systematic review and meta regression analysis of 54 experimental and quasi-experimental studies in low-, middle- and high income countries (Holla, Bendini et al. 2021), provided evidence that when ECEC services are offered, this increased the odds of enrolling in and progressing through ECEC by 30 percentage points. Participation was furthermore associated with statistically significant short-

term improvements in cognitive skills (0.15 SD), and EF, social-emotional learning and behaviours (0.12 SD), with disproportionally higher gains for children from disadvantaged backgrounds. This led the authors to argue for the expansion on ECEC services in low- and middle-income countries, with a particular focus on disadvantaged children.

Summary Findings

Based on data from a systematic review, meta-analyses, randomised control trials and quasi-experimental studies, the relative benefits of participation in ECEC vary according to the age and risk profile of the child:

- At risk children derive greater benefit from ECEC relative to their peers for the same exposure;
- At-risk children benefit from a longer duration of ECEC (more than one year);
- Evidenced is mixed on the dosage and duration of exposure, and varies according to factors including child risk. The quality of program content is also likely to impact on this;
- Outcomes may vary as a result of duration, with some evidence that socioemotional outcomes are less positive with greater ECEC duration.

IMPLEMENTATION MODALITY

The Context

As far as we are aware, no Australian studies have explicitly tested ECEC implementation modalities against each other in an RCT, although there has been some work done using quasi-experimental methods on longitudinal LSAC data (Claessens and Garrett 2014). This work ties in with the current paradigm of multiple modalities existing in the Australian context. Warren et al. (2016) summarises these to preschool, long day care, family day care, mobile children's services, and home-based care, and further qualifies these different contexts such as rural versus urban areas require different solutions. In Australian context, based on AEDC census data, Goldfeld, O'Connor et al. (2016), explored the role of preschool in promoting child development compared with other early childhood care arrangements. Children who attended preschool were less likely to be rated as in the vulnerable range (<10th percentile) based on their AEDC domain scores than children attending other ECEC modalities or exclusively parental care, with the implication that ECEC attendance constitutes an important means of enhancing early childhood development.

The only Australian study we were able to find on the topic was by Claessens and Garrett (2014), who looked at 4-5 year old children within the LSAC dataset and categorised children's attendance into pre-year 1, school-based preschool, standalone preschool's, centre-based child care modalities. The analyses were divided into three parts, firstly, looking at the characteristics of the different pre-school modalities, further, looking at family and home characteristics as predictors as to which modality was preferred, and finally looking at the longitudinal effects of modality against school outcomes at age 6-7, 8-9, and 10-11. They found that pre-year 1 and preschools had higher levels of teacher education than centre-based care, and pre-year 1 classrooms were more focussed on academic learning. Little evidence was found on different predictors of modality choice, however, there was limited evidence that children in pre-year 1 had significant early advantage in school-based outcomes at early ages. This advantage was not sustained through later ages, and other modalities showed no further disadvantage.

Starting in 2009, the World Bank funded expansion of preschool services in rural Indonesia through the Indonesia ECED project (Brinkman, Hasan et al. 2017). The implementation was complicated by the fact that multiple modalities were already in existence, and the oversight of each of these modalities rested with different organisations. Uptake of the existing services was generally low, further complicated by governance issues and little teacher training. The ECED program was therefore devised to improve access in targeted villages considered at-risk due to high poverty rates and low enrolment rates, and provide quality preschool services to these areas. Playgroup covers the 3- to 4-years of age range in Indonesia, therefore the ECED project competed with the existing implementation of religious and government playgroups. Comparative analysis of the different forms of playgroup found that the intervention playgroups were very marginally more successful at increasing child development outcomes than the existing playgroups. The intervention did, however, increase enrolment particularly for younger children resulting in impact for those in poverty and disadvantage.

Through the implementation of the Pacific Early Age Readiness and Learning (PEARL) programme since 2014, children aged 3- to 5-years in Tonga were provided access to Community Play Based Activities

(CPBA) in certain villages to enable communities with no existing ECEC modality to have access to quality play-based learning and encourage good home-based practices (MacDonald, Brinkman et al. 2017). This provided an alternative to existing preschools in Tonga, where uptake is generally low. Both were found to be effective in increasing children's school readiness and child development as measured by the eHCI. CPBA however had an advantage of being lower in cost, and more sustainable, community driven and parental focussed, when compared to preschool. A particular focus on CPBA was the promotion of parents as the child's first teacher, which promoted a more stimulating home environment.

Ultimately the applicability of these studies to the Australian context is uncertain. Within these countries the existing services modalities were either of low quality or non-existent, within a background context widespread family poverty. Thus, starting from a low base, any increase in ECEC attendance will likely be associated with improved outcomes, making it difficult to generalise the magnitude of positive impact found in these studies to children living within Australia. Nonetheless, the studies show that there is efficacy in well-designed, low-cost implementations, especially those where there is a commitment not only in the delivery of ECEC to children but also a strong parental engagement including role modelling play based learning activities that can be replicated at home.

Recent Evidence

The Lao PDR Early Childhood Education Project (ECEC Project) (Brinkman, Lam et al. 2022) started in 2016, and the World Bank funded the implementation of ECEC in 5 provinces in the north of the country. The modalities tested were Community Child Development Groups (CCDG) where purpose-built huts were used to provide community-based playgroups for 3–4-year-olds (available every weekday for a minimum of half a day). Facilitators were recruited from the village locally and were trained to deliver the program with an activity-based curriculum and minor resources (toys). The other modality tested was Multi-age Teaching (MAT), where the existing pre-primary school was opened to further accept children aged 3-4 years of age in their pre-primary classes (originally restricted to 5-year-olds). Teachers were trained to deliver curriculum designed for the 3- to 5-year-old cohort. MAT was considered the more cost-effective of the approaches as it required little investment in infrastructure and new staffing compared to CCDG. The trial was run for 5 years, tracking the children from age 3- to 4-years of age to age 8- to 9-years, and measuring child development outcomes using the early Human Capability Index (eHCI) and other diagnostics such as attendance. Although CCDG showed greater acceptance by the community, leading to higher attendance and participation rates, ultimately both modalities were equally successful in improving child development outcomes.

Using data from the Early Learning Ohio project in a quasi-experimental analysis, Rhoad-Drogalis, Justice et al. (2021) explored attendance by program type, based on parent-report for 422 children. They identified three distinct preschool attendance profiles (part-time Head Start, Public Preschool and other care programs, and full time Head Start), with concomitant differences in child and family characteristics of the participants, but no observed differences in school readiness by care profile. This latter finding highlights the importance of other factors such as quality for understanding the value of care. Of note, children were found to participate in more than one care type, with obvious implications for, and increasing the complexity of, interpretation of impact on development outcomes.

Summary Findings

There was a significant lack of high-quality research on implementation modality within Australia, however based on data from longitudinal cohort studies and RCTs, the most recent research suggests:

- ECEC modalities should be tested against existing implementations to ensure efficacy and cost-effectiveness;
- Low-cost, well-designed implementations may be able to achieve similar results to more expensive implementations;
- With adequate data collection, analysis of modalities is easy to implement and informative as to what is successful within implementations.

ACADEMIC PULSE SURVEY (including local, national and international expertise)

In order to complement the literature survey, we conducted a highly targeted survey to capture the views of expert academics from across the world, working in the field of Early Childhood Education and Care. The survey was created and hosted using LimeSurvey, included basic details on the respondent's position, role, research location, experience and academic background. The aim of the survey was to inform the Commission as to areas where the evidence is clear, the strength of that evidence, and to identify where further evidence is required. The survey consisted of three sections, the first asked basic demographic information including age, gender, position, primary research focus areas, and regions in which their research was primarily undertaken. The second involved rating the perceived strength and importance of key focus areas of 3-year-old ECEC including:

- teacher's qualifications
- child to staff ratios
- pay and conditions
- implementation modality
- curriculum and pedagogy
- preschool "dose" (i.e., optimal number of hours) for children aged 3 years
- universal versus targeted service delivery
- economic benefits
- parental/guardian involvement and
- physical infrastructure and resources

The respondent was asked to rate the strength and importance separately of each of these categories using a Likert like scale ranging from 1 (weak evidence, not very important) to 5 (strong evidence, highly important). The third section of the survey also included open-ended questions seeking respondent's views on the most important considerations regarding delivering preschool for 3-year-old children in comparison to 4-year-old children. They were also asked to suggest any they deemed relevant to this topic. These papers were then included in the literature review in part A of our commissioned works.

The survey was first trialled by staff at Education Futures – UniSA before being circulated to targeted respondents. To control the quality of responses received, the survey was circulated via cold email to selected academic experts in the field only (N=59), of which a response rate of approximately 36% was observed (n=21). The full list of experts is available in Appendix 3.

Statistical analysis was conducted in StataBE 17. Summary statistics of basic demographic information was calculated along with geographic information displayed using Choropleth maps. Average scores of the Likert-like scale were derived for each domain's strength of evidence and importance. Summaries of strength and importance of ECEC characteristics were then presented using arrow plots to illustrate the relative differences. Further, free text responses for each domain were exported and made available in Appendix 4.

ACADEMIC SURVEY RESULTS

Table 6 shows basic demographic information of the cohort surveyed. A majority of respondents were Female (58%), most were aged between 60-69 (37%) and were largely University based academics (58%).

Table 6, Characteristics of academic survey cohort

		n	%
Gender	Female	12	57.1%
	Male	9	42.9%
Age category	30-39	1	4.8%
	40-49	3	14.3%
	50-59	6	28.6%
	60-69	8	38.1%
	70+	3	14.3%
Researcher type	Non-university based academic with adjunct type status	5	23.8%
	Non-university based researcher	2	9.5%
	Other - researcher	1	4.8%
	Other- non-researcher	1	4.8%
	University based academic	12	57.1%

Research focus locations were represented globally (aside from Antarctica) within the cohort (
Figure 3, Continents of research focus of academic experts), however, focus on the Asian, and North American continents were strongly represented.

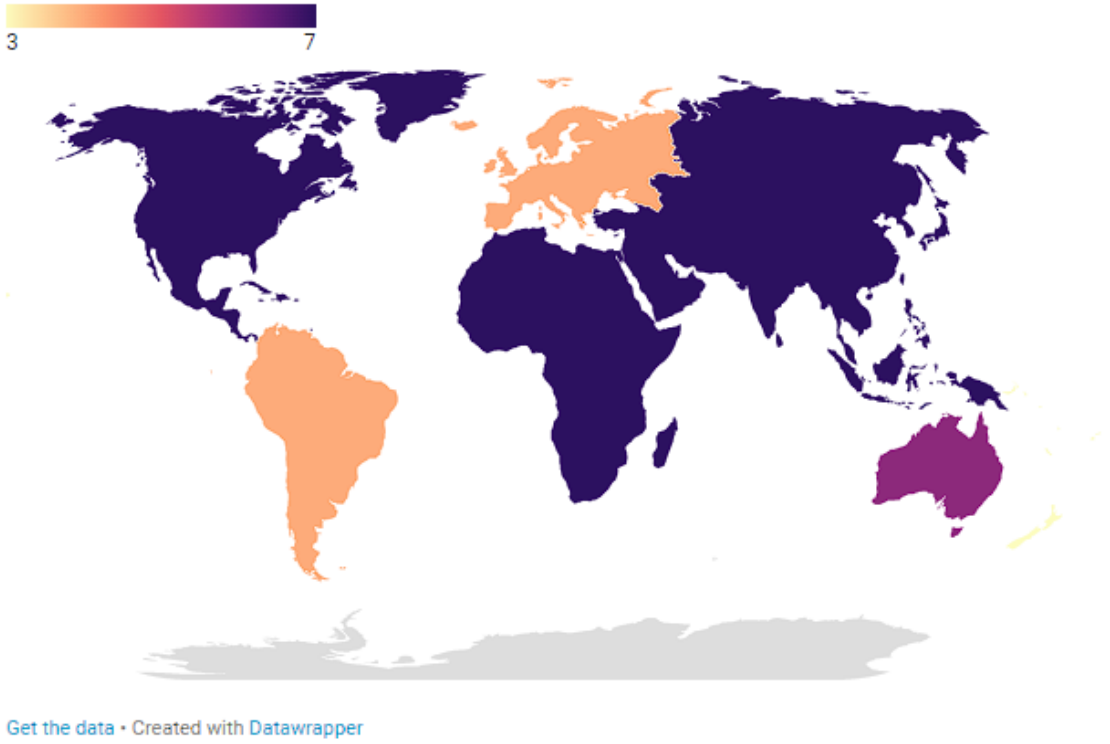

Figure 3, Continents of research focus of academic experts

Respondents who had conducted research in Australia were predominantly focused on eastern states as well as South Australia (Figure 4).

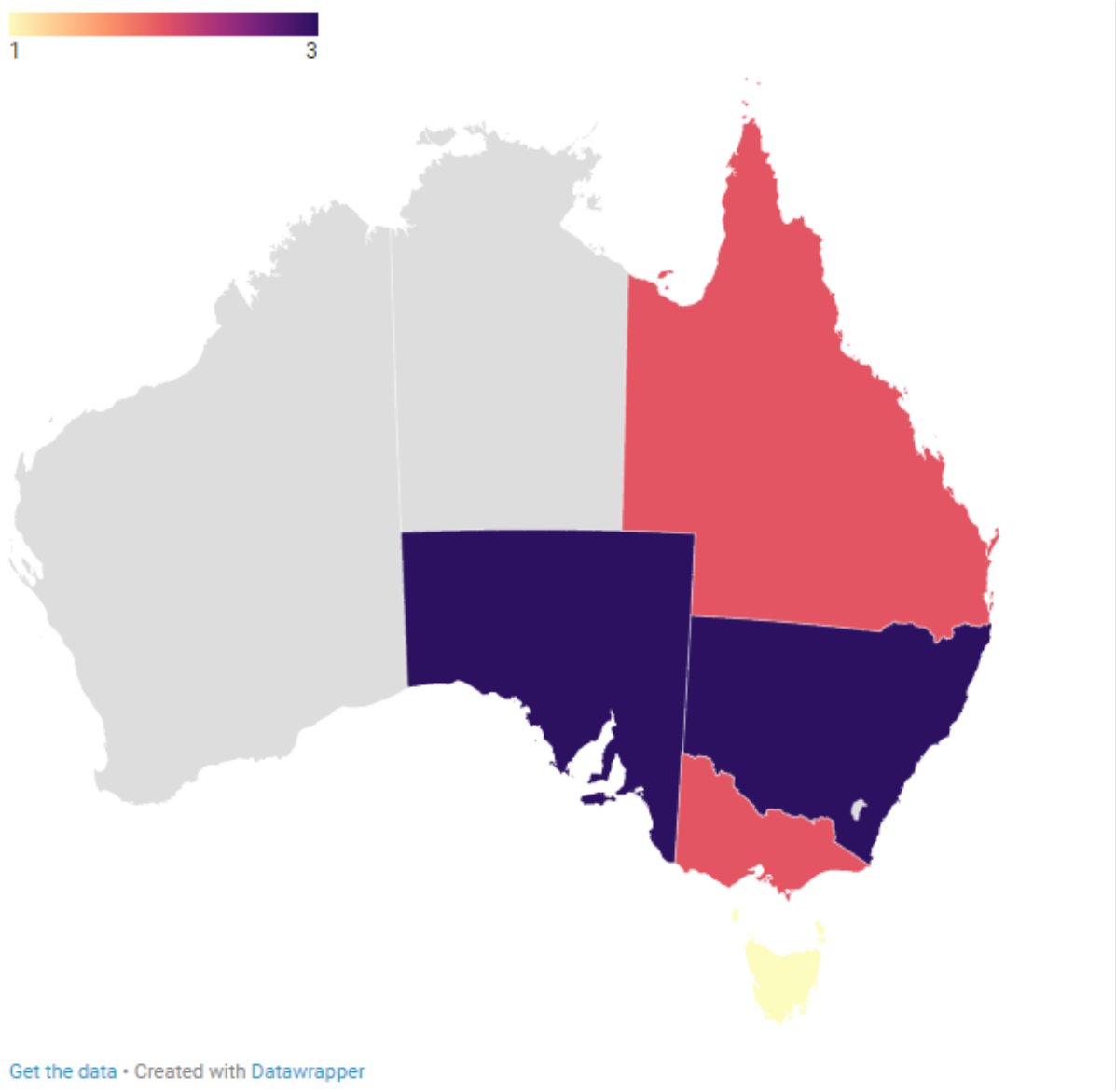

Figure 4, Australian States & Territories of focus for academic experts

An arrow plot (Figure 5) was created to highlight the discrepancies in perceived strength of evidence versus the perceived importance. Arrow plots are generally used to show change over time, however in this context it provides a concise visualisation of the relative discord between strength and importance. The point estimates represent the mean score of strength and importance respectively. The wider the difference, the larger the perceived gap in knowledge of that focus area. Ordered in terms of highest strength of evidence to weakest, the arrow plot also allows us to rank areas where evidence deficits exists and where it excels. Means and standard deviations of these outcomes are shown in table 7.

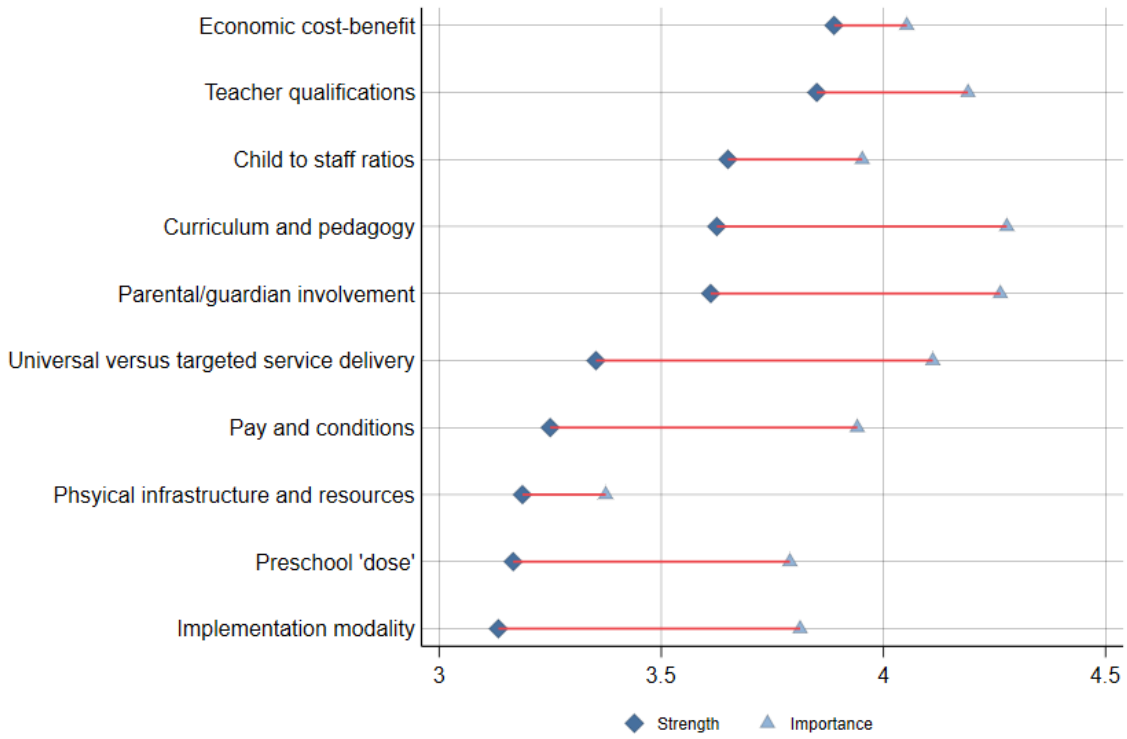

Figure 5, Arrow plot of average score of strength of evidence and relative importance

Overall, in terms of strength, there is consensus that the focus areas we selected had at least some basis, with the average score not falling below 3 on a 1-5 Likert scale. However, simultaneously, there is no area where research strength is considered near perfect, as the highest scores do not go above 4 (on a scale of 1-5). Furthermore, results from the survey indicate that there is generally a perception of importance beyond the strength of evidence. Curriculum and pedagogy, parental/guardian involvement, universal versus targeted service delivery, and pay and conditions all have large gaps between importance and strength, indicating that the perceived importance may not be based entirely on research vigour, but rather could be a combination of the academic's own experiences, or influential singular studies. On the contrary, there is no single domain where the strength of evidence outweighs the perceived importance, indicating that on average, researchers find the want for evidence lacking in every single domain. Ranked in terms of strength, economic cost-benefit and teacher qualifications stand out, however in terms of importance, economic cost-benefit is perceived as less beneficial. What academics rate as most important are teacher qualifications, curriculum and pedagogy, parental/guardian involvement, and universal versus targeted service delivery.

Table 7, Means and standard deviations of surveyed items

	Strength		Importance	
	Mean	Standard deviation	Mean	Standard deviation
Teacher Qualifications	3.9	1.0	4.2	1.0
Child to staff ratios	3.6	1.0	4.0	0.9
Pay and conditions	3.3	1.3	3.9	0.9
Implementation modality	3.1	1.3	3.8	1.0
Curriculum and pedagogy	3.6	1.3	4.3	1.0
Preschool 'dose'	3.2	1.2	3.8	1.1
Universal versus targeted service delivery	3.4	1.3	4.1	1.1
Economic cost benefit	3.9	1.2	4.1	1.2
Parental/guardian involvement	3.6	1.3	4.3	1.2
Physical infrastructure and resources	3.2	1.0	3.4	1.1

Each domain is further explored in the free text responses. Each respondent was given the opportunity to include any thoughts or comments they had regarding each domain with the qualifying element that it be relevant to the implementation preschool for 3-year-old children. The majority of respondents chose to comment. We have included all responses to the domains verbatim within Appendix 4, however short summaries of responses for each domain are below.

Teacher qualification: there is general consensus that some level of qualification should be mandatory to ensure teacher quality, most suggest at least graduate level. However, a couple responses also indicate that research on this tends to stem from wider age ranges (4+), and little research exists on the topic for 3-year-olds.

Child to staff ratios: A few respondents suggest ratios of 1:8 to 1:10, however many note that cost-effectiveness would be the deciding factor. Thematically, children having quality interactions with the teacher was deemed important, however some noted that most studies were consistent in ratios, suggesting that research into smaller ratios yields higher variation and weaker evidence.

Teacher pay: There was strong consensus that the teacher should be paid adequately for their role, with many indicating a link of teacher morale to stability, child interactions, and quality. Other points to note were the importance of attractive renumeration to incentivise quality teachers, and that the overall difficulty of teaching very young children warrants higher awards.

Modality: There was some confusion amongst the respondents over the definition of modality in this context, resulting in less responses. This result is interesting in its own right, indicating that there has been limited exploration of different implementation modalities for delivering early childhood education and care to young children. However, of those that did respond, most indicated that even if implementation was universal, certain elements would have to be targeted to suit the community.

Curriculum: Many noted that curriculum was highly important and there was strong consistency amongst the respondents that play-based, child-centric curricula in balance to adult driven activities would be successful. Another point of importance was the age-appropriateness of the curriculum, with many indicating that it would differ for 3-year-olds.

Dosage: Responses to dosage were mixed, with some researchers indicating that there was not enough evidence, and some giving discrete responses in terms of hours per week or hours per year. Many replied that the correct dosage would allow for adequate family time and address the individual child's behaviours and learning needs. Discrete responses suggested were 20 hours per week to 600 hours per year.

Universal versus targeted service delivery: Interestingly, there was contention over which provision is the most effective. Some regarded universal as better than targeted at providing care for disadvantaged children. On the other hand, some argued that targeted was better from a cost-benefit point of view. Many indicated South Australia as a great opportunity to be able to test these two delivery methods. Proportionate universality was also suggested to bridge the gap between the two.

Economic cost-benefit: Strong consensus for the cost-benefit of pre-schooling was present. Nearly all of those who responded to this domain was clear in that there were significant benefits not only economically but also to human capital of the children and the teachers/staff involved.

Parent/guardian involvement: There was consensus that parent involvement is highly important, but there was little regarding how it could be implemented. Most indicated that at some level, parental involvement would be necessary to have a holistic approach to child development.

Physical infrastructure and resources: There was little support for physical resources above and beyond the other categories. Most indicated little evidence on the matter, although some linked it to cost-effectiveness and resourcing. No recommendations were presented as to the best approach.

DISCUSSION

Recent trial evidence from low- and middle-income countries, as well as evidence from high quality and high intensity programs delivered in the USA decades ago clearly evidences that the provision of ECEC delivered to families living in disadvantage is beneficial and has long lasting positive impact (Cascio and Schanzenbach 2014, Meloy, Gardner et al. 2019). These findings have prompted many countries to invest in expanding targeted early education opportunities to disadvantaged preschool-aged children, and in some cases making free preschool universally available to all children, essentially lowering the age at which public education begins. However, through our extensive literature search and review, it is clear the quantity and quality of recent research in high income countries into the impact of universal ECEC for 3-year-old children on developmental and long terms outcomes is not as strong, or as consistent, as policy makers may like. Additionally, positive effects from recent quasi-experimental and RCT studies in the USA, such as Head Start, have shown that early positive effects can fade out. The impact of differing methodologies to evaluate diverse programs has resulted in mixed results, confounding to some extent interpretation of the overall impact and best practice for ECEC for different children. It has been suggested that whilst continuing to remediate these factors through conducting high quality trials, the focus should also include developing a greater understanding of the critical elements of ECEC quality and subsequent support in the school system to promote and perpetuate skill development (Meloy, Gardner et al. 2019). Of course, the degree to which evidence generated from international studies can be generalised to contemporary South Australia, is also debatable. Taken together the current state of the scientific evidence makes it difficult for policy makers to act confidently and heightens the importance of contemporary rigorous research to be conducted in Australia.

Ultimately the challenge for policy makers is to understand the right “ingredients” (both inputs and quantity of those inputs) for a universal ECEC system that will support families across the socio-economic spectrum. One key ingredient to consider is “dose” i.e., the number of hours per week that a child attends ECEC. Evidence from high quality studies is contradictory, with some indicating that simply more hours is better and others suggesting that this is the case for children from challenging home environments but greater hours either has no effect or a negative effect on children from supportive home environments (Warren, O’Connor et al. 2016). These null or negative effects are potentially related to the level of quality of the pre-school services provided, however this evidence challenges implementation considerations for universal provision of ECEC for 3-year-old children. To complicate considerations over and above total hours further, are attendance patterns, for example is half a day every weekday better than 2 full days within a week, or is attending in the morning better than attending in the afternoon? Of course, pragmatically, parents will have preferences depending on employment flexibility and other care arrangements and these considerations will also influence children’s attendance patterns.

In terms of quality, the literature clearly supports high quality ECEC provision. There is less robust evidence supporting the benefit of high-quality resources, although some evidence of greater physical activity levels in children attending ECEC services with outdoor play areas. Observed overall effects can vary substantially between and within studies, and variations may partly be explained by different program structures and measures. Research nevertheless supports many process elements including the need for staff-to-child interactions to be positive, kind and caring, with staff pro-actively seeking

to enhance children's development and learning through a range of pedagogies. Further there is strong evidence for higher staff-to-child ratios having better outcomes, with those ratios being more important for the younger children. Additionally, the research supports the benefits of teachers informed through formal qualifications and ongoing PD, including a thorough understanding of child development, to inform pedagogy and practice, ongoing program evaluation and development, and meaningful interactions and support of families. Programs with many or all of these elements present demonstrate the strongest and most persistent development outcomes for children (Meloy, Gardner et al. 2019). Significant challenges of universal implementation of these program elements exist due to cost, resources and complexity of aligning programs to diverse contexts.

Engagement and inclusion of parents/caregivers by the ECEC service is another important factor in achieving a holistic approach. A common element of programs evaluated to be impactful on children's development is the inclusion of parenting support through either playgroup type models where parents are learning and having activities role modelled, or with the embedding of parenting practice support programs. Indeed, high quality evidence shows that parenting programs for families with children aged from birth through to 3 years are effective for improving ECD outcomes and enhancing parenting outcomes across low-, middle-, and high-income countries (Jeong, Franchett et al. 2021).

There is very little quality evidence from high income countries to guide policy makers on implementation modality, however, it is still important to consider within implementation planning. The evidence that does exist comes from a few international studies in low- and middle-income countries. Perhaps due to a backdrop of low service provision there is greater interest in undertaking high quality evaluations to inform any future scale-up. In most high-income countries, expanding access to 3-year-old children has been constrained to established service models, leveraging their existing physical infrastructure and staffing i.e., expanding existing preschool services to 3-year-old children. This expansion of existing services makes high quality evaluation a little more difficult. As such, evaluating initiatives such as Head Start in the United States has required quasi-experimental approaches to determine program impact. Relevant to the Australian context, to date we are unaware of any high-quality evaluation to compare the differential impact of early childhood education being delivered through family day-care, long day-care providers, or preschool on developmental outcomes.

A further ingredient to consider is pedagogy, however the evidence behind the best approach to early childhood pedagogy continues to be debated in the scientific literature. Evaluation results from the Head Start program in particular indicate impact "fade-out", where the positive effects of 3-year-old children attending pre-Kindergarten on children's academic and cognitive skills become smaller and sometimes disappear by the third grade of primary school. This fade out is actually due to those children who didn't attend pre-school "catching-up" to those that did after a few years of attending primary (so the difference between the two groups fades out). The authors of some of these studies showing fade out (Puma, Bell et al. 2010, Abenavoli 2019) suggest that to make pre-K programs more effective, it may be important to increase the amount of instructional pedagogy to support children's unconstrained skills, and in particular vocabulary, problem-solving and critical thinking. This research highlights that consideration of 3-year-old preschool does not stop at dose and teaching ratios, but also the mix of pedagogies. Blending pedagogies together, including instructional with inquiry and play based learning appropriate for 3-year-old children, requires well trained staff with formative assessments to support their practice.

Variability in the impact of outcomes according to the different developmental domains for different participant characteristics have been noted across studies. Whilst evidence is relatively robust for ECEC having a positive impact on cognitive outcomes this is not the case for socioemotional outcomes (Yoshikawa, Weiland et al. 2013, Phillips, Lipsey et al. 2017, Molloy, Quinn et al. 2019). Negative socio-emotional outcomes have been linked to exposure to centre-based care in RCT, quasi-experimental and longitudinal cohort studies (Gormley and Gayer 2005, Fitzpatrick 2008, Siraj-Blatchford, Taggart et al. 2008). By contrast, other large scale longitudinal studies report positive socioemotional outcomes (Zhai, Brooks-Gunn et al. 2011). A recent study using instrumental variable analysis (Lee, Nakamura et al. 2022) analysing Head Start data, showed positive socioemotional outcomes including decreased behavioural concerns measured at one year post the intervention, in contradiction to previous analyses of Head Start data sets (Puma, Bell et al. 2010, Lee, Zhai et al. 2014). Positive socioemotional skills based on teacher report, were also noted in a US RCT of the effects of a full day pre-K program on development in the early primary years, in this case coupled with improvements in a range of cognitive and physical measures (Atteberry, Bassok et al. 2019). The mixed results, and relative lack of studies evaluating socioemotional outcomes, have been attributed to a number of factors including variation in evaluation methodology, including for example teacher- or parent-report, the relatively less developed measures for social-emotional and executive function domains compared with academic outcomes, and a relative lack of research into which socioemotional elements at pre-school are most important for later development (Meloy, Gardner et al. 2019, Horm, Jeon et al. 2022).

A key consideration for the expansion of early childhood education to 3-year-old children is the combination of base universal services with progressively targeted services/elements for those that need greater support. In the context of ECEC, universal services are inclusive and available to all children with the aim to enhance development, whereas targeted services are provided for selected high risk populations groups (often based on socio-economic background, parental characteristics, geographical locations, or developmental concerns). This targeting can miss many of the children who ultimately should receive support, whereas not all those who are identified as being at risk require the service, often leading to enhanced stereotyping and stigma. As such, universal services are more effective at identifying and reaching all targeted children, however the targeting of services is less costly, allowing for these services to be of higher intensity compared to universal services. Considering the findings from this review (i.e., evidence for targeted services and mixed evidence for universal services), any consideration of universal service provision should ensure that children and families with the greatest needs are afforded more intensive supports ideally with an efficient tiered system of targeted services including parental support. Proposed explanations for differences in outcomes between universal and targeted programs include variations in quality, program design and implementation, the sample population, and the broader context of the study setting (Barnett and Jung 2021).

No matter if targeted or universal, when considering the evidence behind quality, pedagogy and service modality together, the optimal number of hours per week, assuming a minimum quality standard, will differ depending on the home circumstances of the child, meaning a flexible high quality service system will be required. Aspects of quality should primarily consider delivering services in a way that facilitates a close and positive relationships between the staff, children and parents, where a child sees their ECEC as a safe, fun and affirming learning environment. Any modality of service delivery should engage parents, ideally with role modelling and assistance to facilitate their ability to support their child's growth, development and learning. Both parents and children are more likely to

be engaged when they trust that their ECEC service will provide encouragement and emotional support, thus leadership in the centre/pre-school should foster an inclusive culture supporting all families no matter what their socio-economic or cultural background.

Although the academic survey we conducted was small and targeted, it largely reflects our finding of mixed evidence and lack of quality findings within the context of 3-year-old preschool. What is mostly agreed amongst the academics are the cost-benefits of childcare and the structural elements that make a quality service such as teacher qualifications, staff:child ratios, pedagogy, and parental involvement. Alternatively, there is more debate over evidence of dosage, universal or targeted implementations, and implementation modality. What the data shows for academics is there is a clear gap of knowledge in terms of what is considered 'important' and where the scientific evidence sits in terms of strength. The strength of evidence for all domains does not outweigh its importance, thus there is a great opportunity for further research into the implementation of 3-year-old preschool, and South Australia has a rare opportunity to be able to scientifically test what works and what does not.

Opportunity for new evidence

Given the findings from both the literature review and survey of eminent academics, it would be remiss not to highlight the unique opportunity South Australia has to make a significant contribution to the generation of high-quality evidence for preschool, especially for children under 4 years of age. Indeed, the need for such evidence is sought by policy makers worldwide. Recently, through the rollout of 3-year-old kindergarten in Victoria, the Educational and Developmental Gains in Early Childhood (EDGE) study is being run by the University of Melbourne in partnership with the Front Project and the Victorian Department of Education and Training (The University of Melbourne 2022). It aims to evaluate the universal implementation of three-year-old kindergarten in the state, although as the study is in the early stage, there is little information on how they intend to conduct this research. Unfortunately, there is also no possibility of EDGE conducting the research in the form of a randomised control trial, as the roll out of 3-year-old preschool has already started as a universal implementation.

Ideally any new roll out of 3-year-old preschool, in whatever form/s eventuates, would have a randomised element i.e., rolled out in a staggered start or stepped wedge approach, allowing for genuine impact evaluation and economic assessment. Such evaluations need not be cumbersome nor expensive if designed well, but could establish contemporary evidence for continuous improvement and enhancements.

At a minimum there should be specific documentation of modalities, and performance information embedded in any budget development processes and any contracting arrangements. Data should be collected for individual children in a way that can be administratively linked to the existing data linkage infrastructure within South Australia. Such data should include enrolment and participation levels (days, hours). Use of child development checks and formative assessments should be integrated into practice to support both early identification of any developmental delays and to support staff in tailoring their practice to children's developmental/learning stage and needs. Of course, service level data should include quality measures, as well as program details to understand how different pedagogical programming benefits children in different ways across time.

Considering the strong evidence behind the importance of high quality and intensity, services should be externally monitored to ensure that programs are effectively delivered and are faithful to their

intended design with appropriate quality standards. Any measures of child outcomes should be of value to educators and caregivers, as well as for community and system use.

The key aspects of quality conditional on participation level are live research questions with significant economic implications and deserved of robust cost-benefit evaluation. Ultimately, we would seek to demonstrate the programs benefits to the community, improve effectiveness, and create an opportunity to share information about what works and what doesn't as the service expands to scale.

APPENDICIES

APPENDIX 1: DEVELOPMENTAL MILESTONES

	75% can do by 3 years	75% can do by 4 years	75% can do by 5 years
Social/Emotional Development	• Calms down within 10 minutes after you leave her, like at a childcare drop off • Notices other children and joins them to play	• Pretends to be something else during play (teacher, superhero, dog) • Asks to go play with children if none are around, like "Can I play with Alex?" • Comforts others who are hurt or sad, like hugging a crying friend • Avoids danger, like not jumping from tall heights at the playground • Likes to be a "helper" • Changes behaviour based on where she is (place of worship, library, playground)	• Follows rules or takes turns when playing games with other children • Sings, dances or acts for you • Does simple chores at home, like matching socks or clearing the table after dinner
Language/Communication	• Talks with you in conversation using at least two back-and-forth exchanges • Asks "who," "what," "where," or "why" questions, like "Where is mummy/daddy?" • Says what action is happening in a picture or book when asked, like "running," "eating," or "playing" • Says first name, when asked • Talks well enough for others to understand, most of the time	• Says sentences with four or more words • Says some words from a song, story, or nursery rhyme • Talks about at least one thing that happened during his day, like "I played soccer." • Answers simple questions like "What is a coat for?" or "What is a crayon for?"	• Tells a story she heard or made up with at least two events. For example, a cat was stuck in a tree and a firefighter saved it • Answers simple questions about a book or story after you read or tell it to him • Keeps a conversation going with more than three back-and-forth exchanges • Uses or recognizes simple rhymes (bat-cat, ball-tall)
Cognitive	• Draws a circle, when you show him how • Avoids touching hot objects, like a stove, when you warn her	• Names a few colours of items • Tells what comes next in a well-known story • Draws a person with three or more body parts	• Counts to 10 • Names some numbers between 1 and 5 when you point to them • Uses words about time, like "yesterday", "tomorrow", "morning" or "night" • Pays attention for 5 to 10 minutes during activities • Writes some letters in her name • Names some letters when you point to them
Physical Development	• Strings items together, like large beads or macaroni • Puts on some clothes by himself, like loose pants or a jacket • Uses a fork	• Catches a large ball most of the time • Serves himself food or pours water, with adult supervision • Unbuttons some buttons • Holds crayon or pencil between fingers and thumb (not a fist)	• Buttons up buttons • Hops on one foot

Source: Centres for Disease Control https://www.cdc.gov/ncbddd/actearly/milestones/index.html

APPENDIX 2: SEARCH CRITERIA

Database	HITS	Exported to endnote
Pubmed		
Search: (((((child*[Title/Abstract] OR toddler*[Title/Abstract] OR boy*[Title/Abstract] OR girl*[Title/Abstract] OR preschooler* or[Title/Abstract]) AND (kindergarten*[Title/Abstract] OR preschool*[Title/Abstract] OR childcare[Title/Abstract] OR playgroup*[Title/Abstract] OR ECE[Title/Abstract] OR "early childhood education*"[Title/Abstract])) AND (learning[Title/Abstract] OR development[Title/Abstract] OR well-being[Title/Abstract] OR education*[Title/Abstract])) AND (outcome*[Title/Abstract] OR development*[Title/Abstract])) AND (intervention*[Title/Abstract] OR program*[Title/Abstract] OR approach*[Title/Abstract])) AND ("3 year old"[Title/Abstract])	39	11
Search: ((((outcome*[Title/Abstract] OR development*[Title/Abstract])) AND (intervention*[Title/Abstract] OR program*[Title/Abstract] OR approach*[Title/Abstract])) AND (kindergarten*[Title] OR preschool*[Title] OR childcare[Title] OR playgroup*[Title] OR ECE[Title] OR "early childhood education*"[Title])) AND (learning[Title] OR development*[Title] OR well-being[Title] OR education*[Title]) Filters: Meta-Analysis, Randomized Controlled Trial, Review, Systematic Review, in the last 10 years	93	38
Search: ((((kindergarten*[Title] OR preschool*[Title] OR childcare[Title] OR playgroup*[Title] OR ECE[Title] OR "early childhood education*"[Title])) AND (learning[Title/Abstract] OR development[Title/Abstract] OR well-being[Title/Abstract] OR education*[Title/Abstract])) AND (outcome*[Title/Abstract] OR development*[Title/Abstract])) AND (intervention*[Title] OR program*[Title] OR approach*[Title]) Filters: Meta-Analysis, Randomized Controlled Trial, Review, Systematic Review, in the last 10 years	161	22
((3 year old[Title]) AND (kindergarten*[Title] OR preschool* OR childcare[Title] OR playgroup* OR ECE[Title] OR "early childhood education*")) AND (learning*[Title] OR development*[Title] OR well-being[Title] OR outcome*[Title])	1	0
(("3 year old"[Title/Abstract]) AND ("kindergarten*"[Title] OR "preschool*"[Title] OR "childcare"[Title] OR "playgroup*"[Title] OR "ECE"[Title] OR "early childhood education*"[Title]) AND ("learning*"[Title] OR "development*"[Title] OR "well-being"[Title] OR "outcome*"[Title] OR quality[Title]))	2	0
((duration[Title] OR dosage[Title]) AND (kindergarten[Title] OR preschool[Title] OR childcare[Title] OR playgroup[Title] OR ECE[Title] OR early childhood education[Title])) AND (learning[Title] OR development[Title] OR well-being[Title] OR outcome[Title])	1	0
((duration[Title/Abstract] OR dosage[Title/Abstract]) AND (kindergarten[Title/Abstract] OR preschool*[Title/Abstract] OR childcare*[Title/Abstract] OR playgroup[Title/Abstract] OR ECE[Title/Abstract] OR early childhood education[Title/Abstract])) AND (learning[Title/Abstract] OR development*[Title/Abstract] OR well-being[Title/Abstract] OR outcomes*[Title/Abstract])	103	Poor relevance
(((duration[Title/Abstract] OR dosage[Title/Abstract]) AND) AND (learning[Title/Abstract] OR development*[Title/Abstract] OR well-being[Title/Abstract] OR outcomes*[Title/Abstract])) AND (kindergarten[Title] OR preschool*[Title] OR childcare*[Title] OR playgroup[Title] OR ECE[Title] OR early childhood education[Title])	30	Poor relevance
(("learning"[Title/Abstract] OR "development*"[Title/Abstract] OR "well-being"[Title/Abstract] OR "outcomes*"[Title/Abstract]) AND ("kindergarten"[Title] OR "preschool*"[Title] OR "childcare*"[Title] OR "playgroup"[Title] OR "ECE"[Title] OR "early childhood education"[Title]) AND ("duration"[Title] OR "dosage"[Title])) AND ((y_10[Filter]) AND (clinicaltrial[Filter] OR meta-analysis[Filter] OR randomizedcontrolledtrial[Filter] OR review[Filter] OR systematicreview[Filter]))	1	0
Subtotals	431	71
Scopus		
(SRCTITLE (3 year AND old) AND TITLE-ABS-KEY (childcare OR daycare OR kindergarten OR pre-k OR pre-kindergarten OR preschool*) AND TITLE-ABS-KEY (quality OR outcome* OR learning* OR "development*" OR "well-being" OR "outcome*" OR quality))	0	
(KEY (3 year AND old) AND TITLE-ABS-KEY (childcare OR daycare OR kindergarten OR pre-k OR pre-kindergarten OR preschool*) AND TITLE-ABS-KEY (quality OR outcome* OR learning* OR "development*" OR "well-being" OR "outcome*" OR quality))	27	2
(KEY (3 year AND old) AND KEY (childcare OR daycare OR kindergarten OR pre-k OR pre-kindergarten OR preschool*) AND KEY (quality OR outcome* OR learning* OR "development*" OR "well-being"))	0	
(TITLE-ABS-KEY (3 year AND old* OR 3-year-old*) AND TITLE (childcare OR daycare OR kindergarten OR pre-k OR pre-kindergarten OR preschool*) AND TITLE-ABS-KEY (quality OR outcome* OR learning* OR "development*" OR "well-being") AND TITLE-ABS-KEY (program* OR intervention* OR approach*))	499	29
TITLE-ABS-KEY (two AND versus AND one AND year AND of AND preschool AND outcomes) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (SUBJAREA , "PSYC") OR LIMIT-TO (SUBJAREA , "MULT") OR LIMIT-TO (SUBJAREA , "SOCI")) AND (LIMIT-TO (LANGUAGE , "English"))	56	5
Subtotals	582	36
Campbell Library		
"dosage or duration" in Title and "kindergarten OR ECECor early childhood education or preschool or playgroup" in Title and "outcome* or development or well-being" in Title published in "Campbell Systematic Reviews"	0	0
"dosage or duration" in Keywords and "kindergarten OR ECECor early childhood education or preschool or playgroup" in Keywords and "outcome* or development or well-being" in Keywords published in "Campbell Systematic Reviews"	0	0
"preschool or kindergarten or childcare or playgroup or ECECor early childhood education or Pre-K" anywhere	1	0
Subtotals	1	0
World Bank		
"preschool or kindergarten or childcare or playgroup or ECECor early childhood education or Pre-K"	3	2

Subtotals	3	2
ERIC		
("3 year olds") AND ("pre-school) OR (“Kindergarten”) OR (“early childhood education”) OR (“Montessori”) OR (“Reggio Emilia”) OR (“Pre-K”) OR (“playgroup”) OR (“community playgroups”) OR (“Steiner”) AND (“learning”) OR (“skill development”) OR (“achievement”) OR (“emotional development”) OR (“outcome”) OR (“intervention”) OR (“approach”) Last 10 years, reports and research, Journal articles, RCT, intervention	15	0
("3-year-olds") AND ("pre-school) OR (“Kindergarten”) OR (“early childhood education”) OR (“Montessori”) OR (“Reggio Emilia”) OR (“Pre-K”) OR (“playgroup”) OR (“community playgroups”) OR (“Steiner”) AND (“learning”) OR (“skill development”) OR (“achievement”) OR (“emotional development”) OR (“outcome”) OR (“intervention”) OR (“approach”) Last 10 years, reports research, interventions, ECE	20	3
(“dosage or duration”) AND (“kindergarten”) OR (“ECE”) OR (“early childhood education”) OR (“preschool”) OR (“playgroup”) AND (“outcome”) OR (“development”) OR (“well-being")	18	2
Subtotals	53	5
Google Scholar		
quantifiable impact of ECEC on child development and early skill formation (2013-2022)	988	4
quantifiable impact of ECEC on 3-year-old development and early skill formation (2013-2022)	27	0
impact of ECEC on 3-year-old development and early skill formation (2013-2022)	46	1
Subtotals	1061	5
Cochrane		
(“Dosage”) OR (“Duration”)("3 year olds") AND ("pre-school) OR (“Kindergarten”) OR (“early childhood education”) OR (“Montessori”) OR (“Reggio Emilia”) OR (“Pre-K”) OR (“playgroup”) OR (“community playgroups”) OR (“Steiner”) AND (“learning”) OR (“skill development”) OR (“achievement”) OR (“emotional development”) OR (“outcome”) OR (“intervention”) OR (“approach”) Last 10 years, reports and research, Journal articles, RCT, intervention, child health	1808	0
(“3 year olds") AND ("pre-school) OR (“Kindergarten”) OR (“early childhood education”) OR (“Montessori”) OR (“Reggio Emilia”) OR (“Pre-K”) OR (“playgroup”) OR (“community playgroups”) OR (“Steiner”) AND (“learning”) OR (“skill development”) OR (“achievement”) OR (“emotional development”) OR (“outcome”) OR (“intervention”) OR (“approach”) Last 10 years, reports and research, Journal articles, RCT, intervention, child health	1051	0
Subtotals	1051	0
Subtotals (all databases)	3179	119

APPENDIX 3. SUMMARY OF STUDIES FOUND BASED ON SEARCH CRITERIA

Resource	Study type	Theme	Origin	Participants (N)	Age	Intervention	Content	Primary outcome	Results
(Morgan, Grounds et al. 2022)	RCT	Physical activity, parenting	Aus	125 fathers, 125 children	3.9 +/- 0.8 years	Parenting program (Healthy Youngsters, Healthy Dads)	Workshops, education sessions, home based activities	Children's mean steps/day	significant group-by-time effect for steps per day at 10-weeks (+ 1417, 95%CI: 449, 2384) and 9-months follow-up (+ 1480, 95%CI: 493, 2467)
(Alhassan, St Laurent et al. 2019)	RCT	Healthy lifestyle	USA	15 (I): 20 (C)	PADS age 3.7 years; CON age 3.6 years	Physical activity (PA), diet and sleep (PADS) preschool intervention	12-week health behaviour intervention based on Massachusetts Early Learning Standards; fun, age-appropriate activities implemented 4 days per week; short bouts of curriculum (10-15mins) and short bouts of PA (5 mins); diet curriculum (15mins) sleep curriculum 10 mins; home online newsletters and content	PA levels assessed at baseline, 6 and 127 weeks	Significant group by time interactions were observed for moderate to vigorous PA (percentage of time) during the preschool day (PADS: baseline = 10.6% (4.2%), 12 wk = 13.2% (2.3%); CON: baseline = 12.4% (3.9%), 12 wk = 11.2% (3.6%); P = .02).
(Iaia, Pasini et al. 2017)	RCT	Healthy lifestyle	Italy	199 (I); 226 (C)	3.39 years (I): 3.43 (C)	Health promotion (4 or more serves of veg/fruit per day, 2 or more of active play per day, less than one hr of TV, O sugar sweetened beverages per day	6-month intervention at local health centres (2 x motivational interviews with parents); childcare: teacher training, followed by involving children in learning on healthy eating	Children's combined health behaviour score (CHBS) at home; secondary outcome BMI trajectory	After 2 years from baseline, 48.4% of intervention group children showed a low-risk CHBS in comparison with 28.0% of control group children. A multilevel analysis showed that they were by far more likely to achieve low-risk scores (adjusted OR: 3.41; 95% CI: 1.48–7.88; P = 0.004). Our BMI outcomes showed no significant difference between groups
(Fernandez-Rao, Hurley et al. 2014)	Cluster RCT	Nutritional intervention-micronutrition fortification	India	Preschool phase:	38-48 mo.	Micronutrient supplement in govt run preschool centres for 12 mo.		Child development, growth, micronutrient status	
(Toussaint, Streppel et al. 2021)	RCT	Healthy eating/ exercise	Netherlands	137 (I); 112 (C)	Mean age 3 years (I/C)	A Healthy Start (AHS),	9-month program with face-to-face meetings, for teachers	Teachers' knowledge, attitude,	A positive effect on teachers' knowledge about the Dutch dietary guidelines was found after the

						PLAYgrounds for TODdlers		food/activity-related practices, level of confidence in promoting healthy behaviours; teachers' and children's BMI, body composition, dietary intake, physical activity level	programme A Healthy Start (difference = 1.38; 1-sided 95% CL = 0.29; p = 0.02). This effect was not sustained at 9 months (difference = 0.34; 1-sided 95% CL = -0.76; p = 0.31). The overall intervention had a positive effect on 3 of the 5 attitude statements regarding a healthy lifestyle (difference ranged from 0.34 to 0.55) and on the practice scale Activity-related-Modelling (difference = 0.16; 1-sided 95% CL = 0.06; p = 0.01). No intervention effects were observed on food-related practice scales and the level of confidence in promoting healthy behaviours. At this stage, no effects were seen on teachers' and children's BMI (z-score).
(Toussaint, Streppel et al. 2020)	RCT	Physical activity program in deprived urban areas	Nether lands	41 preschools in Amsterdam	2.5 up to 4 years	PLAYgrounds for TODdlers program (PLAYTOD)	2x teacher training sessions and coaching	Activating roles of the teachers, number of activities on the playground, number of fundamental movement skills of children, estimated physical activity	After the program, the activating role of teachers on intervention playgrounds improved. Moreover, the program and consecutively the changes made by teachers had a positive effect on the number of different activities and the quality of children's physical activity

(Okely, Stanley et al. 2020)	RCT	Physical activity	Aus	283 (I), 225 (c)	3-year-olds	Jump Start	18-month multi-component physical activity intervention; teaches gross motor skills with daily 20-minute lessons, practice sessions, short periods of high intensity activities per day; connection of movement with learning; family education	Accelerometry data; weight, height, BMI	no significant intervention effects on mins/hr. spent in physical activity (adjusted difference = − 0.17 mins/hr., 95% CI (− 1.30 to 0.97), p = 0.78). A priori sub-group analyses showed a greater effect among overweight/obese children in the control group compared with the intervention group for mins/hr. of physical activity (2.35mins/hr., [0.28 to 4.43], p = 0.036).; lack of effect largely due to low levels of implementation
(Nekitsing, Blundell-Birtill et al. 2019)	Cluster RCT	Healthy diet	UK	267	38.9+/- 0.5 months	Story book and sensory play	Group reading of supplied storybook 5 times over 9 preschool days (2 weeks) plus congruent (celeriac) or noncongruent (carrot) sensory play; sound, sight, touch, smell	Primary: celeriac intake; secondary recognition of target vegetable, age/sex of child	Children receiving the congruent (celeriac) storybook had higher odds of eating celeriac compared to children who received the incongruent (carrot) storybook. Receiving congruent sensory play increased the odds of eating celeriac, whereas receiving incongruent sensory play did not. Sensory play (congruent or incongruent) increased the odds of eating some celeriac in non-eaters compared to storybook only conditions.
School Readiness, literacy, numeracy									
(Cuder, Vidoz et al. 2022)	RCT	numeracy	Italy	43 (I); 43 (C)	Mean age 42.9 months (I); mean age 43.7 months	Numerical training	Small group exposure to numerical training video twice a week for 12 sessions	Counting, cardinality, number line knowledge	significant main effect of group (Wilks' Lambda = 0.725, F(5,80) = 6.07, p < 0.001, _p 2 = 0.275), suggesting statistically significant differences between the two groups at post-test. The univariate analysis showed a statistically significant difference between the groups for counting F(1,84) = 25.8, p < 0.001, _p 2 = 0.235, pointing to different effects of the two interventions. Bonferroni's adjusted pairwise

									post-hoc comparisons indicated a significant effect of the numerical training on counting ability compared with the control group (Meandiff = 5.00, p < 0.001, d = 1.095). No statistically significant difference emerged between the groups for cardinality F(1,84) = 0.19, p = 0.661, _p 2 = 0.002, or number line knowledge F(1,84) = 1.16, p = 0.285, _p 2 = 0.014.
Socioemotional Skills									
(Solomon, Plamondon et al. 2018)	RCT	Self-regulation	Canada	106 (I); 89 (C)	mean age = 45.1 months, range 37.2–55.34 months (I); mean age = 45.9 months, range 36.5–62.3 months (C)	Tools of the Mind curriculum versus YMCA Playing to Learn curriculum ("control group")	Teacher directed play-based activities to promote SR	HTT, SDQ, SCBE scores	We found no evidence that curriculum had an effect on the primary outcomes; affect of curriculum moderated by initial language ability not significant; we found a significant interaction between curriculum and children's initial level of hyperactivity/inattention on one of our executive functions tasks. Amongst children with high levels of hyperactivity/inattention, those who received Tools instruction showed significantly greater improvement than those who received YMCA PTL instruction on HTT
Childcare characteristics									
(Landry, Zucker et al 2014)	RCT	Responsive teacher practices	USA	N=542	Mean age at pre-test 2.90 years (SD 0.59)	Responsive Early Childhood Curriculum (RECC), and RECC plus explicit social–emotional classroom activities (RECC_).	Curriculum manuals, materials, training, stipends; training and coaching	Childcare teacher behaviours (TBRS); child emotional understanding (expressive emotion understanding, receptive emotion understanding, situational emotion	RECC and RECC_ interventions had several important impacts on children's skills related to social competence and behavior regulation (effect size range _ 0.21– 0.41), and emotion understanding (effect size range _ 0.25– 0.48); greater decreases in anxiety than children in the control condition (effect size _ _0.55); lower anger and aggression scores in the RECC group compared with the RECC_ (effect

								understanding; child social-emotional functioning (social competence); child cognitive performance (EOWPVT); receptive language (PLS-4); early literacy skills (Pre-CTOPPP); mathematical knowledge (CMA-DE); children's relationship with teacher (adult-child relationship)	size _ _0.36) and control groups (effect size _ _0.55). Greater gains for children in both interventions compared with control children on teachers' ratings of the closeness of the teacher– child relationship (effect size _ 0.42) and decreases in conflict (effect size__0.49)
Access									
Price et al., (2022)	RCT	Impact of Nurse Home Visiting on the Use, Dose and Quality of Formal Childcare	Aus	722 pregnant Australians Eighty-three percent of parents provided data at 2 years (306 intervention/290 control); and 69% at 3 years (255 intervention/240 control).	3-year-olds	Intervention: 25 nurse home visits to 2 years; Control: universal well-child nursing service.	Parents reported formal ECEC use (government approved and subsidized), comprising long or family day care (LDC), and reasons for use	There was no evidence of group differences in ECEC uptake or quality, although control families may have used more LDC at 3 years. The right@home NHV program did not impact ECEC uptake or quality, although it	Intervention parents reported using ECEC to support their children's social development more frequently than controls (48% vs 33%) but less for work/study (39% vs 46%).

								may influence parents' reasons for using ECEC.	
Implementation Modality									
Brinkman et al., 2022	RCT	Testing multiple modalities of ECEC interventions. Classroom based or ECEC specific	Lao PDR	7,520	2-year-olds	Community Child Development Groups (CCDG) versus Multi Age Teaching (MAT)	Purpose built childcare intervention, or expansion of pre-primary classrooms to include 2-year-olds	eHCI	Implementation modalities were largely equal in terms of increasing child development outcomes with CCDG favoured in some domains in short term outcomes but not sustained. MAT significantly cheaper to implement for little drop in efficacy.

APPENDIX 4. FULL LIST OF THOSE INVITED TO PARTICIPATE IN THE PULSE SURVEY

International academics:

A/Prof Bet Helena Caeyers – Norwegian School of Economics
Prof Ted (Edward) Melhuish – Oxford University
A/Prof Eric Duku McMaster University
Dr Erika Dunkelberg, Universidad Antonio Ruiz de Montoya
Dr Eugenia Volen, Trust for Social Achievement
Prof Jian Fan Shanghai Medical University
Dr Edwina Zhang, Shanghai Medical University
Dr Jin Zhao, Shanghai Medical University
Prof John Frank, Edenborough University, UK
Prof Joost de Laat, University of Amsterdam, Netherlands
Dr Kimberly Boller, Nicholson Foundation, USA
Dr Luis Crouch, RTI, USA
Prof Michael Willoughby, RTI, USA
Dr Catherine Henny, RTI, USA
Prof Menno Pradhan, Vanderbilt University
A/Prof Magdalena Janus, McMaster University
Prof Margaret Curtin, University College Cork
Prof Marni Bronwnell, University of Manitoba, Canada
Dr Mary Young, Harvard University, USA
Prof Nirmala Rao, University of Hong Kong
Dr Nozomi Nakajima, Harvard University
Dr Patricia Kariger, University of California, Berkley
Prof Patrick Ip, Hong Kong ECD Research Foundation
Prof Paul Gertler, University of California, Berkley
Dr Peter Srouji, Poverty Action
Mr Plamen Danchev, Global Partnerships for Education
Prof Scott D Rozelle, Stanford University
A/Prof Stephen Bayley, University of Cambridge
Prof Susan Walker, University of West Indies
Prof Stephen Barnett, National Institutes for Early Childhood Education Research, Rutgers
Prof Milagros Nores, National Institutes for Early Childhood Education Research, Rutgers
Dr Christian Morabito, Regio Emilio
Dr James Dietz, UNESCO Expert Consultant
Prof Michel Vandenbroeck, University of Gent
Prof Abbie Raikes, University of Nebraska
Prof Linda Platas, University of California

World Bank

Dr Dessislava Valerieva Kuznetsova
Ms Deborah Newitter Mikesell
Prof Eduardo Velez Bustillo
Dr Harry Anthony Patrinos
Dr Janssen Edelweiss Nunes Teixeira
Ms Karishma Talitha Silva

Dr Kevin Alan David Macdonald
Dr Ning Fu
Mr Pedro Cerdan-Infantes

University of South Australia
Dr Anne Glover
A/Prof Victoria Whitington

The University of Adelaide
Dr Angela Gialamas
Dr Catherine Chittleborough

Other Australian Universities
Prof Geoff Woolcock - Centre for Evidence and Implementation, University of Southern Queensland
Prof Marc de Rosnay, University of Woolongong
Prof Robert Tanton, University of Canberra
Prof Sharon Goldfeld, Royal Childrens Hospital, University of Melbourne
Prof Susan Woolfenden, University of New South Wales
Prof Susan Mentha, University of Melbourne
Prof Tim Moore, University of Melbourne
Prof Valsamma Eapen, University of New South Wales

Smith Family – Director of Research
Dr Anne Hampshire

Director of the Benevolent Organisation and now the Australian Commissioner for Children
Ms Anne Hollonds

APPENDIX 5. FREE TEXT RESPONSES FROM PULSE SURVEY PARTICIPANTS

opinion[quali]	opinion[ratio]	opinion[pay]	opinion[modality]	opinion[curric]	opinion[dose]	opinion[uni]	opinion[econ]	opinion[parent]	opinion[phys]
Children of all ages need the best qualified educators: regardless of which stage of development they are at	These need to be commensurate with best practice	Qualified educators warrant relevant pay and conditions: early childhood educators are laying the foundations fo all education which follows, so they must be properly renumerated for the work and qualifications they hold	All other areas are outside my expertise and I am not across the evidence.....						
To make a substantial difference at least 50% of staff would need to be of a bachelors' degree(ISCED 6). However, continuous PD os of equal importance (and therefore: so are child-free hours)	For 3-year-olds, ratios better not be above 1:8 or 1:10, depending also on logistical support and qualifications	Low conditions increase staff turnover and that is detrimental for quality		Beware of a curriculum that is too narrowly focused on early learning as it may prove to be counterproductive. A social pedagogy oriented curriculum with attention for "educare" (the integration of care and education) is best practice.	At least half time, but research yields inconsistent results	this is a false dichotomy. Worldwide, children at risk are best teacher and served in universal provision.	the benefits regarding employment (and thus tax returns) are clear. The other return on investment research rests on very weak methodology	Is important and should be reciprocal	less my field of expertise
need a graduate in each classroom	current ratios are Ok. Good ratios more important for younger children	You need stability of staff. Without good pay and conditions this is impossible.	Various types of early education can be effective. Staff quality, pp for adult-child interactions is crucial.	A mixed model involving both child-initiated and adult-initiated activities works best. Structure is necessary but not to the exclusion of child-initiated activities.	20 hours a week.	Universal services will be better quality. Services only for poor people become poor services. Pre-school benefits everyone but benefits the poor the most.	Benefits include increased female workforce participation with increase in taxes received, better educational and social out comes for children all the way through to adulthood therefore improving the competitiveness of the nation.	Parenting is the strongest influence on child outcomes. The evidence is overwhelming.	No strong evidence, but that does not mean unimportant, evidence is null, however, good resources will increase staff morale and potentially offer wider experiences to children.
This is very important.						Targeted is cost-effective			
4 year university degree early childhood teachers or equivalent, eg 2 year Master of Education ECE) leading programs supported by diploma in ECECeducators	1:10	Teacher level pay equivalent to teachers working in schools and some preschools, so not the Modern award	I don't know what this term means, needs explanation	EYLF, updated version, employing a play based curriculum, within a context of attachment based care, and inquiry and strengths based approaches that position children as active and capable agents who are contributing citizens from birth. Pedagogies should be culturally responsive and inclusive.	Determined between parents, teachers, educators and including children's views/reactions/ behaviours	Universal, we already have targeted	Every child has the right to an optimum early childhood education and start in life, one that enables them to participate fully in society in a way that they choose with abilities and qualifications to match, however children should not be seen as economic units who feed national outputs and wealth.	Teachers and educators at early years settings do well when they make partnerships that build mutual trust to the benefit of children	If children are currently located in long day childcare then the physical requirements should largely be in place, as long as they enable the offering of a rich learning environment. The issue lies with standalone preschools that don't have the space and other necessary physical provisions for three year olds.r three year olds

Qualifications matters in terms of specialization in early development and quality	Most studies have little variation in these, but studies that have randomly assigned lower ratios show important effects.	This is hard to randomize. But the literature shows low conditions affect morale, teacher depression, and teacher interactions.	It is more important that quality and the above are present.	Research based curriculums.	This also has to do with understanding the dual role of these programs in relation to childcare and preschool. the research on dosage still considers its important to continue to unpack different aspects of dosage (hours, school year, and quality)	This phrase is confusing. The research does point to universalism as optimal, targeted ends up being an intermediate step that is the choice given budget constraints.	Good quality programs are needed to fulfill the promise of large economic benefits. So quality (and the funding aligned) is critical for this.	Supports for family involvement, as well as for parental support of learning are starting to show to be critical in the process of long-term impact.	Resources are many things and this sentence is therefore confusing. Resources generally include teachers which are the central component in ECEC programs. However, if this is reflecting about solely physical resources some adequate level to support the learning process is important. In addition, systems seems to easily create a lot of inequality in resources if this is not considered carefully.
Key for high quality settings particularly for children from disadvantaged backgrounds	Key for high quality settings particularly for children from disadvantaged backgrounds	Need better recognition through this	Need support at all levels for high quality		600 hours per year	Need proportionate response to support disadvantaged communities	Clear - see Heckman;s work	Clear - see Perry Preschool, ABCderian	
Very important to provide developmentally appropriate care and education	Very important to provide individual attention to young children	Important to attract good teachers	Organised learning is more effective than informal learning to promote children's readiness	should be contextually and age appropriate		depends on resources available		important in all contexts	
relatively strong evidence-note the differences around the world	seems important but not sure if the evidence is very strong but stronger than for other areas	not sure of any evidence to support this-would suggest associated with qualifications	not sure what this meant	this is important in as much as educator-child relationship is important as is the understanding of child development etc	from a policy perspective this is very important and not much known- would be impotent to understand what the universal dose versus the proportionate dose for those children who may require/benefit from more	the only evidence is for targeted. No evidence for universal-what an opportunity SA! also to trial proportionate rather than targeted	important to establish a trial to show this-not aware of any good economic analysis of universal 3yo	this should be important but almost no evidence other than int he targeted trials which were holistic interventions eg Abcdenarian	not sure this is important in and of itself
								This is most important in rural China. Almost 0 child care	
		This is central to success, especially if there is an existing differential between teachers 0-3, 3-5, and 6+	I am not sure what this means. Here we talk about the confusing idea of a mixed delivery system--family or home-based care, regulated care in the community, and care in schools. Is that what you are getting at here? It is important as we see lower quality in community-based care.	To get to high quality implementation of an evidence-based curriculum, teachers need coaching and data to determine what aspects require quality improvement. What is missing from your list is evidence/data informed practice--with out it you cannot help teachers achieve a culture of continuous improvement.	There have been a few studies of this in the US, but not universal. We do know that very short exposure to care that is not well funded can do harm (Tennessee).	New York City, Georgia, Boston, and to some extent New Jersey are good examples of universal. We are missing great tests of one approach vs the other. These are hard studies to do and expensive which is why we need clever designs to get them done.		Our theories would imply this should be important but Greg Duncan and others have conducted analyses of Head Start and other programs with a parenting component and found it challenging to tease apart but generally not where the action is in outcomes.	Educare is an example of a commitment to physical space and design that is meant to enhance the experience of all enter. The SA Children's Centres were as good in this area and in most cases better than Educare in the US.

Implementation would be aligned with current certification/training for preschool teachers engaged with 4-year olds- so this might not be a significant constraint to implementation depending on the rate of pre-service graduation for teachers.	While there may be scope to decrease child to staff ratios for a three-year old classroom (from current standards for 4-year old classroom), research has not robustly shown small variations in such ratios having much impact on student outcomes. It would be instructive to look at ways to increase teaching assistants with commensurate qualifications to work with young children. Many countries find this a good way to build their ECECworkforce as such TAs gain experience and seek further PD in the field.	The work load for managing ECEC classrooms, especially for such young ages should not be underestimated. It is a very physical job and conditions and pay should not undervalue the teacher or the work that is conducted in such classrooms. The implementation modality would determine the conditions, but minimum standards such as functioning child centered bathroom facilities and furniture are essential. In addition, there needs to be access to outdoor play if possible.	If pursuing universal delivery then it will be important to consider whether various modalities would be required for different contexts and communities. ne size fits all	The curriculum is critical- and would need to align with current pre-school curriculum- but pedagogies will need to be developed that really focus on developmental stages for the younger cohort. Play-based learning is key.	For three-year olds, it would be difficult to envisage as long a day as for other pre-school 4 and 5 year olds- certainly the consistency is probably more critical than the exact number of hours. A few hours each morning is probably ideal, but is often not very convenient for families. The dose would need to be contextualized to the community demand. It would likely be aligned with the dose already used for 4 year old class I should think.	Here I am not familiar with the context for South Australia which would require a some kind of gap analysis to understand need for universal service delivery. Given budget considerations, I would guess that a more targeted approach would be prudent and it should be based on low income or other vulnerabilities.	adding the additional year would create more teaching jobs and TA jobs and provide some limited child care for working parents. The benefits from educating 3 year olds is more long term in school readiness and learning outcomes.	critical area	I don't have much information on physical infrastructure and resources currently available for 4 year olds- but would imagine some retrofitting for a younger cohort, and certainly adequate WASH facilities and outdoor play space.
From far away I hope that local authorities will be supportive of quality of teachers' policies	Hope cost-effectiveness criteria will be used to decide. I think quality of teachers and curriculum and pedagogy are more important	Opportunity cost will be taken into account to establish a market-defined salary. Support for teachers in the classroom is critical. Do not leave them alone providing materials and strong school principal		Critical, so I hope local authorities will recommend proper curricular content attending local conditions and national requirements	Time on task is relevant (number of days and hours in quality activities)	Use cost-effectiveness criteria. If budget is not a constrained, equity criteria will be justified.	This is the name of the game	For low-income families this will be critical	Cost-effectiveness criteria
My knowledge of evidence regarding teacher qualifications generally draws from a wider age range. The thrust of my understanding is that teacher qualifications are less important than teacher experience and the quality of their interactions with learners.		I understand that decent pay tends to be a necessary but not sufficient condition for achieving teacher quality.					There seems to be strong evidence regarding the importance of support for early years children.	Similarly, we know that parent/guardian involvement creates early gaps between rich and poor, which often widen over time. Interventions to support poor parents in children's early years can be valuable to close these gaps.	
Teacher education is really important	The lower the better, but there must be a sweet spot to balance to ensure cost-effectiveness	Hugely important	Not sure what that means	i'm not the best person to comment on that	Check the evidence	Proportional universality is the best of both worlds	As long as it is affordable to access, economic benefits are huge	Needs to be encouraged	Important, but the things listed above should be a priority

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