

# Child development education in the Neonatal Unit: Understanding parent developmental literacy needs, priorities and preferences

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## ABSTRACT

**Objective:** To describe child development knowledge needs, priorities, and preferences for education to enhance developmental literacy among parents with children admitted to the neonatal unit (NNU).

**Methods:** Two separate cohorts completed a survey; 1) Parents with children graduated from Australian NNUs (n = 316); 2) Parents with infants' inpatient at two South Australian NNUs (n = 209).

**Results:** Parents considered it extremely important to understand child development (Graduates: 80%; Inpatients: 71%). Inpatient parents reported lower child development knowledge. Almost half (42%) of graduate parents described the child development education provided by neonatal staff as poor or inadequate. There was consistency in preferences for developmental literacy education provision. Parents desired education to commence during NNU and continue post discharge. Priorities included content specific to preterm birth and how to support child development over the first two years of life. Individualised education by a Neonatal Nurse/Midwife was most preferred.

**Conclusion:** Mothers and fathers value guidance to support their child's development during NNU admission and early childhood. Our study highlights the importance of improved early developmental literacy education for parents with children admitted to the neonatal unit.

**Practice implications:** Our findings can be used to inform the creation of future educational resources targeting improved parent developmental literacy.

## 1. Introduction

Children admitted to a neonatal unit (NNU), particularly those born preterm (<37 weeks' gestation), are at increased risk for long-term neurodevelopmental morbidity [1–4]. Biological and medical factors that affect neurodevelopmental outcome are well documented [1,3,5–8]; yet recent evidence suggests that post-natal environmental factors, such as parenting, also influence long-term neurodevelopment and warrant further investigation [9,10]. Bio-ecological Theory [11] proposes that opportunities for learning that occur within the family are key proximal processes that drive and shape child development. As such,

parents are well placed to support child development within the NNU and over the early years of life [12,13]; maintaining exposure to behaviours and environments that foster developmental attainment and buffer risk for atypical development [14].

Research strongly supports that in order to optimally contribute, parents require adequate child development knowledge [15–18]. This knowledge of developmental milestones, beliefs, and behaviours that support their child's development and facilitate early identification of delay is termed developmental literacy [19]. Yet, few studies have assessed the level of knowledge parents have about child development [20], particularly among parents with NNU admitted children. Studies

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conducted to date focus on normative populations [16,21–23] or families in the post-discharge period, in countries other than Australia, with a paucity of fathers represented [15,17,18,24]. Similarly, much of what is known of parent education priorities and preferences in NNU has come from mothers [25,26]. Therefore, in-depth understanding of the perspectives and information requirements of fathers [27], and effective educational strategies to support parent developmental literacy in the NNU remain knowledge gaps. This is noteworthy given the increasing acknowledgement that parent education is an important duty of nurses and medical staff, with parents reliant on them as essential sources of information [21,28]. To inform the creation of novel patient-centred educational resources for developmental literacy, more information is needed from parents on the content to include and how best to provide it.

The aim of the current study was to specifically address these knowledge gaps by describing the child development knowledge needs of mothers and fathers with children admitted to Australian NNU's, comprising neonatal intensive care (NICU) or special care (SCBU). We sought to determine parent priorities and preferences regarding the content, timing, and delivery of education to enhance developmental literacy.

## 2. Methods

### 2.1. Study design

This is a descriptive, cross-sectional study. We considered this design appropriate for addressing study aims as it provides information on the prevalence of a problem or experience in a clinical population [29] and has been used by others to explore developmental care practices [30] and parental perspectives in the NNU [31–33] and in neonatal follow-up clinics [34]. This study obtained data from a survey completed by parents enrolled in two separate cohorts: 1) parents of NNU graduate children; and 2) parents of NNU inpatient infants. Results are presented in accordance with the Checklist for Reporting Results of Internet E-Surveys (CHERRIES) [35].

### 2.2. Variables

This study utilises responses from a 21-item research specific survey informed by a conceptual framework for parental information behaviours in NNU [36], and previously published elsewhere [31]. Mothers ( $n = 7$ ) with experience of their child requiring admission to an Australian NNU provided input into the survey length and ease of comprehension. The survey comprised three sections: 1) parenting experience; 2) concerns for their child's development; and 3) perceived child development knowledge level and educational delivery preferences. Relevant to this study is section three (Appendix A). Survey questions were designed to capture insights into parent developmental literacy needs, priorities, and preferences and were presented in either dichotomous (True / False) or multiple-choice format. Likert-type scales were used to assess parents perceived current developmental knowledge level, to rate the importance of understanding child development and content to include in educational resources (from not at all important to extremely important). The scales for adequacy of child development education provided by NNU staff ranged from inadequate to great; where "good" or "great" indicated high quality education provision; "poor" or "inadequate" indicated low quality. Ranking was used to determine parents' preferred method of education delivery; 1–2 indicated high preference; 3–4 medium preference; and 5–6 low preference.

### 2.3. Setting and participants

Cohort 1: Between 11th and 16th May 2015, an invitation and link to complete the open, voluntary online parent survey "Mums, Dads, Child Development and NNU", was posted to the Facebook page of the Miracle

Babies Foundation; a large Australian neonatal consumer organisation for parents with children born preterm or critically ill. Parents were eligible to participate if their child/ren had previously been admitted to NICU or SCBU as an infant. Participants completed the survey online using Survey Monkey (average response time 7 min). IP addresses were used to determine unique site visitors. No financial or other incentives were offered for participation.

Cohort 2: Parents with infants currently inpatient in NNU of two large, demographically diverse metropolitan teaching hospitals providing specialist neonatal services in Adelaide, South Australia: the 65 cot Women's and Children's Hospital (WCH), providing tertiary NICU and SCBU for critically ill and preterm newborns; the Lyell McEwin Hospital (LMH), comprising 16 SCBU cots. Parents who were over the age of 18 and the legal guardian of an infant not receiving palliative care were eligible to participate. Parents required sufficient English to provide informed consent and complete the study documents. In-person recruitment occurred seven days per week, including at night to reach working parents not available during office hours, between the two study sites: over 10 months (March – December 2017) at the WCH, and over 3 months (October – December 2017) at the LMH. Eligible parents were approached when their baby was clinically stable. Participants completed the survey on paper or online using Survey Monkey. Hospital medical records were accessed to confirm birth and demographic information.

### 2.4. Data analysis

Data analyses were performed with SPSS version 28.0 [37]. To address study aims, descriptive statistics (i.e. frequencies and percentages) were used to calculate the proportion of parent reported developmental knowledge level, information content priorities and educational delivery preferences, using the parent as the index. Given the differences in the selection and recruitment processes for the two parent cohorts (including the amount of time between their baby's NNU admission and survey response), we did not conduct comparative analyses. Rather, data is reported for each cohort separately. Percentages were calculated on the proportion of responses received for each survey item. To provide greater contextual understanding of whether preterm birth is a factor associated with parent developmental literacy needs, priorities and preferences, sub-group analyses were conducted to explore differences in responses between parents whose children were born preterm compared to term, using the chi square test (Yates continuity correction). Statistical significance was set at  $p \leq 0.05$ . Confidence intervals were set at 95%. No imputations were made for missing data.

### 2.5. Ethics

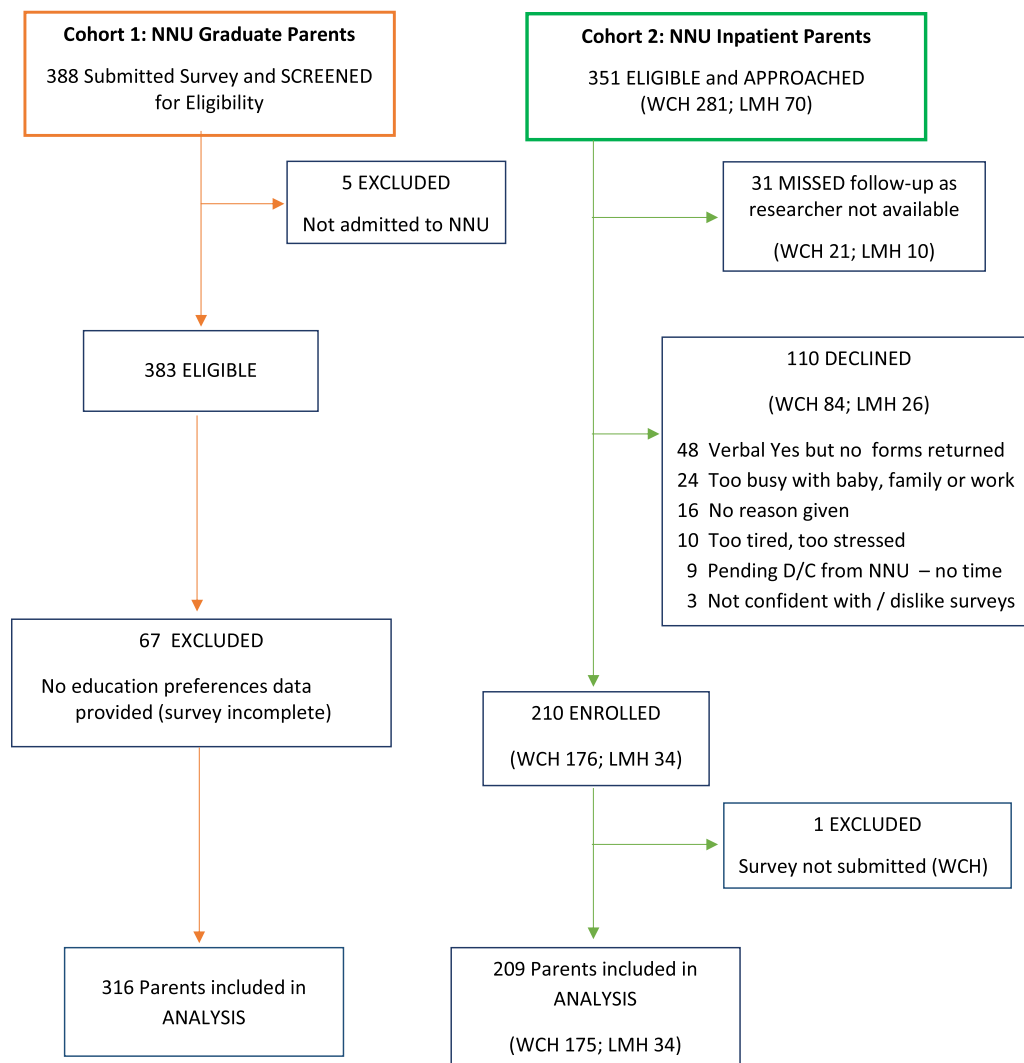
This study was approved by the Human Research Ethics Committee at the WCH and the LMH (HREC/15/WCHN/106). All parents gave consent to participate.

## 3. Results

### 3.1. Participants

Cohort 1, NNU Graduates: Of the 388 parents who consented to the online survey, 5 did not meet eligibility criteria (Fig. 1: Participant Study Flow). A further 67 failed to submit responses to this section of the survey and were excluded due to significant missing data. Therefore, responses from 316 parents were included in the analysis (82.5% survey completion rate). Cohort 2, NNU Inpatients: 351 eligible parents were approached to participate in the study; 210 parents consented, however 1 did not submit a survey. Therefore, 209 parents were included in the analyses; 42 (20%) during admission to NICU; 167 (80%) during admission to SCBU.

Study participants were predominantly parents with children born



**Fig. 1. Participant Study Flow.** Abbreviations: NNU, Neonatal Unit; WCH, Women's and Children's Hospital; LMH, Lyell McEwin Hospital; D/C, discharge.

preterm (Graduates: 288, 91%; Inpatients: 175, 84%); with a greater proportion of very preterm (VP: <32 weeks' gestation) children among NNU graduates (Table 1). Whilst the proportion of first-time parents was consistent between cohorts, NNU graduate responders were predominantly mothers, and were more likely to have experienced repeat NNU exposure. Greater father participation rates were seen in the NNU inpatient cohort, where the proportion of relative socio-economic advantage / disadvantage was similar to 2016 South Australian census data [38]; however, study parents were more likely to have attained a Bachelor degree or higher compared with national census data [39]. This information was not available for NNU graduate parents.

### 3.2. Child development knowledge needs and priorities

#### 3.2.1. Perceived importance of understanding child development

Most parents in each cohort considered it extremely important (Graduates: 254, 80%; Inpatients: 149, 71%) or very important (Graduates: 60, 19%; Inpatients: 58, 28%) to understand child development. Within each cohort, parents with children born preterm were significantly more likely to describe understanding child development as extremely important than parents with term born children (Graduates: PT: 233, 81% vs T: 21, 75%,  $p = 0.62$ ; Inpatients: PT 130, 74% vs T: 19, 56%,  $p = 0.05^*$ ).

#### 3.2.2. Current knowledge of child development

While parents most frequently described their current level of child development knowledge as good, this differed between cohorts and with the child's current age (Table 2). Parents of inpatient infants reported the lowest child development knowledge levels (15% poor or inadequate) and NNU graduate parents with high school aged children the highest. Within each cohort, minimal differences were seen between parents with preterm and term ( $\geq 37$  weeks' gestation) born children (Supplementary information 1).

#### 3.2.3. Adequacy of child development education provided by NNU staff

Parent evaluation of child development education received during NNU admission differed according to cohort (Fig. 2a). Almost half (42%) of graduate parents described receiving low quality education (poor or inadequate levels), while the rate for inpatient parents was 12%. Parents of inpatients in SCBU were more satisfied with the adequacy of staff provided child development education than parents in NICU ("Great": SCBU: 33, 20%; NICU: 4, 10%). No significant differences in parent responses were observed according to child's gestational age category within either cohort (Supplementary information 2).

### 3.3. Preferences for developmental literacy education

#### 3.3.1. Specific to preterm birth

Within each cohort, parents with children born preterm principally

**Table 1**

Characteristics of study participants and their children.

	COHORT 1 NNU Graduates	COHORT 2 NNU Inpatients
<b>PARENTS</b>	<b>N = 316</b>	<b>N = 209</b>
Mothers	310 (98.1)	120 (57.4)
Fathers	6 (1.9)	89 (42.6)
First time parent	197 (62.3)	132 (63.2)
Repeat NNU exposure	34 (10.8)	13 (6.2)
Current age, median <sup>†</sup>		31.5 years
minimum – maximum <sup>†</sup>		18 – 61 years
Completed secondary education ≤ year 12 <sup>†</sup>		63 (30.1)
Attained Bachelor degree or higher <sup>†</sup>		93 (44.5)
SEIFA IRSAD quintile 1 most disadvantaged <sup>†</sup>		50 (23.9)
SEIFA IRSAD quintile 5 most advantaged <sup>†</sup>		21 (10.0)
<b>CHILDREN</b>	<b>N = 408</b>	<b>N = 245</b>
Gestational age (GA) weeks, median (IQR)	30 (27–33)	32 (29–34)
Very Preterm	261 (64.0)	118 (48.2)
Moderate to late Preterm	111 (27.2)	92 (37.5)
Term	36 (8.8)	35 (14.3)
Multiple birth	97 (23.8)	68 (27.8)
Current age, median (IQR)	2 years (1 month – 4 years)	14 days (8 – 31 days)

Data presented as N (%) unless otherwise stated, <sup>†</sup>data were available for NNU Inpatient cohort only

Abbreviations: IQR, interquartile range; NNU, Neonatal Unit SEIFA IRSAD, Socio-economic indices for areas index of relative socio-economic advantage and disadvantage; Very preterm: Gestational age < 32 weeks; Moderate to late preterm: 32 – < 37 weeks; Term: ≥ 37 weeks.

**Table 2**

Parent's current level of child development knowledge, according to cohort and age of child.

	Great	Good	Adequate	Poor	Inadequate
<b>COHORT 1: NNU Graduates N = 316</b>					
<b>Infant</b> (<12 months old) N = 77	7 (9.1)	43 (55.8)	24 (31.2)	3 (3.9)	0
<b>Toddler</b> (1 – 2 years old) N = 132	33 (25.0)	70 (53.0)	27 (20.5)	2 (1.5)	0
<b>Preschool</b> (3 – 4 years old) N = 58	10 (17.2)	37 (63.8)	7 (12.1)	3 (5.2)	1 (1.7)
<b>Primary School</b> (5 – 11 years old) N = 41	11 (26.8)	22 (53.7)	8 (19.5)	0	0
<b>High School</b> (12 – 15 years old) N = 7	5 (71.4)	2 (28.6)	0	0	0
<b>Age not specified</b> N = 1	0	1 (100)	0	0	0
<b>Cohort 1 Total</b>	66 (20.9)	175 (55.4)	66 (20.9)	8 (2.5)	1 (0.3)
<b>COHORT 2: NNU Inpatients N = 209</b>					
<b>Infant</b> (<12 months old) N = 209	8 (3.8)	95 (45.5)	74 (35.4)	29 (13.9)	3 (1.4)

Data presented as N (%); Abbreviations: NNU, Neonatal Unit.

agreed with the statement “I think for it to be relevant, information given to me about child development needs to be specific to children born prematurely” (Graduates: 247, 86%; Inpatients: 142, 81%).

### 3.3.2. Child's age

Parents' widely held view was that it is extremely important to include information about how to support their child's development over the first 2 years of life (Fig. 3), with birth to 6 months of age a particular focus for inpatient parents. Parents of both inpatient and NNU graduates born preterm most frequently identified this as extremely important across every child age-group category, from birth through to two years of age. (Supplementary Information 3).

### 3.4. Optimal timing for education provision

Parents reported a preference for child development education to begin during NNU admission and continue after they had brought their baby home (Graduates: 216, 68%; Inpatients: 172, 82%). Neither length of admission or severity of infant illness influenced preferences, as a similar proportion of parents with infants currently in NICU (86%) or SCBU (81%) identified the inpatient phase as the optimal time to begin child development education. No significant differences in parent responses were observed according to child's gestational age category within either cohort (Supplementary Information 4).

### 3.5. Preferred mode of education delivery

28 (9%) graduate parent responses were not available for items relating to preferred mode of education delivery analysis due to a technical issue with the online survey. One-on-one teaching provided by a Neonatal Nurse or Midwife was parents' most preferred delivery mode in each cohort (Figs. 4a and 4b). Teaching in small groups with other parents of premature or sick babies was also highly preferred. Medium preference was given to printed handouts / information sheets, short videos and for website links sent to smartphone or home computer, with webinars parents' least preferred delivery mode in both cohorts. Within each cohort, minimal differences in delivery preference were seen between parents with preterm and term born children (Supplementary information 5).

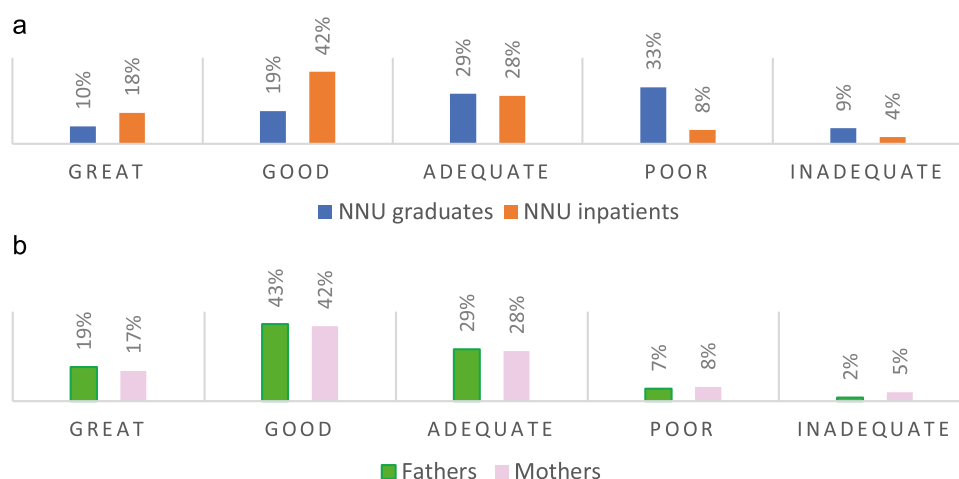
### 3.6. Fathers' knowledge, educational experiences, and preferences

Father's preferences are reported solely for the inpatient cohort (n = 89), as they comprised just 2% of NNU graduates. Fathers and mothers generally reported similarly: understanding child development was considered extremely important at comparable rates (fathers: 67%; mothers: 74%); perceived adequacy of child development education provided by NNU staff were similar (Fig. 2b); and priorities for education delivery also closely matched, with individual teaching from a Neonatal Nurse/ Midwife highly preferred (Table 3). However, there were a few notable differences. Fathers were more likely to prefer e-resource education formats, including short videos or website links sent to smart-phone or home computer. While 40% of fathers reported their current knowledge base as adequate, they identified as having lower child development knowledge than mothers; describing poor or inadequate levels at almost double the frequency (fathers: 19, 21%; mothers: 13, 11%).

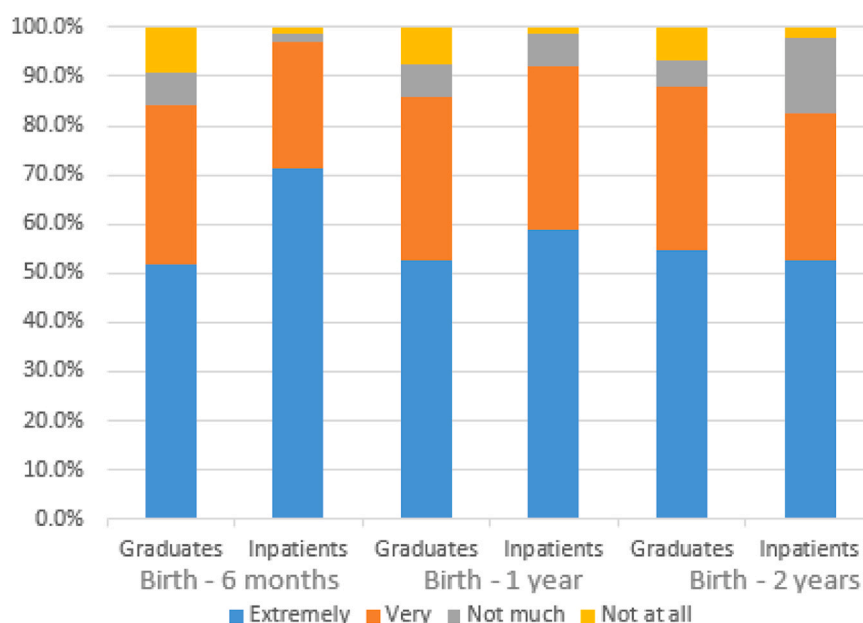
## 4. Discussion and conclusion

### 4.1. Discussion

Understanding and integrating parents' perceived needs and preferences is fundamental to the design of educational interventions that promote effective learning opportunities for mothers and fathers within the NNU [40]. As such, this study makes a valuable contribution to the literature regarding educational strategies to enhance parent knowledge and support for their child's development following admission to neonatal care. We found that self-reported developmental literacy varied by parent cohort, gender, and their child's current age; with NNU



**Fig. 2.** a: Parent described adequacy of child development education provided by NNU staff, according to parent cohort. Abbreviation: NNU, Neonatal Unit. b: Parent described adequacy of child development education provided by NNU staff, according to parent role. b is collated on NNU Inpatient Parent Cohort responses. Abbreviation: NNU, Neonatal Unit.



**Fig. 3.** Perceived importance of content: How mums and dads can support child development at different ages, according to parent cohort. Figure is collated on the number of responses received for this survey item: a total of 7 data-fields from 3 graduate cohort parents contained no response and are not shown here.

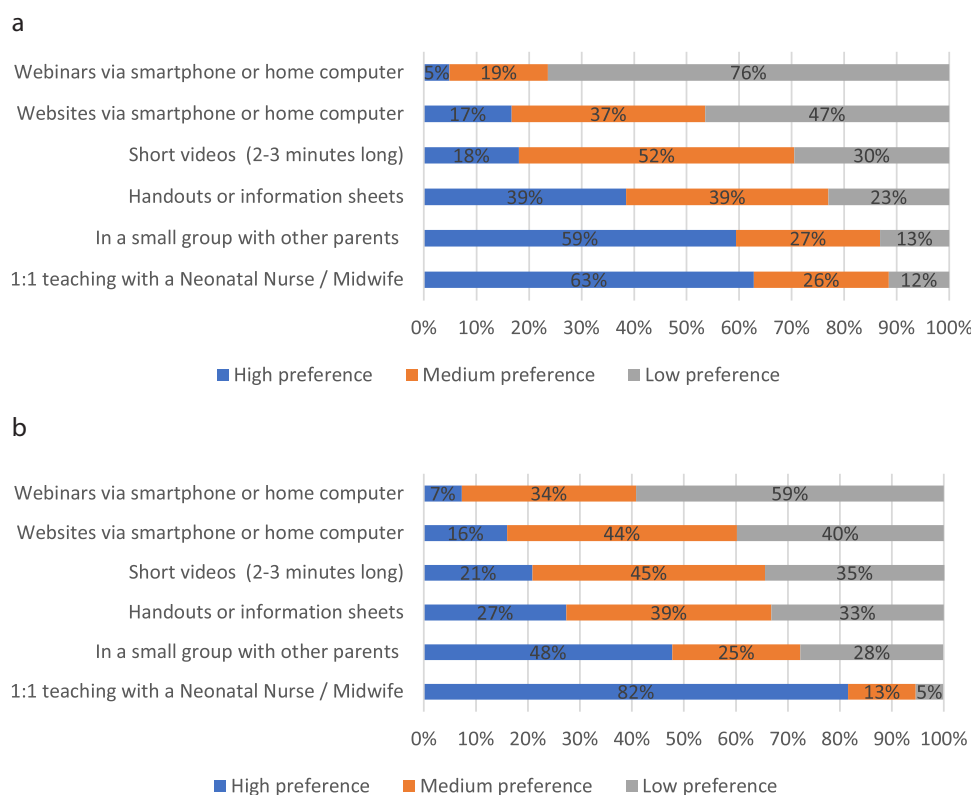
inpatient parents (particularly fathers) reporting lower knowledge levels. The results indicate that while parents consider it extremely important to understand their child's development, they often perceived the education provided by NNU staff to be poor or inadequate. Consistency in parent priorities and preferences for child development education were observed; both during NNU admission and following hospital discharge; for parents with children born preterm compared to term; and between mothers and fathers with infant's inpatient in NNU. Parents in both cohorts highly preferred education to be provided by a neonatal nurse/midwife (either one-on-one or in a small group setting), and prioritised individualised content tailored to their child's (corrected) gestational age and health needs, delivered both during NNU admission (including in NICU) and following hospital discharge.

Knowledge of child development is influenced by many factors, including parent age [16], gender [22,23], socio-economic status including maternal education [15,16,18,41], personal experience of

direct child care-giving responsibilities [16,17], and the child's age [22]. By including an in-patient cohort and one comprising NNU graduates, it is possible that higher developmental literacy levels described by NNU graduate parents could simply be explained by their child's age, with a longer period of time to directly experience and observe developmental milestones, or by having additional children (particularly if they also required NNU admission). However, other factors may also have contributed to the between cohort differences we observed in perceived developmental literacy. For example, nearly a quarter of NNU inpatient parents resided in areas of greatest socio-economic disadvantage and within that cohort there were also more fathers, known to be less informed than mothers about child development norms and milestones [22,23].

Our results suggest that the quality and amount of developmental literacy education currently offered to families with preterm or critically ill newborns can be improved. Throughout their NNU stay, parents seek





**Fig. 4. a: Parents' Preferred Education Delivery Mode - Cohort 1, NNU Graduate Parents.** Responses for 28 parents were not available for analysis and are not shown here. **b: Parents' Preferred Education Delivery Mode - Cohort 2, NNU Inpatient Parents.** Figure is collated on the number of responses received for this survey item: 3 parents submitted responses for high preference delivery mode only; remaining data-fields contained no preference response and are not shown here.

**Table 3**

Father's and mother's highly preferred method for education delivery, NNU Inpatient parent cohort.

	Fathers N = 89	Mothers N = 120
1:1 teaching with a neonatal nurse / midwife	68	101
Small group teaching with other parents of PT or sick babies	(76.4)	(84.2)
Handouts or printed information sheets	40	59 (49.2)
	(45.0)	33 (27.5)
Short videos (2–3 min long)	24	21 (17.5)
Links to good quality websites	(26.9)	15 (12.5)
Participating in Webinars	22	10 (8.3)
	(24.7)	
	18	
	(20.2)	
	5 (5.6)	

Data presented as N (%); Abbreviations: PT, Preterm (gestational age <37 weeks').

clear, accurate information about their baby's care from nurses and the multi-disciplinary health care team [27,42,43]. As such, this is an opportune time to acquire the essential knowledge and skills required to meet the developmental needs of their child that will continue to guide them after discharge to home. Indeed, one could propose that access to high quality child development education plays a key role in meeting the developmental literacy needs of parents with children admitted to the NNU. Therefore, a number of developmentally focused approaches have been implemented within the NNU environment, including the Newborn Individualised Developmental Care and Assessment Program (NIDCAP) [44–46], Family Integrated Care (FICare) [44–48] and developmental care ward rounds [49]. Despite this, health literacy remains low among parents with infants admitted to NNU [25,50] and a growing body of evidence indicates parents with children born preterm experience

knowledge gaps about what to expect for their child's development and desire more information to address their uncertainty [26,31,51,52]. Underlying factors likely include suboptimal provision of parent education in NNU, particularly insufficient premature infant development information [26–28] and poor perceived educational support from neonatal nurses and health professionals [53,54]. The current data suggests that the provision of high quality (described by parents in this study as "good" or "great") developmental literacy education during NNU admission remains elusive for many. Yet, few NNUs offer structured parent education programmes [52] and differing department resources, clinical policies, and workforce capability further compound inconsistencies in parent education provision.

In most cases neonatal nurses provide parent education and instruction during NNU admission due to their direct and continual care of admitted infants and families [43,52,55]. However, education about basic infant care and management of physical health are generally prioritised [56]. In addition, while nurses' educational roles are instrumental to enhancing parental knowledge and autonomy [57], workload demands related to staffing shortages, skill mix, or nurse-patient ratios may leave little time to assess parent knowledge needs and provide timely, individualised education. Staff clinical experience also impacts implementation; education provided by NNU nurses with less than 2 years' experience significantly lower in quality compared to more experienced nursing colleagues [54]. Topic expertise may further inhibit the provision of parent education [57] or developmentally supportive care [30], with NNU healthcare providers themselves often requiring additional child development knowledge and competence. Finally, health professionals receive little training in educational theory, leading to lack of a sound understanding of adult learning principles among many working in the paediatric field [57]. Together, these knowledge deficits directly impact the adequacy of child development education provided to families during NNU admission and may contribute to

parent reported experiences of unmet information needs [28,53].

These barriers must be addressed to achieve evidence based best practice for NNU education and training in neurodevelopmentally supportive care [58]. We recommend the inclusion of comprehensive training in developmental care education during orientation of neonatal multi-disciplinary health professionals [58,59] to better support parents to successfully learn and apply new developmental literacy knowledge in NNU and following discharge. Further embedding patient education theory into nursing, medical, and healthcare professional curricula is likely to improve teaching competency and patient care [40,60]. Finally, staff progression to advanced training or post-graduate programmes results in improvements to education delivery [54] and application of developmental care [30] by NNU nurses. Improved staff access to further professional development related to parent education should therefore be a priority for healthcare organisations.

#### 4.1.1. Strengths and limitations

The current study is the first to describe child development knowledge needs, and developmental literacy education priorities and preferences of mothers and fathers with children admitted to the NNU. Previously identified research gaps are addressed: we elucidate similarities in information needs between parents with children born term and preterm [27]; identify parents' optimal timing for education interventions in the neonatal unit [42]; and report novel perceived child development knowledge and developmental literacy education requirements of fathers with infant's inpatient in NNU [27,52]. The high proportion of fathers that provided information during NNU admission is also a strength, with growing recognition of their contribution to optimal child development [61] and the importance of early developmental interventions to support fathers' active involvement and participation in their baby's care from birth [62]. However, it is also a study limitation as a very small percentage of fathers participated in cohort 1 (NNU graduate parents). We acknowledge that there are other study limitations. Given the time that has spanned since the collection of the data, it is possible that our findings may not be representative of current parent developmental literacy preferences. Considering advancements in technology uptake (ie: apps) and neonatal service delivery adaptations that have subsequently occurred in response to the Covid-19 pandemic, replication of this study in a contemporary NNU parent cohort may be helpful to determine whether the findings continue to represent the perception of parents today. We investigated parental self-perception of child development knowledge level but are not able to confirm whether this is an accurate reflection of their developmental literacy. It is recommended that future studies assess both the actual and perceived knowledge level of parents to address this study limitation. We acknowledge that among NNU graduate (Cohort 1) participants, there is a possibility of modification in parental perception over the years regarding the level of child development education provided by staff during their child's admission to NNU. We also acknowledge the potential for self-selection bias among NNU graduate participants recruited online via a neonatal consumer organisation. Lack of parent demographic data such as socio-economic status, age and educational attainment for this cohort makes it difficult to comprehensively compare our NNU graduate cohort with wider NNU graduate parent populations. As such, further analysis to quantify the relationship between factors such as parent / NNU admitted child characteristics and parental priorities and preferences for education to enhance developmental literacy was beyond the scope of this study and is recommended for future research. Several strategies were implemented to reduce potential risks to study validity arising from the cross-sectional study design; each cohort comprised the perspectives of a large number of parents; multi-centre recruitment of inpatient parents from hospitals with diverse socio-economic and patient population profiles; recruitment occurred outside of office hours to reach working parents. Yet, each cohort was surveyed at a single time point, and replication studies should consider longitudinal designs in which information on parent

perceptions can be evaluated across their child's development. Finally, the survey was only available in English, and to parents over 18 years of age. The child development information priorities and education delivery preferences of younger parents or those from non-English speaking backgrounds could potentially differ to those described.

#### 4.2. Conclusion

Knowledge gained from parent perspectives reported in this study may inform future innovations in educational resources for mothers and fathers with infants admitted to neonatal care. We propose that parents should receive individualised child development education to enhance developmental literacy. Education should include a Neonatal Nurse / Midwife in the delivery, begin during NNU admission and continue after families have brought their babies home from hospital. Furthermore, information should be specific to children born preterm and focused on how parents can support child development from birth through to 2 years of age.

#### 4.3. Practice implications

To enhance family centred, neurodevelopmentally supportive care within the NNU, healthcare organisations must allocate sufficient time, staff training and budget to parent education [32,49]. Therefore, the substantial cost to implement an education model comprised solely of one-on-one delivery with a Neonatal Nurse / Midwife is important to consider, due to the potential for this labour intensive approach to restrict scalability and limit translation into clinical practice. Given parents' acceptability of education delivered via short videos and websites in our study, an alternative approach may be to supplement individualised parent education sessions with e-health (eg: web-based platforms, videos, or smartphone applications) [63]. Indeed, readily accessible, accurate child development information sources are important to parenting knowledge acquisition [16]. Current evidence indicates e-health interventions confer benefits to the interaction skills of mothers [64] and fathers [65] with preterm infants, parent self-efficacy and preparedness for NNU discharge [66]. As such, using e-health to supplement one-on-one education delivery has the potential to address parent demand for improved and extended developmental literacy education through the provision of additional pre and post-discharge developmental information and support. Future research is needed to critically evaluate whether parents with infants admitted to NNU find a combination of individual neonatal nurse / midwife provided child development education and e-health approaches helpful.

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#### CRediT authorship contribution statement

**Megan. L. Bater:** Conceptualisation, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Writing – original draft, Writing – revised draft. **Michael. J. Stark:** Writing – review & editing, Funding acquisition, Supervision. **Jacqueline. F. Gould:** Writing – review & editing, Methodology, Supervision. **Peter. J. Anderson:** Writing – review & editing, Supervision. **Carmel. T. Collins:** Supervision, Resources. All authors approved the final

manuscript.

## Declaration of Competing Interest

The authors have no interests to declare.

## Data Availability

The datasets generated and analysed during the current study are available from the corresponding author on reasonable request. I confirm identifiable information about participants are not included in this manuscript.

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## Appendix A. : Section 3 of Parent Survey; Parent knowledge and educational preferences for child development

### Your thoughts on child development.

1. How important is understanding child development to you?

Not at all.

Not very.

Very.

Extremely.

2. What is your current level of knowledge around child development?

Inadequate.

Poor.

Adequate.

Good.

Great.

3. Which best describes the level of child development education given by staff in the Neonatal Unit?

Inadequate.

Poor.

Adequate.

Good.

Great.

4. When is the best time for Mums and Dads to be given information on how to help with their child's development?

While my baby is in the Neonatal Unit.

Not in the Neonatal Unit. Wait until the baby has been brought home.

Both in the Neonatal Unit and after we have brought our baby home.

5. I think for it to be relevant, information given to me about child development needs to be specific to children born prematurely.

True False.

6. What is the best way we can help you learn more about child development? Rank the list below 1–6 in order of your preference where 1 is the most helpful way and 6 is the least helpful:

— Providing me with one on one teaching with a Neonatal Nurse / Midwife.

— Teaching me in a small group setting with other parents of premature or sick babies.

— Giving me handouts or information sheets that I can read and keep.

— Being sent short videos (2–3 min long) about baby and child development.

— Sending me links to good quality websites to my home computer or phone.

— Participating in Webinars that I can log on to from my home computer or phone.

7. I think the following topics should be included in parent education to support our knowledge of child development:

7a. How mums and dads can support babies' development from birth

to 6 months of age.

Not at all.

Not much.

Very.

Extremely.

7b. How mums and dads can support babies' development from birth to 12 months of age

Not at all.

Not much.

Very.

Extremely.

7c. How mums and dads can support child development from birth to 2 years of age.

Not at all.

Not much.

Very.

Extremely.

## Appendix B. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.pec.2023.108058.

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