

## RESEARCH ARTICLE

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# Risk of behavioural and developmental difficulties in early childhood in the Australian Capital Territory

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## Abstract

**Aim:** We aimed to estimate the prevalence of risk for developmental and behavioural problems for children in their first year of full-time primary education in the Australian Capital Territory (ACT).

**Methods:** We conducted an analysis of the 2014–2017 Kindergarten Health Check (KHC), an annual series of complete enumeration surveys of all children in their first year of full-time primary education in the ACT. Risk for developmental and behavioural problems was determined using the Parents' Evaluation of Developmental Status (PEDS) questionnaire.

**Results:** 19 414 children (mean age 5.56 years; 51.4% boys; 2.3% Aboriginal and Torres Strait Islander; 18.4% quintile of greatest relative disadvantage) who participated in the 2014–2017 KHC were included in the study (87%). More than half of ACT children in their first year of primary education had low/no developmental risk identified through the PEDS questionnaire, with 1 in 10 at high risk.

**Conclusions:** Those more likely to have a high risk PEDS score were boys, those from the areas experiencing relative disadvantage, and Aboriginal and Torres Strait Islander children. While we can identify children at risk through screening, the greater challenge remains to identify and address the underlying causes of healthy inequalities, even within highly socioeconomically advantaged communities.

## KEYWORDS

child development, primary care

## 1 | INTRODUCTION

Developmental delay and disability are significant conditions for Australian children with impacts on learning, socialisation and their families. Typical development in children follows a broadly consistent timeline in the areas of motor skills, speech and language, social skills, and vision and hearing. Significant delay in one or more of these domains may be due to underlying medical conditions (Bellman et al., 2013; Miall et al., 2016). A person experiencing disability has an ongoing limitation, restriction or impairment (Australian Bureau of

Statistics [ABS], 2019). Early intervention is important for children who have or are at risk of developmental difficulties, as appropriate support and services can improve outcomes for children and their families (Bellman et al., 2013; Royal Australasian College of Physicians, 2013).

In 2018, 11.9% of boys and 7.1% of girls aged 5–14 (4.8% of boys and 2.7% of girls aged <5 years) were reported to be living with a disability (ABS, 2019). This equates to nearly 300 000 school-aged children across Australian households. The 2021 Australian Early Development Census (AEDC) found one in 20 (5.2%) children had a

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special needs status, meaning they required special assistance because of chronic medical, physical or intellectual disability (Australian Government Department of Education, Skills and Employment [DESE], 2022). The proportion of children considered developmentally vulnerable increased with relative socioeconomic disadvantage at a national level (14.9% of children in the least disadvantaged quintile compared with 33.2% of children in the most disadvantaged quintile) (DESE, 2022). While the Australian Capital Territory (ACT) is a jurisdiction of relatively low socioeconomic disadvantage, and the prevalence of vulnerability is typically lower in areas of less disadvantage, the AEDC found the proportion of children in the ACT who were developmentally vulnerable to be higher than the national average (26.7% of children in the ACT compared with 22.0% nationally) (DESE, 2022).

In addition to those with developmental delay and disability, children with behavioural challenges also experience negative impacts on their learning and functioning, and on their families (Ogundele, 2018). Over 1 in 10 Australian children aged 4–12 years displayed aggression or hyperactivity, with a similar proportion experiencing anxiety and depression (Luangrath & Hiscock, 2011).

Importantly, children with the highest need are less likely to access healthcare services and may not be identified without screening programs (Woolfenden et al., 2020). Various screening tools exist to identify children at risk of developmental vulnerability. The Parents' Evaluation of Developmental Status (PEDS) is a well-validated screening tool widely used in Australia and worldwide (The Royal Children's Hospital Melbourne, 2022b; PEDStest Online, 2018). It is included in routine developmental checks for children from 6 months to 4 years of age in many jurisdictions, including the ACT (ACT Health, 2018). It is also included in screening offered to all children in their first year of primary education in the ACT through the Kindergarten Health Check (KHC) (Supplementary File 1) (The Royal Children's Hospital Melbourne, 2022a). Children in the ACT are eligible to start kindergarten in term 1 (early February) if they are 5 years of age as at 30 April of that year. Younger children may be considered for early kindergarten enrolment if they meet criteria for being gifted/talented, or their parents are in selected mobile employment positions (ACT Education, 2022). In 2017, there were 105 schools included in the KHC. Being able to identify all children at risk is important to help improve equity of access to services.

The relationship between socioeconomic position and measures of developmental vulnerability is typically analysed in studies looking across whole populations. It is known that, even in generally well-off areas, there is still a gradient in relative risk associated with socioeconomic position; however, it is often not well described for these advantaged populations (Marmot, 2005, 2017). A recent systematic review of developmental screening in children identified nine studies which included the PEDS (Cibralic et al., 2023). However, there is a paucity of data published on results using this screening tool in Australia. Only two of the PEDS studies included in the systematic review were based in Australia, and just one comprised quantitative analysis of cross-sectional data. In the KHC, for example, individual

results are provided to the child's general practitioner if nominated, but collated results are not routinely published. Determinants of health operate not just at the individual level but also at the community/population level. Targeting individuals identifies those who are vulnerable to underlying causes of disease but does not address broader causes (Rose, 2001).

Therefore, taking these individual data to the population level by identifying the characteristics of children who may be more likely to experience developmental delay or difficulty, may assist in targeting community-level service provision.

Our study aimed to estimate the prevalence of risk for developmental and behavioural problems for children in their first year of full-time primary education in the ACT. We aimed to explore how this varies for sociodemographic characteristics, with a focus on relative disadvantage within the ACT.

## 2 | METHODS

The KHC is an annual cross-sectional complete enumeration survey offered to children in their first year of full-time primary education (kindergarten) in the ACT. The survey consists of a questionnaire completed by parents at the start of the school year, and a physical health check completed during the school year for all children whose parents consent to their participation. Children identified as having physical, developmental or behavioural concerns are followed up by contacting the child's parents and/or nominated general practitioner, suggesting need for further investigation.

The annual KHC consent, data collection and analysis process has been granted ethics approval through the ACT Health Human Research Ethics Committee (ETHLR.13.316). Ethics approval for our study was granted by the ACT Health Human Research Ethics Committee's Low Risk Sub-Committee (ETHLR.17.080 and ETHLR.17.259).

The KHC collects demographic data (date of birth, sex, Aboriginal and Torres Strait Islander background, and home address) and information on selected conditions and behaviours. The questionnaire includes standardised screening modules such as the Strengths and Difficulties Questionnaire (SDQ) and the PEDS.

### 2.1 | Scope

Our study analyses data from the 2014–2017 KHC surveys. The questionnaire underwent significant change and standardisation in 2014; thus, 2014 was used as our starting year (Academic Unit of General Practice, 2021). At the time of data request and extraction, the 2017 data were the most up-to-date available. The 2017 questionnaire has been included in Data S1.

Children were excluded from our study if they were identified as having participated in the KHC in the previous year. Repeating students were identified by matching on date of birth, sex, last name, and the first five letters of first name.

## 2.2 | Age

Age was calculated at the cut-off date for general eligibility (1 May of the school year).

## 2.3 | Parents' evaluation of developmental status

The PEDS was developed by Frances Glascoe and has been validated for the Australian setting (Coghlan et al., 2003; PEDStest Online, 2018). The PEDS includes 10 questions and asks parents to list concerns about their child's learning, development and behaviour. The number of predictive and non-predictive answers are scored and allocated to pathways of risk and referral (The Royal Children's Hospital Melbourne (RCH), 2016). Predictive concerns are those known to be predictive of developmental delay and require further evaluation and support. Non-predictive concerns are those that warrant advice and monitoring, such as behavioural difficulties. Pathway A indicates high risk for developmental delay or difficulty (two or more predictive concerns); Pathway B indicates moderate risk for developmental delay or difficulty (one predictive concern); Pathway C indicates increased risk of behavioural and emotional difficulties (one or more non-predictive concerns, but no predictive concerns); and Pathway E indicates no reported concerns (Glascoe, 1999). The PEDS has been shown to have high sensitivity in identifying disabilities and good

acceptability by parents (Glascoe, 2000; The Royal Children's Hospital Melbourne (RCH), 2016).

The PEDS has not been specifically validated for Aboriginal and Torres Strait Islander children; however, the national guidelines for health assessment for Aboriginal and Torres Strait Islander peoples notes that PEDS may be used (National Aboriginal Community Controlled Health Organisation (NACCHO) & The Royal Australian College of General Practitioners (RACGP), 2018).

Children for whom PEDS pathway was not available (due to the module being incomplete) were excluded from the study.

## 2.4 | Socioeconomic position

Participants' home addresses were geocoded to the Australian Bureau of Statistics' (ABS) 2016 Mesh Block level, which allowed linkage of the KHC to the ABS 2016 Index of Relative Socio-Economic Disadvantage (IRSD) via the Statistical Area Level 1 (SA1), the finest level available (Australian Bureau of Statistics (ABS), 2018a). IRSD is a summary area-based measure derived from Australian Census of Population and Housing data, using inputs such as household income, employment, education and English language proficiency. Lower scores indicate relative disadvantage (e.g., people with lower incomes and those in lower skilled occupations) (Australian Bureau of Statistics (ABS), 2018a).

**TABLE 1** Factors associated with being at high risk (Pathway A), 2014–2017.

Characteristic		Pathway A ( $\geq 2$ developmental concerns)				p-value <sup>a</sup>	OR <sup>b</sup> (95% CI)
		Yes		No			
		n	%	n	%		
Age at 1 May of school year	<5 years	6	5.2	109	94.8	<0.001	0.51 (0.22–1.15)
	5 to <6 years	1764	9.8	16 206	90.2		Reference
	6 years or older	228	17.2	1101	82.8		1.90 (1.64–2.21)
Sex	Male	1346	13.5	8630	86.5	<0.001	2.10 (1.91–2.32)
	Female	652	6.9	8786	93.1		Reference
Indigenous background <sup>c</sup>	Aboriginal and Torres Strait islander	90	19.8	364	80.2	<0.001	2.21 (1.75–2.80)
	Not aboriginal or Torres Strait islander	1902	10.1	17 010	89.9		Reference
Relative socioeconomic disadvantage <sup>d</sup>	Most disadvantaged (quintile 1)	457	12.9	3092	87.1	<0.001	Reference
	Quintile 2	422	10.8	3475	89.2		0.82 (0.71–0.95)
	Quintile 3	397	9.4	3838	90.6		0.70 (0.61–0.81)
	Quintile 4	368	9.4	3535	90.6		0.71 (0.61–0.81)
	Least disadvantaged (quintile 5)	349	9.3	3404	90.7		0.69 (0.60–0.80)
Usual general practitioner	No	286	10.0	2561	90.0	0.643	Reference
	Yes	1712	10.3	14 855	89.7		1.03 (0.90–1.18)

<sup>a</sup>Wald chi-square statistic.

<sup>b</sup>Odds ratios reference categories: age 5 to <6 years; female; Not Aboriginal or Torres Strait Islander; most disadvantaged (quintile 1); no usual GP.

<sup>c</sup>Excludes 48 students for whom Indigenous status was not identified.

<sup>d</sup>Based on ACT IRSD rankings. Excludes 77 students for whom socioeconomic position could not be identified.

We then created an indicator of socioeconomic position by ranking IRSD scores for ACT SA1 and dividing them into five equal cohorts. This allowed the effects of relative socioeconomic disadvantage within the ACT to be measured, as the socioeconomic characteristics of the ACT are significantly different from Australia as a whole. Based on national IRSD scores, half of all KHC participants (51%) are in the least disadvantaged quintile, and just 1% in the most disadvantaged group.

## 2.5 | Statistical analysis

Characteristics of the study population were summarised by unweighted descriptive statistics (mean and standard deviation for age, and number and percentage for categorical variables). The distribution of children's PEDS Pathway by selected demographic variables was summarised with percentages. Confidence intervals for prevalence estimates were calculated using binomial sampling methods.

Factors associated with being high risk were analysed by comparing children on PEDS Pathway A to all others. Significance of the relationship between PEDS Pathway A and categorical variables of interest was assessed using Wald chi-square test statistics (significance set at 0.05). See Table 1.

Multivariate analysis was explored using ordered logit/proportional odds and generalised ordered logit/partial proportional odds models. The model assumptions for proportional odds were not met, so the final analysis was conducted using multinomial logistic regression with the dependent variables PEDS pathway (reference category pathway E), and independent variables sex, Aboriginal and Torres Strait Islander background, relative socioeconomic disadvantage, and age. Age was symmetrically but not normally distributed, nor readily transformed, so it was included in the model as a categorical variable. See Table 2.

Missing data were assumed to be random and excluded from the main analysis. A comparative analysis of children based on whether or not a PEDS score could be calculated (and thus included in the analysis) is presented in Table 3. Chi-squared tests comparing PEDS completion versus non-completion against key variables were conducted.

Analysis was conducted in SAS Version 9.4.

## 3 | RESULTS

The KHC has a high participation rate, as shown in Figure 1. The questionnaire was completed for 91% of the 22 445 children eligible to participate in the survey ( $n = 20\,412$ ). Our study excluded children participating in the KHC for the second time ( $n = 149$ ), living outside of the ACT ( $n = 687$ ), and those for whom a PEDS score could not be calculated ( $n = 162$ ). Our final dataset included 19 414 children, 87% of those eligible to participate.

Demographics of children in the study are shown in Table 4. The average age of those in our study was nearly 5 years and 7 months (range 4 years 3 months to 6 years 11 months) at 1 May of the school

**TABLE 2** Associations with PEDS pathways, 2014–2017.<sup>a,b,c</sup>

PEDS pathway	Adjusted odds ratio (95% CI)							
	Age at start of school year		Sex	Indigenous background	Quintile of relative socioeconomic disadvantage			
	<5 years vs. 5 to <6 years	6 years or more vs. 5 to <6 years	Male vs. female	Aboriginal and Torres Strait Islander vs. non-Indigenous	Quintile 2 vs. 1	Quintile 3 vs. 1	Quintile 4 vs. 1	Quintile 5 vs. 1
A	0.53 (0.23–1.22)	1.73 (1.47–2.03)*	2.39 (2.16–2.65)*	2.29 (1.77–2.96)*	0.84 (0.72–0.97)*	0.71 (0.61–0.83)*	0.67 (0.58–0.78)*	0.64 (0.57–0.78)*
B	0.73 (0.45–1.20)	1.09 (0.94–1.26)	1.67 (1.55–1.80)*	1.15 (0.90–1.48)	1.00 (0.89–1.12)	0.95 (0.85–1.06)	0.85 (0.76–0.96)*	0.87 (0.77–0.98)*
C	0.76 (0.40–1.43)	0.94 (0.77–1.14)	1.32 (1.21–1.45)*	1.37 (1.02–1.83)*	0.93 (0.80–1.07)	0.98 (0.86–1.13)	0.75 (0.65–0.88)*	0.75 (0.65–0.87)*

\*Statistically significant at  $\alpha = 0.05$ .

<sup>a</sup>Generalised logit model. The model includes 19 289 records. Model convergence criterion satisfied.

<sup>b</sup>Global null hypothesis ( $\beta = 0$ ): Wald  $\chi^2 = 588.33$ ,  $df = 24$ ,  $p < 0.0001$ .

<sup>c</sup>Reference categories: PEDS pathway E, female, not Aboriginal or Torres Strait Islander, quintile 1 - most disadvantaged, age 5 to <6 years at 1 May.

**TABLE 3** Factors associated with completion of PEDS/inclusion in analysis.<sup>a</sup>

Characteristic		PEDS score available				p-value <sup>b</sup>	OR <sup>c</sup> (95% CI)
		Yes		No			
		n	%	n	%		
Age at 1 May of school year	<5 years	115	97.5	3	2.5	0.142	0.32 (0.10–1.01)
	5 to <6 years	17 970	99.2	149	0.8		Reference
	6 years or more	1329	99.3	10	0.7		1.10 (0.58–2.10)
Sex	Male	9976	99.1	90	0.9	0.291	0.85 (0.62–1.15)
	Female	9438	99.2	72	0.8		Reference
Indigenous background <sup>d</sup>	Aboriginal and Torres Strait islander	454	99.1	4	0.9	0.897	0.94 (0.35–2.54)
	Not aboriginal or Torres Strait islander	18 912	99.2	156	0.8		Reference
Relative socioeconomic disadvantage <sup>e</sup>	Quintile 1 (most disadvantaged)	3549	99.1	34	0.9	0.097	Reference
	Quintile 2	3897	99.1	34	0.9		1.10 (0.68–1.77)
	Quintile 3	4235	98.9	45	1.1		0.90 (0.58–1.41)
	Quintile 4	3903	99.3	28	0.7		1.34 (0.81–2.21)
	Quintile 5 (least disadvantaged)	3753	99.5	20	0.5		1.80 (1.03–2.13)
Usual general practitioner	No	2847	98.6	39	1.4	<0.001	Reference
	Yes	16 567	99.3	123	0.7		1.85 (1.28–2.65)

<sup>a</sup>Children living in the ACT only.

<sup>b</sup>Wald chi-square statistic.

<sup>c</sup>Odds ratios reference categories: No PEDS score; age 5 to <6 years; female; not Aboriginal or Torres Strait Islander; most disadvantaged (quintile 1); no usual GP.

<sup>d</sup>Excludes 50 students for whom Indigenous status was not identified.

<sup>e</sup>Based on ACT IRSD rankings. Excludes 78 students for whom socioeconomic position could not be identified.

year. One in 40 children were identified as being of Aboriginal and Torres Strait Islander background ( $n = 454$ , 2.3%). Using ACT specific IRSD rankings, 3549 (18.4%) children came from the areas of greatest relative disadvantage. This compares to just 218 (1.1%) children being in the areas of greatest relative disadvantage if using national IRSD rankings. In the ACT, half of all kindergarten children are in the quintile of least disadvantage based on national rankings.

More than half of the children in our study had no predictive or non-predictive concerns based on the PEDS assessment; however, 2 in 10 ( $n = 4253$ , 21.9%) had one predictive concern and a further 1 in 10 ( $n = 1998$ , 10.3%) had two predictive concerns.

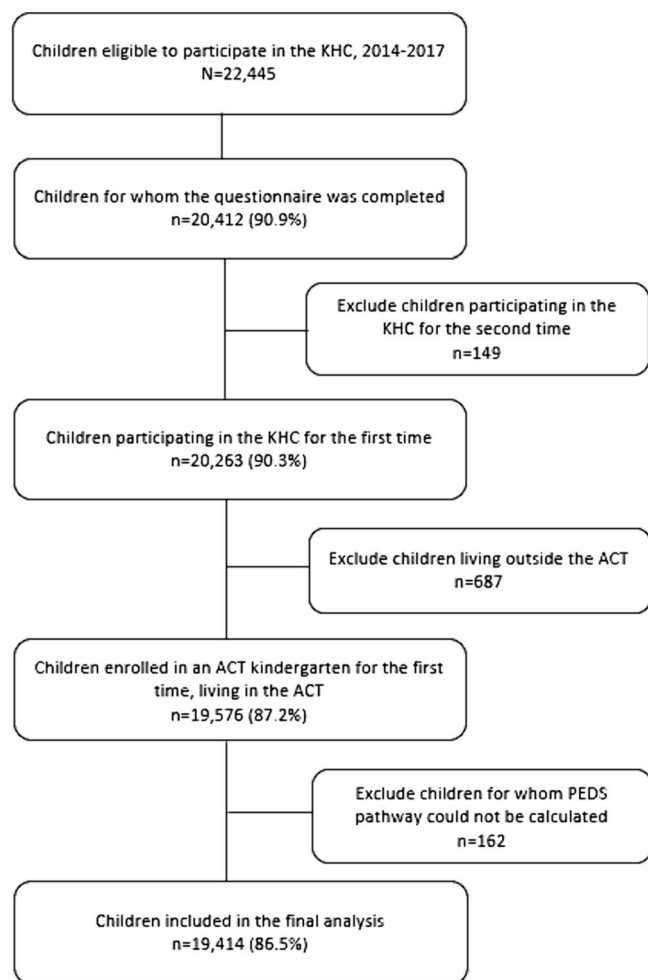
Figure 2 shows the distribution of children across the PEDS pathways by selected demographic characteristics. Boys were more likely than girls to have predictive concerns (boys—1346 (13.5%) on pathway A and 2485 (24.9%) on pathway B; girls—652 (6.9%) on pathway A and 1768 (18.7%) on pathway B) but were equally likely to have non-predictive concerns. Aboriginal and Torres Strait Islander children were twice as likely to have two or more predictive concerns than their non-Indigenous counterparts (90 vs. 1902, 19.8% vs. 10.1%); however, there were only small differences in the proportions on pathways B or C. Children in the quintile of greatest relative disadvantage were more likely than other children to be on pathway A (427 (12.9%) compared with 349–422 (9.3% to 9.7%) across all other groups). A slightly higher proportion of those children with predictive/non-predictive concerns had a usual GP nominated to receive their results compared with those without a usual GP (7300 vs. 9267, 44.1% vs. 41.2%).

Children aged 6 years or older at the reference date were at increased odds of being on Pathway A than those aged 5 to <6 years of age (OR 1.90, 95% CI 1.64–2.21). The odds of having two or more developmental concerns was 2.10 (95% CI 1.91–2.32) for boys and 2.21 (95% CI 1.75–2.80) for Aboriginal and Torres Strait Islander children. Children living in areas of less relative disadvantage had lower odds of being at high risk compared with those in the area of greatest relative disadvantage.

A generalised logit model generated adjusted odds ratios comparing the likelihood of being on PEDS Pathways A, B or C compared with PEDS Pathway E (Table 2). Children aged 6 years or more at the reference date had higher odds of being on pathway A than those aged 5 to <6 years, but no difference for pathways B or C. Male sex was significant for higher odds of being on pathways A, B, or C. Indigenous children had significantly higher odds of being on pathway A and C (but not B). Children living in less relatively disadvantaged areas were at lower odds of being on pathways A, B or C.

### 3.1 | Non-response analysis

Table 3 shows the characteristics of children for whom a PEDS pathway could be determined (and therefore included in the analysis) against those for whom it could not. Those in the least disadvantaged quintile were more likely to complete the PEDS module than those in



**FIGURE 1** Participation in the Kindergarten Health Check and study participants, 2014–2017.

the most disadvantaged quintile, although this difference was small. Similarly, those for whom a regular GP was not nominated were less likely to have a completed PEDs score than others, but with very small differences only.

## 4 | DISCUSSION

Our analysis of children in their first year of primary education found that over half ( $n = 10\,940$ , 56.4%) had no parental concerns identified, and thus were at low risk of disability or developmental delay. However, one-third were at moderate-to-high risk, and a further 1 in 10 were at increased risk of emotional and behavioural difficulties. As our study is based on a large survey with a high participation rate, our analysis provides a representative picture of those children at high risk. These children were more likely to be from areas experiencing the greatest relative disadvantage, be boys, or be of Aboriginal and Torres Strait Islander background.

Our finding that one in 10 children (10.5%) in ACT kindergartens were at high risk is lower than that seen globally; a further two in

10 children (21.9%) were at moderate risk, higher than the global rate, but with the total at moderate-to-high risk (32.4%) being slightly lower overall. Woolfenden et al. (2014) conducted a systematic review of the prevalence of developmental risk as identified through PEDS for children aged under 8 years, with 37 studies across 12 countries, meeting inclusion criteria. They found that 13.8% of children were classified as high risk for developmental problems while 19.8% of children was classified as having moderate risk for developmental problems (33.6% moderate-to-high risk overall). Countries included in the review represented diverse populations. Within Australia, 15%–16% of Victorian school entrants over the period 2014–2017 were at high risk based on PEDS; in 2017, a further 28.6% were at moderate risk (44.1% at moderate-to-high risk in 2017) (Victoria State Government Education and Training, 2018). Demographically, there are key differences between the ACT and Victoria. Estimates from the 2016 Australian Census found that 3.1% of children aged 0–9 years were identified as Aboriginal and Torres Strait Islander in the ACT, and 1.7% in Victoria (ABS, 2018b). The more striking difference is in relative socioeconomic disadvantage. Based on national 2016 IRSD scores, the median decile ranking for ACT SA1 groups is 9/10 compared with 6/10 for Victoria; 12% of ACT residents are in the most disadvantaged half of the Australian population (deciles 1–5) compared with 45% of Victorians (ABS, 2018a). This is notably contributed to by the ACT being almost wholly urban. Despite the relatively high socioeconomic position of the ACT, a significant proportion of children entering primary school were at risk of developmental problems.

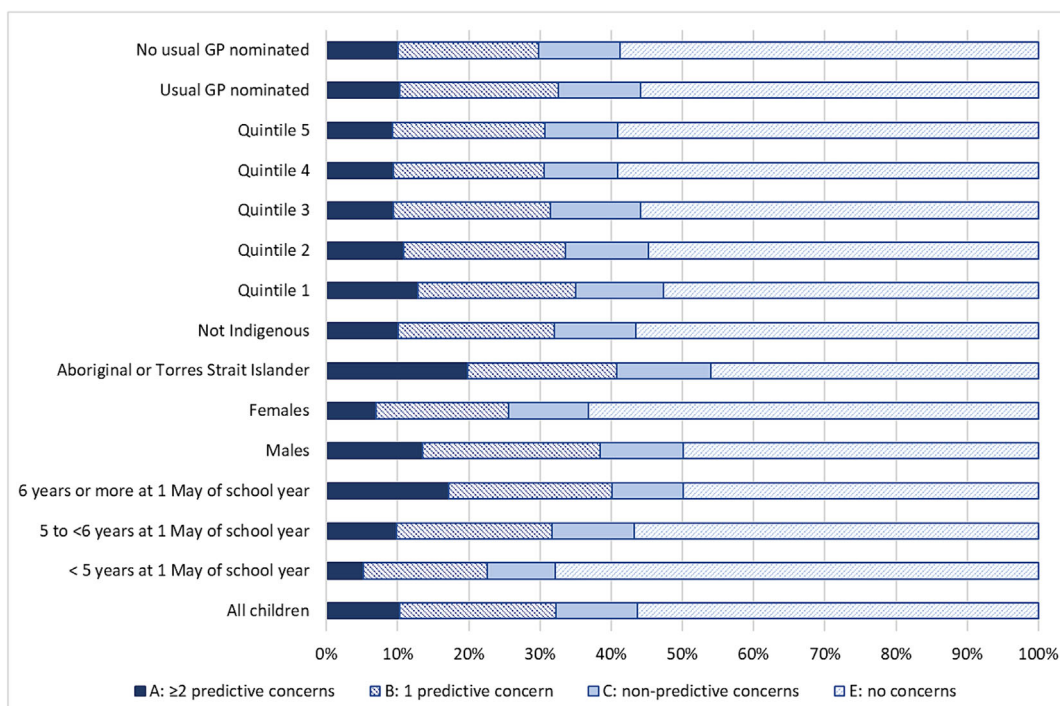
Children living in the quintile of greatest relative disadvantage were more likely to be at high risk of developmental concerns compared with their peers. Comparing the most socioeconomically disadvantaged group to each other group found that the trend in the proportion of children on Pathway A compared with *relative* socioeconomic disadvantage was also significant. These findings held when adjusting for age, sex, and Indigenous identification. Eight studies were identified by Woolfenden et al. (2014) where low family socioeconomic status was a predictor of being at high risk (pooled OR 2.21; 95% CI 1.65–2.72); however, none of these studies were from an Australian setting. The AEDC reports across five developmental domains, and children are classified as developmentally vulnerable if they rank below the 10th percentile (DESE, 2022). Australian data from the 2021 AEDC found that children in the most disadvantaged socioeconomic quintile (derived from national IRSD scores) were twice as likely as those in the least disadvantaged quintile to have developmental vulnerabilities (33.2% vs. 14.9%), with a clear decreasing gradient in the proportion of children with developmental vulnerabilities from the most to the least disadvantaged (DESE, 2022). The relationship between socioeconomic disadvantage and poorer health outcomes is well established. The World Health Organization (WHO) notes that socioeconomic gradient exists in poorer and wealthier countries alike (Commission on Social Determinants of Health [CSDH], 2018). Our study builds on work demonstrating the relationship between gradients of disadvantage and health outcomes even within relatively advantaged jurisdictions (such as the ACT). As shown

**TABLE 4** Characteristics of children in the Kindergarten Health Check, 2014–2017.

Characteristic		Mean (SD)	
Age (years) at 1 May of school year		5.56 (0.31)	
		Number	Per cent <sup>a</sup> (95% CI)
Age at 1 May of school year	<5 years	115	0.6 (0.5–0.7)
	5 to <6 years	17 970	92.6 (92.2–92.9)
	6 years or more	1329	6.8 (6.5–7.2)
Sex	Male	9976	51.4 (50.4–52.4)
	Female	9438	48.6 (47.9–49.3)
Indigenous background	Aboriginal and/or Torres Strait islander	454	2.3 (2.1–2.6)
	Not aboriginal or Torres Strait islander	18 912	97.7 (97.4–97.9)
	Not available	48	n.a.
Quintile of relative socioeconomic disadvantage (ACT IRSD rankings)	Quintile 1 (most disadvantaged)	3549	18.4 (17.8–18.9)
	Quintile 2	3897	20.2 (19.6–20.7)
	Quintile 3	4235	21.9 (21.3–22.5)
	Quintile 4	3903	20.2 (19.6–20.7)
	Quintile 5 (least disadvantaged)	3753	19.4 (18.9–20.0)
	Not available	77	n.a.
Nominated a usual general practitioner	No	2847	14.7 (14.1–15.2)
	Yes	16 567	85.3 (84.8–85.8)
PEDS pathway <sup>b</sup>	Pathway A	1998	10.3 (9.8–10.7)
	Pathway B	4253	21.9 (21.2–22.6)
	Pathway C	2223	11.5 (11.0–11.9)
	Pathway E	10 940	56.4 (55.3–57.4)
All children		19 426	100

<sup>a</sup>Percentages calculated excluding not available.

<sup>b</sup>PEDS pathways. A – 2 or more predictive concerns; B – one predictive concern; C – one or more non-predictive concerns (excludes those children on pathways A or B); E – no predictive nor non-predictive concerns.

**FIGURE 2** Characteristics of children by PEDS pathway, 2014–2017.

in Data S1, the ACT has a radically different socioeconomic profile to the country overall. This is important, because if just considering disadvantage at a macro level, children at risk within these areas may be overlooked. The WHO identifies removing avoidable health inequalities both between and within countries as key to achieving health equity (CSDH, 2018). This similarly applies at finer levels, such as within jurisdictions.

Boys had twice the odds as girls to be at high risk of developmental concerns (OR 2.10; 95% CI 1.91–2.32). This was again consistent with international PEDS findings by Woolfenden et al. (2014) and Australian measures of developmental vulnerability from the 2021 AEDC (DESE, 2022). Boys are also twice as likely to be at high risk based on Strengths and Difficulties scores (another validated and widely used screening tool) (O'Brien et al., 2020), and were found to have higher prevalence of mental disorders in the *Young Minds Matter* study (Goodsell et al., 2017). This again highlights the possible need for different approaches and supports for boys and girls at school entry.

A significant number of children (6.8%, 1329/19414) were aged over 6 years at 1st May in their first year of kindergarten, two-thirds (67.8%, 927/1329) of whom were boys. These children appear to have been 'held back' from starting school—either by their parents or by preschool educators—as they would have been eligible to enrol a full year earlier. In our study, older age at school start was associated with a higher risk of being on pathway A. Pre-existing parental concerns may have led to the delay starting in fulltime formal education and are reflected in the KHC or, alternatively, these children having missed the benefits of the early formal education may have led to concerns. Being a cross-sectional study, the KHC cannot determine causality. Australian children are required to be enrolled in school by the time they turn six years of age, with some flexibility in their starting age. There are two key influences on starting school at play: 'negative selection', where a child is held back because they are considered not ready; and 'positive selection', where a child is held back because it is considered beneficial for them to be older when starting school (Fortner & Jenkins, 2017). Prominent Australian child psychologist Steve Biddulph highlights the challenges for formal education for young boys and advocates delaying the start of school for them. It is possible that his and similar opinions have contributed to the disproportionate number of boys we saw held back, which has been observed elsewhere in Australia (Hanly et al., 2019; Mergler & Walker, 2017).

In our study, 19.8% of Aboriginal and Torres Strait Islander children were at high risk (Pathway A); double the odds of their non-Indigenous peers. Similarly, the 2021 AEDC found Aboriginal and Torres Strait Islander children were twice as likely as non-Indigenous children to be developmentally vulnerable in one or more domains (42.3% vs. 20.6%) (Australian Government Department of Education, Skills and Employment (DESE, 2022). Despite Australia overall being a relatively advantaged society, Aboriginal and Torres Strait Islanders experience greater disadvantage than non-Indigenous Australians (Australian Institute of Health and Welfare, 2020). In their analysis of PEDS data in a 2008–2012 study of 725 4–8 year old urban

Aboriginal children in NSW, Chando et al. (2020) found 32% at high risk and a further 28% at moderate risk. Within their cohort, factors associated with high risk included both personal factors such as male sex, age, and a history of otitis media, and family factors such as housing instability, whether the child lived with their parent(s), and whether their carer experienced psychological distress. To support action on the findings from the KHC, results are presented to the ACT's Aboriginal and Torres Strait Islander Elected Body to inform decision making and advocacy by local Aboriginal and Torres Strait Islander leaders.

Children from areas of relative disadvantage were more likely to have non-predictive concerns (without predictive concerns) identified (Pathway C); these children are more likely to present with behavioural or emotional challenges. If these difficulties continue, there can be negative impacts on schooling, relationships, physical and mental health (Ogundele, 2018). Glascoe (2000) suggests that parents identifying these children may be seeking support or advice, and that patient education is an important first step. Where these measures are not sufficient, or there are additional concerns for the child and/or their family, referrals to additional services may be beneficial (Glascoe, 2000; Luangrath & Hiscock, 2011).

Our findings replicate those seen elsewhere, despite the unique sociodemographic make-up of the ACT. This has implications for resourcing and follow up; one in 10 children is scored as high risk for developmental concerns. If a parent has indicated significant concerns in the PEDS component of the KHC, a report is sent to the child's nominated GP. As PEDS is a screening tool, review and additional developmental assessment may be needed. A recent Australian study of implementing PEDS into general practice identified barriers to the utility of developmental screening such as lack of clear referral pathways, cost barriers for parents, and increased consultation time for GPs (Alexander & Mazza, 2023). Nevertheless, parents and professionals will benefit from being aware that there are differences in early developmental vulnerabilities for those children identified as being at higher risk, and this can be incorporated into primary health care. The KHC team in the ACT worked closely with Emerging Minds and with the local ACT and South East NSW HealthPathways teams to develop specific resources and clinical pathways that GPs could access to support them in working with families following feedback from the KHC program, thus addressing some of the barriers identified by Alexander and Mazza (2023) (Emerging Minds, 2023; HealthPathways, 2023).

## 5 | STRENGTHS AND LIMITATIONS

A key strength of our study is the large sample size and high participation rates. The questionnaire comprises widely used and validated tools.

As a cross-sectional study, we can identify associations, but not causation.

The PEDS is a screening tool, and not intended for use in diagnosis; however, it has an important role in identifying children at risk.

For example, children on Pathway A have 20 times the risk of developmental delay or disability compared with their peers whose parents report no concerns (Glascoe, 2000). For these children, engaging a general practitioner, paediatrician, and/or allied health professionals for early intervention and formal diagnostic testing is paramount.

## 5.1 | Non-response analysis

We assumed that children who participated in the survey had the same characteristics as those who did not. Were this not the case, there is a risk of non-response bias.

We compared the characteristics of children for whom a PEDS pathway could be determined against those for whom it could not. There were significant differences for socioeconomic position, where those in the least disadvantaged quintile were more likely to complete the PEDS module than those in the most disadvantaged quintile. While this difference was statistically significant, it was quite small: 99.1% of those in quintiles 1–4 had a valid PEDS pathway compared with 99.5% of those in quintile 5 (least disadvantaged). If children from more disadvantaged areas are underrepresented in the PEDS responses, this may reduce the calculated effect size, albeit by a small amount. Similarly, those for whom a regular GP was not nominated were less likely to have a completed PEDs score than others, but with very small differences only.

## 6 | CONCLUSION

More than half of ACT children in their first year of primary education had low/no developmental risk identified through the PEDS questionnaire, with one in 10 at high risk. Those more likely to be identified at high risk were boys, those from the most disadvantaged socioeconomic groups, and Aboriginal and Torres Strait Islander children.

Children identified as high risk through the PEDS screening tool require referral to a primary health care professional for diagnosis and support and this is supported through the KHC process. Thus, the KHC remains a valuable tool for screening ACT children for risk of developmental disability and delay with appropriate links to allow intervention for those identified.

While we can identify children at risk through screening, the greater challenge remains to identify and address the underlying causes of healthy inequalities, even within highly socioeconomically advantaged communities.

### AUTHOR CONTRIBUTIONS

**Kathleen O'Brien:** Conceptualization; methodology; formal analysis; writing—original draft; writing—review and editing; data curation.

**Jason Agostino:** Conceptualization; methodology; writing—original draft; writing—review and editing. **Karen Ciszek:** Conceptualization; data curation; writing—review and editing. **Kirsty A. Douglas:** Conceptualization; methodology; writing—original draft; writing—review and editing.

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### CONFLICT OF INTEREST STATEMENT

None declared.

### DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the data custodians. Restrictions apply to the availability of these data, which were used under license for this study. Data are available from <https://www.canberrahealthservices.act.gov.au/services-and-clinics/services/kindergarten-health-check> with the permission of the data custodians.

### ETHICS STATEMENT

The KHC data collection and consent process has been granted ethics approval through the ACT Health Human Research Ethics Committee (ETHLR.13.316). Ethics approval for our study was granted by the ACT Health Human Research Ethics Committee's Low Risk Subcommittee (ETHLR.17.080 and ETHLR.17.259).

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## SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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