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# Inequities in vulnerable children's access to health services in Australia

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## ABSTRACT

**Introduction** Children born into families at risk of becoming or remaining poor are at significant risk of experiencing childhood poverty, which can impair their start to life, and perpetuate intergenerational cycles of poverty. This study sought to quantify health service utilisation, costs and funding distribution amongst children born into vulnerable compared to non-vulnerable families.

**Methods** This study used a large linked administrative dataset for all women giving birth in Queensland, Australia between July 2012 and July 2018. Health service use included inpatient, emergency department (ED), general practice, specialist, pathology and diagnostic imaging services. Costs included those paid by public hospital funders, private health insurers, Medicare and out-of-pocket costs.

**Results** Vulnerable children comprised 34.1% of the study cohort. Compared with non-vulnerable children, they used significantly higher average numbers of ED services during the first 5 years of life ( $2.52 \pm 3.63$  vs  $1.97 \pm 2.77$ ), and significantly lower average numbers of specialist, pathology and diagnostic imaging services. Vulnerable children incurred significantly greater costs to public hospital funders compared with non-vulnerable children over the first 5 years of life (\$16 053 vs \$10 247), and significantly lower private health insurer, Medicare and out-of-pocket costs.

**Conclusion** There are clear inequities in vulnerable children's health service utilisation in Australia. Greater examination of the uptake and cost-effectiveness of maternal and child services is needed, as these services support children's development in the critical first 1000 days of life.

## INTRODUCTION

Poverty can be defined in a number of ways, though is commonly defined as household income below a specified threshold (eg, 50% of a nation's average or median household income).<sup>1,2</sup> While this understanding of poverty is easily measured, other definitions have emerged to more accurately demonstrate that poverty is fluid and multidimensional, and that inadequate income is just one of many significant contributors. Sen defined poverty as 'the deprivation of basic capabilities rather than merely as lowness of incomes'; highlighting that poverty

## WHAT IS ALREADY KNOWN ON THIS TOPIC

- ⇒ Roughly one in seven children live in income poverty across Organisation for Economic Co-operation and Development countries.
- ⇒ Even in countries with universal healthcare coverage (eg, the UK, Canada and Australia), impoverished children and those at risk of poverty are less likely to access primary and secondary care services for ill-health prevention, health maintenance and chronic disease management.

## WHAT THIS STUDY ADDS

- ⇒ The present study demonstrates that vulnerable children in Australia cost public hospital funders significantly more over the first 5 years of life compared with non-vulnerable children, who cost significantly more in Medicare, private hospital funding and out-of-pocket costs.
- ⇒ Vulnerable children were also more likely to use fewer primary and secondary care services during the first 5 years of life compared with non-vulnerable children, but significantly more emergency department services.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE AND/OR POLICY

- ⇒ Disparate patterns of health service use between vulnerable and non-vulnerable children in this study suggests inequitable access to primary and secondary healthcare for vulnerable Australian children.
- ⇒ While public hospitals offer essential tertiary care for children and attract no out-of-pocket charge, they are not designed to support ill-health prevention, health maintenance or disease management, which is of particular importance to vulnerable children as their vulnerability also confers poorer health.
- ⇒ Health policy that supports children and their parents during early developmental years is necessary to reduce inequities within Australia and other high-income countries.

encompasses the deprivation of freedom to live the kind of life that an individual values.<sup>3</sup> Since Sen's capability approach to poverty, shifts have been made toward measuring poverty in a more holistic sense. Nussbaum developed a list of 'The Central Human Capabilities', which included life (being able to avoid premature death); bodily health (being

**Table 1** Demographic and clinical characteristics of women and children at birth based on vulnerability classification

Characteristics	Vulnerable (n=124 668)	Non-vulnerable (n=240 470)
<b>Women</b>		
Age (mean±SD)	28.4±6.5	31.0±4.9
Identified as Indigenous (n %)	18 708 (15.0%)	2489 (1.0%)
Single (n %)	77 053 (61.8%)	27 579 (11.5%)
Smoked after 20 weeks' gestation (n %)	29 548 (23.7%)	5769 (2.0%)
Pre-existing medical condition (n %)	70 589 (56.6%)	35 719 (14.9%)
Born in Australia (n %)	49 654 (39.8%)	47 646 (19.8%)
Socioeconomically disadvantaged (n %)*	27 928 (22.6%)	12 669 (5.3%)
<b>Children</b>		
Weeks' gestation at birth (mean±SD)	38.4±2.4	38.7±2.1
Gender (n %)		
Male	64 347 (51.6%)	123 730 (51.5%)
Females	60 308 (48.4%)	116 618 (48.5%)
Stillborn (n %)	742 (0.6%)	1123 (0.5%)
Admitted to SCN or NICU (n %)	27 428 (22.0%)	38 679 (16.1%)
Low APGAR score (<7 at 5 min) (n %)	3834 (3.1%)	5203 (2.2%)
Developed a chronic health condition (n %)†	13 707 (11.0%)	29 351 (12.2%)
*Defined as Q1 or Q2 of the Index of Relative Socio-economic Advantage and Disadvantage.		
†Within the timeframe of the dataset (between 2 and 5 years of age).		
APGAR, Appearance, Pulse, Grimace, Activity and Respiration; NICU, neonatal intensive care unit; SCN, special care nursery.		

able to have good health); bodily integrity (being able to move freely); senses, imagination and thought; emotions (being able to have attachments); practical reason (being able to critically reflect); affiliation (being able to live with and around others); other species (being able to live with and around animals and nature); play (being able to enjoy recreational activities); and control over one's environment (both in material and political terms).<sup>4</sup> More recently, Callander *et al* proposed three key broad areas of capability that encapsulated those espoused by Nussbaum—health, education and income.<sup>5</sup>

Poverty is typically associated with developing countries, famine and poor sanitation. However, even among some of the most developed nations, poverty is rife. In 2016, the Organisation for Economic Co-operation and Development (OECD) reported that the average poverty rate across OECD countries was 11.8%, ranging from 5.4% in Iceland to 17.9% in Israel and 17.8% in the USA.<sup>6</sup>

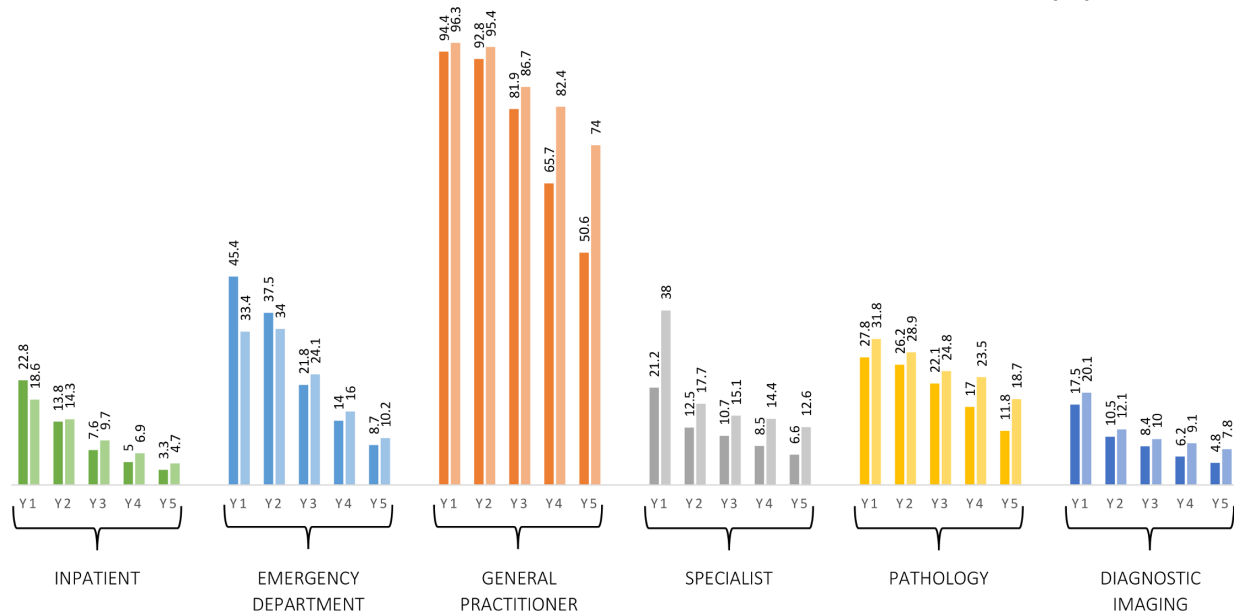
A report from the US Census Bureau identified that black (18.8%) and Hispanic (15.7%) Americans, individuals with a disability (22.5%), and those without a high school diploma (23.7%) were significantly more likely to be living in poverty.<sup>7</sup> Furthermore, over 92 million (21.1%) people across Europe were at risk of poverty in 2019; a greater proportion of which were female (22.0% vs 20.2%).<sup>8</sup>

Australia also reports a poverty rate worse than the OECD average. One in eight Australians (13.6%) live in poverty based on having a household income lower than 50% of the median income poverty line.<sup>2</sup> Major contributors to poverty in Australia are the affordability of housing and limited disposable income.<sup>9</sup> More concerning is that poverty affects greater than one in six (17.7%) Australian children.<sup>2</sup> Poverty can have significant impacts on children's cognitive, social-emotional and health outcomes both during childhood and as they transition into adulthood and the labour force.<sup>10 11</sup> Further, children born into poverty are more likely to remain entrenched in poverty, perpetuating cycles of intergenerational poverty<sup>12 13</sup>; with significant implications for the child, their family and broader society. Data from the Longitudinal Study of Australian Children demonstrates that poverty has negative impacts on cognitive outcomes such as vocabulary, reading and numeracy, particularly in early childhood years.<sup>14</sup> Moreover, Australian children experiencing poverty are more likely to be obese, report lower levels of participation in physical activity and demonstrate poorer social behaviours towards other children (eg, consideration of others' feelings, sharing, etc).<sup>14</sup>

Vulnerable families—those at risk of becoming poor or at risk of remaining poor<sup>15</sup>—are more likely to experience poverty. In Australia, Aboriginal and Torres Strait Islander people are disproportionately more vulnerable and more likely to experience poverty compared with non-Indigenous Australians.<sup>16</sup> Vulnerability is also associated with sole parent families, young parent families, unemployment, relationship breakdowns, illness, frequent family relocation and locational disadvantage, family violence, alcohol and other drugs, discrimination (eg, racism) and social isolation.<sup>17 18</sup> A report by the Australian Institute of Family Studies (AIFS) shows that despite the high rate of childhood poverty in Australia, strategies to improve service accessibility for vulnerable families are ad-hoc, and resource availability to support these types of programmes remains scarce.<sup>18</sup> Health is a key capability that provides individuals with the opportunity to improve education attainment, participate in the labour force and increase economic resources.<sup>19 20</sup> Thus, for children born into vulnerable families, good health and a positive start to life are key to breaking the poverty cycle.<sup>21</sup>

In 2017, the AIFS reported that children from birth to age 5 in the lowest quartile of equalised household income had significantly lower odds of accessing general practitioner (GP) services than children in the third and fourth quintiles.<sup>22</sup> Moreover, children living

## PROPORTION OF CHILDREN USING DIFFERENT HEALTH SERVICES (%)



**Figure 1** Proportion of vulnerable children compared with non-vulnerable children using different types of health services between birth and 5 years of age.

in outer regional and remote locations of Australia had significantly lower odds of accessing GP and paediatric services than their major city counterparts.<sup>22</sup> Yet beyond this, minimal research has looked at health service use by Australian children born into vulnerable families. Given the prevalence of childhood poverty in Australia, and the impetus for supporting a healthy start to life for all children (ie, the first 1000 days),<sup>23–25</sup> a greater understanding of health service use among children from vulnerable families is critical. This will help inform policy that supports access to and funding of the services that these children need in order to prevent persistent poverty. Thus, this study sought to quantify the type of health service use, costs and funding distribution for children born into vulnerable families in Queensland, Australia, compared with children born into non-vulnerable families.

## METHODS

### Study population and data source

This was a retrospective cohort study using a linked administrative dataset called Maternity1000.<sup>26–27</sup> The Maternity1000 population is defined by the Queensland Perinatal Data Collection (QPDC), which includes all births in Queensland between 1 July 2012 and 30 June 2018 (n=365 138 births). Women and children's information as described in the QPDC was subsequently linked to Admitted Patient Data Collection (APDC), Emergency Department Collection (EDC), Death Registration Data, Medicare Benefits Schedule (MBS) claims, Pharmaceutical Benefits Scheme (PBS) claims and Clinical Costing Unit Data records (see online supplemental appendix 1 for an illustration of the data linkage). Respectively, these records detail inpatient admissions to public hospitals, private hospitals, and day surgery units (APDC);

presentations to public hospital emergency departments (EDs) (EDC); reported deaths (Death Registration Data); government rebated services, specifically GP's, specialists, pathology tests and diagnostic tests (MBS); prescription medications subsidised by the Australian Government (PBS); and public hospital costs based on Diagnosis Related Groups (Clinical Costing Unit Data). Out-of-pocket costs paid by families were identifiable from MBS data records.

For the purpose of this study, we define a vulnerable child as one whose family is at risk of becoming poor or at risk of remaining poor.<sup>15</sup> Children were categorised as 'vulnerable' or 'non-vulnerable' based on women's characteristics. 'Vulnerable' children were defined as those whose mother met two or more of the following criteria: aged <23 years old (young pregnancy); identified as Indigenous (Aboriginal and/or Torres Strait Islander); were single; smoked at >20 weeks' gestation; reported a pre-existing medical condition (any health condition that may significantly affect care during pregnancy and/or the pregnancy outcome); were born in a country other than Australia; and reported a residential postcode in quintiles one or two (greater disadvantage) of the Index of Relative Socio-economic Advantage and Disadvantage. The variables were selected as they align with previous research related to vulnerable Australian families, and will enable comparison with future results of a proposed sustained nurse home visiting programme to support vulnerable Australian families.<sup>28</sup> All other children were categorised as 'non-vulnerable'.

### Study outcomes

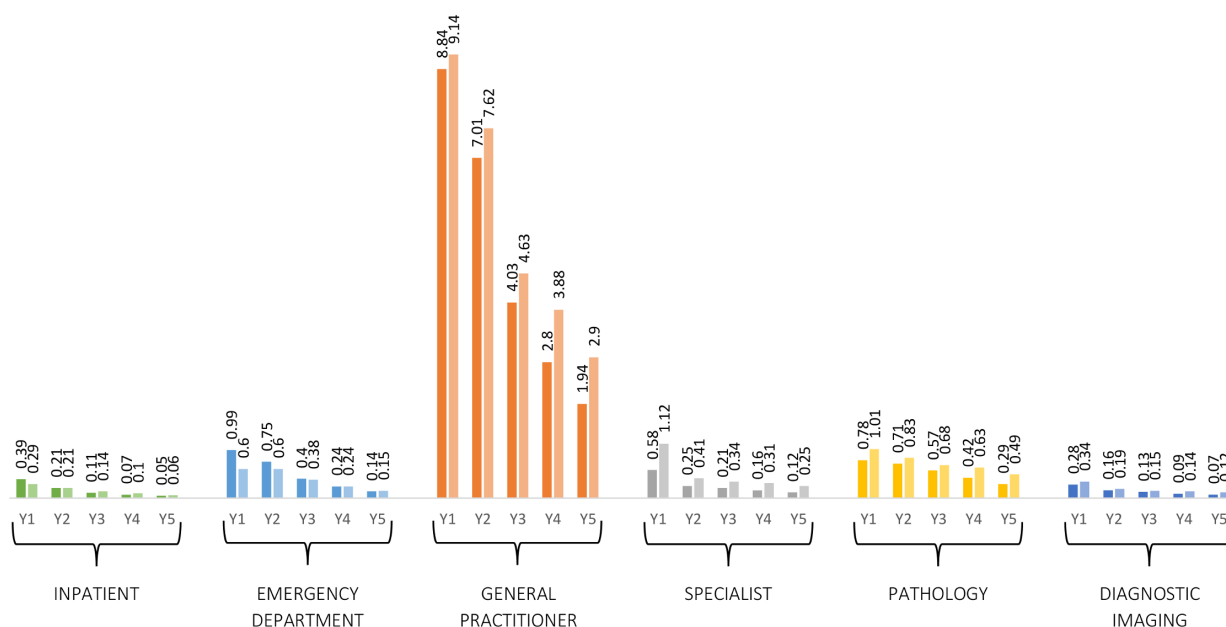
The study outcomes of interest were type of health service use, costs and funding distribution for vulnerable

**Table 2** Proportion of children using at least one health service between birth and 5 years of age based on vulnerability classification

Service type	Vulnerable children (n=124 668), n (%)	Non-vulnerable children (n=240 470), n (%)	Relative risk ratio (95% CI)*
<b>Primary care services</b>			
General practitioner			
Year 1	117 627 (94.4)	231 571 (96.3)	0.84 (0.83 to 0.85)
Year 2	115 629 (92.8)	229 320 (95.4)	0.83 (0.82 to 0.84)
Year 3	102 053 (81.9)	208 378 (86.7)	0.87 (0.87 to 0.88)
Year 4	81 863 (65.7)	198 146 (82.4)	0.70 (0.69 to 0.71)
Year 5	63 069 (50.6)	177 821 (74.0)	0.68 (0.68 to 0.69)
Total	121 047 (97.1)	236 184 (98.2)	0.82 (0.80 to 0.84)
<b>Secondary care services</b>			
Specialist			
Year 1	26 423 (21.2)	91 281 (38.0)	0.78 (0.77 to 0.78)
Year 2	15 532 (12.5)	42 547 (17.7)	0.88 (0.88 to 0.88)
Year 3	13 285 (10.7)	36 392 (15.1)	0.88 (0.88 to 0.89)
Year 4	10 639 (8.5)	34 707 (14.4)	0.84 (0.84 to 0.85)
Year 5	8264 (6.6)	30 239 (12.6)	0.82 (0.81 to 0.82)
Total	43 826 (35.2)	127 569 (53.1)	0.78 (0.78 to 0.79)
Pathology			
Year 1	34 651 (27.8)	76 471 (31.8)	0.94 (0.93 to 0.94)
Year 2	32 641 (26.2)	69 453 (28.9)	0.96 (0.95 to 0.96)
Year 3	27 516 (22.1)	59 678 (24.8)	0.95 (0.95 to 0.96)
Year 4	21 215 (17.0)	56 549 (23.5)	0.88 (0.88 to 0.88)
Year 5	14 648 (11.8)	44 928 (18.7)	0.85 (0.84 to 0.85)
Total	75 084 (60.2)	163 080 (67.8)	0.89 (0.89 to 0.89)
Diagnostic imaging			
Year 1	21 832 (17.5)	48 252 (20.1)	0.95 (0.94 to 0.95)
Year 2	13 050 (10.5)	29 005 (12.1)	0.95 (0.94 to 0.96)
Year 3	10 430 (8.4)	24 030 (10.0)	0.94 (0.93 to 0.95)
Year 4	7740 (6.2)	21 978 (9.1)	0.88 (0.87 to 0.89)
Year 5	5932 (4.8)	18 836 (7.8)	0.86 (0.85 to 0.86)
Total	43 176 (34.6)	99 312 (41.3)	0.91 (0.91 to 0.91)
<b>Tertiary care services</b>			
Inpatient			
Year 1	28 419 (22.8)	44 791 (18.6)	1.10 (1.09 to 1.10)
Year 2	17 206 (13.8)	34 339 (14.3)	0.99 (0.98 to 0.99)
Year 3	9418 (7.6)	23 313 (9.7)	0.92 (0.91 to 0.92)
Year 4	6228 (5.0)	16 515 (6.9)	0.90 (0.89 to 0.91)
Year 5	4063 (3.3)	11 317 (4.7)	0.89 (0.88 to 0.90)
Total	47 514 (38.1)	93 035 (38.7)	0.99 (0.99 to 1.00)
Emergency department			
Year 1	56 640 (45.4)	80 392 (33.4)	1.20 (1.19 to 1.20)
Year 2	46 767 (37.5)	81 651 (34.0)	1.06 (1.05 to 1.06)
Year 3	27 163 (21.8)	57 872 (24.1)	0.96 (0.95 to 0.96)
Year 4	17 509 (14.0)	38 542 (16.0)	0.95 (0.94 to 0.96)
Year 5	10 859 (8.7)	24 556 (10.2)	0.94 (0.94 to 0.95)
Total	85 255 (68.4)	156 063 (64.9)	1.05 (1.05 to 1.06)

\*Reference group=non-vulnerable children.

## AVERAGE CHILD HEALTH SERVICE USE (MEAN)



**Figure 2** Average number of services used by vulnerable children compared with non-vulnerable children between birth and 5 years of age.

children compared with non-vulnerable children from birth to age 5. The types of health services reported in Maternity1000 included inpatient, ED, GP, specialist, pathology and diagnostic imaging services. GP services are part of the primary care (community) system. GPs are considered the first point of contact for many patients, and act as a gateway to other specialist services by referral. GP services target ill-health prevention, health maintenance and chronic disease management.<sup>29</sup> Specialist, pathology and diagnostic imaging services are secondary healthcare services, requiring referral from a primary care provider, and each can be accessed in community or hospital settings.<sup>29</sup> These services function in diagnostic, curative, health monitoring and health maintenance capacities. Inpatient and ED services are part of Australia's tertiary care (hospital) system, and can be provided through either public hospital or private hospital providers.<sup>29</sup> These services aim to provide care to individuals requiring immediate, acute and emergency medical care as a consequence of severe injury or illness.<sup>29</sup> Thus, they focus on treating and curing patients.

Costs were described in terms of how health service use was paid for. That is, public hospital funders, Medicare, private health insurance and individual out-of-pocket costs. In Australia, public hospitals are funded by state/territory and federal governments, where funding is activity-based (ie, fee-for-service).<sup>30</sup> That is, public hospitals get paid relative to the number and case-mix of patients they care for.<sup>30</sup> Care outside of public hospitals is partly funded through Medicare, which provides free or subsidised access to primary care providers such as GPs, optometrists and allied health providers. Medicare also provides free or subsidised access to secondary care providers such as specialists, diagnostic and imaging, and

for care received in *private* hospitals.<sup>29</sup> Patients are sometimes required to pay an out-of-pocket cost to partially or fully cover the cost of accessing Medicare-funded services.<sup>31</sup> Indeed, Australians are subject to some of the highest rates of per capita out-of-pocket healthcare costs internationally.<sup>31</sup> In addition, Australians can pay for private health insurance which can contribute fully or partially to covering the costs of admission to a private hospital.<sup>32</sup> Roughly 44% of Australians have private patient hospital cover, which covers all or part of the costs of inpatient treatment for private hospital patients, and can contribute to accommodation and theatre fees.<sup>32</sup>

### Statistical analysis

Data were analysed using SAS V.9.4 (SAS Institute). Demographic and clinical characteristics of vulnerable and non-vulnerable women and children were described in terms of means and SD, and frequencies and percentages. The clinical characteristics of weeks' gestation at birth, proportion of stillbirths, admission to special care nursing (SCN) or neonatal intensive care unit (NICU), low Appearance, Pulse, Grimace, Activity and Respiration (APGAR) score and development of a chronic health condition are presented for children as these are known to impact children's health service use and subsequent healthcare costs in early life.

Health service use for vulnerable and non-vulnerable children was described in terms of the proportion of children using at least one service compared with those not using services between birth and 5 years of age. Differences between groups were described using relative risk ratios. Additionally, means, SD and ranges are used to describe the differences in the number of services used by vulnerable children compared with non-vulnerable

**Table 3** Average number of services used by children based on vulnerability classification

Service type	Vulnerable children (n=124 668), mean (SD)	Non-vulnerable children (n=240 470), mean (SD)	Ratio of service use (95% CI)*
<b>Primary care services</b>			
General practitioner			
Year 1	8.84 (6.20)	9.14 (5.90)	0.98 (0.97 to 0.99)
Year 2	7.01 (5.81)	7.62 (5.90)	0.97 (0.97 to 0.98)
Year 3	4.03 (4.31)	4.63 (4.50)	0.94 (0.94 to 0.95)
Year 4	2.80 (3.69)	3.88 (3.95)	0.80 (0.79 to 0.80)
Year 5	1.94 (3.04)	2.90 (3.31)	0.68 (0.68 to 0.69)
Total	24.62 (17.34)	28.17 (17.93)	0.99 (0.98 to 1.00)
<b>Secondary care services</b>			
Specialist			
Year 1	0.58 (2.53)	1.12 (3.42)	0.56 (0.55 to 0.57)
Year 2	0.25 (1.19)	0.41 (1.56)	0.70 (0.69 to 0.72)
Year 3	0.21 (0.98)	0.34 (1.41)	0.70 (0.69 to 0.72)
Year 4	0.16 (0.73)	0.31 (1.31)	0.59 (0.58 to 0.60)
Year 5	0.12 (0.71)	0.25 (1.08)	0.53 (0.51 to 0.54)
Total	1.31 (4.08)	2.42 (6.00)	0.66 (0.66 to 0.67)
Pathology			
Year 1	0.78 (3.23)	1.01 (4.95)	0.87 (0.86 to 0.89)
Year 2	0.71 (2.96)	0.83 (3.22)	0.91 (0.89 to 0.92)
Year 3	0.57 (2.53)	0.68 (4.2)	0.89 (0.88 to 0.90)
Year 4	0.42 (1.58)	0.63 (3.78)	0.72 (0.71 to 0.74)
Year 5	0.29 (1.34)	0.49 (2.46)	0.63 (0.62 to 0.64)
Total	2.77 (7.09)	3.64 (11.12)	0.89 (0.88 to 0.90)
Diagnostic imaging			
Year 1	0.28 (0.96)	0.34 (1.30)	0.87 (0.86 to 0.89)
Year 2	0.16 (0.62)	0.19 (0.72)	0.87 (0.85 to 0.89)
Year 3	0.13 (0.53)	0.15 (0.61)	0.84 (0.82 to 0.86)
Year 4	0.09 (0.45)	0.14 (0.66)	0.68 (0.66 to 0.70)
Year 5	0.07 (0.37)	0.12 (0.50)	0.61 (0.59 to 0.63)
Total	0.73 (1.69)	0.94 (2.22)	0.84 (0.83 to 0.85)
<b>Tertiary care services</b>			
Inpatient			
Year 1	0.39 (1.07)	0.29 (0.87)	1.22 (1.21 to 1.24)
Year 2	0.21 (0.75)	0.21 (0.80)	0.97 (0.95 to 0.98)
Year 3	0.11 (0.65)	0.14 (0.65)	0.78 (0.76 to 0.80)
Year 4	0.07 (0.5)	0.10 (0.57)	0.73 (0.71 to 0.75)
Year 5	0.05 (0.44)	0.06 (0.42)	0.69 (0.67 to 0.72)
Total	0.83 (2.06)	0.80 (2.01)	0.99 (0.97 to 1.00)
Emergency department			
Year 1	0.99 (1.67)	0.60 (1.18)	1.36 (1.34 to 1.37)
Year 2	0.75 (1.40)	0.60 (1.13)	1.10 (1.09 to 1.12)
Year 3	0.40 (1.01)	0.38 (0.87)	0.91 (0.89 to 0.92)
Year 4	0.24 (0.77)	0.24 (0.69)	0.88 (0.86 to 0.89)
Year 5	0.14 (0.58)	0.15 (0.55)	0.85 (0.83 to 0.87)
Total	2.52 (3.63)	1.97 (2.77)	1.05 (1.04 to 1.06)

\*Reference group=non-vulnerable children.

**Table 4** Average costs (Australian dollars) of health service use by children between birth and 5 years of age based on sources of funding and vulnerability classification

Costs	Vulnerable children	Non-vulnerable children	Cost ratio (95% CI)*
	Cost (mean±SD)	Cost (mean±SD)	
Year 1			
Out-of-pocket costs	107 (762)	252 (1229)	0.42 (0.41 to 0.43)
Public hospital funders	12 766 (23 342)	7376 (14 847)	1.73 (1.70 to 1.76)
Private health insurers	952 (4367)	1480 (4452)	0.64 (0.62 to 0.66)
Medicare	737 (876)	896 (1203)	0.82 (0.82 to 0.83)
Year 2			
Out-of-pocket costs	45 (274)	101 (428)	0.44 (0.43 to 0.46)
Public hospital funders	1607 (7088)	1278 (6496)	1.26 (1.22 to 1.30)
Private health insurers	42 (543)	106 (897)	0.39 (0.34 to 0.45)
Medicare	496 (483)	534 (558)	0.93 (0.92 to 0.94)
Year 3			
Out-of-pocket costs	42 (270)	93 (453)	0.46 (0.44 to 0.47)
Public hospital funders	865 (6538)	789 (5120)	1.10 (1.05 to 1.14)
Private health insurers	19 (305)	68 (536)	0.27 (0.24 to 0.32)
Medicare	339 (429)	366 (500)	0.93 (0.92 to 0.94)
Year 4			
Out-of-pocket costs	31 (221)	95 (519)	0.33 (0.32 to 0.34)
Public hospital funders	510 (4306)	500 (4303)	1.02 (0.97 to 1.07)
Private health insurers	15 (226)	55 (441)	0.27 (0.23 to 0.32)
Medicare	255 (367)	337 (508)	0.76 (0.75 to 0.76)
Year 5			
Out-of-pocket costs	23 (187)	81 (390)	0.28 (0.27 to 0.29)
Public hospital funders	306 (3207)	304 (2653)	1.01 (0.94 to 1.07)
Private health insurers	11 (173)	41 (420)	0.26 (0.21 to 0.31)
Medicare	190 (334)	277 (420)	0.69 (0.68 to 0.70)
Total			
Out-of-pocket costs	248 (1024)	622 (1788)	0.40 (0.39 to 0.41)
Public hospital funders	16 053 (28 353)	10 247 (20 721)	1.57 (1.55 to 1.59)
Private health insurers	1037 (4495)	1750 (4806)	0.59 (0.58 to 0.61)
Medicare	2017 (1718)	2410 (2207)	0.84 (0.83 to 0.84)

\*Reference group=non-vulnerable children.

children. Differences between groups were described using health service use ratios with 95% CIs. Health service use was calculated in 12-month intervals, as well as cumulatively over the first 5 years of life.

The costs of health service use by vulnerable and non-vulnerable children (identified from Clinical Costing Unit Data records and MBS records) were described in terms of means and SD. Costs from birth to age 5 were broken down into 12-month intervals, and categorised according to whether costs were paid by public hospital funders, private hospital funders, Medicare or individual out-of-pocket cost. Generalised linear models with negative binomial distribution and log-link function (to account for the skewed nature of cost data) were used to

compare the differences in health service costs between vulnerable and non-vulnerable children. These cost differences are described in terms of cost ratios with 95% CI.

### Patient and public involvement

Patients and the public were not involved in this research.

## RESULTS

Table 1 shows that of the 365 138 births in Queensland between 1 July 2012 and 30 June 2018, 124 668 were children born into vulnerable families (34.1%) and 240 470 were born into non-vulnerable families (65.9%).

Women's characteristics used to define vulnerability groupings illustrate pronounced differences between these classifications. Compared with non-vulnerable children, vulnerable children were more likely to be stillborn (0.5% vs 0.6%, respectively), admitted to NICUs or SCNs (16.1% vs 22.0%, respectively), and have an APGAR score <7 at 5 min (2.2% vs 3.1%, respectively). Conversely, non-vulnerable children were significantly more likely to develop  $\geq 1$  chronic health condition within the first 5 years of life compared with vulnerable children (12.2% vs 11.0%, respectively).

Differences between the proportion of vulnerable compared with non-vulnerable children using different types of services is illustrated in [figure 1](#). Vulnerable children had a significantly lower relative risk of accessing GP services across all years ([table 2](#)), this difference was particularly pronounced in year 4 and year 5 where the relative risk of accessing GP services was 0.70 (95% CI 0.69 to 0.71) and 0.68 (95% CI 0.68 to 0.69), respectively, compared with non-vulnerable children. Compared with non-vulnerable children's use of secondary services—specialist, pathology and diagnostic imaging services—vulnerable children had a significantly reduced relative risk of using these services across all years. Vulnerable children had a significantly greater relative risk of inpatient service use in the first year of life (1.10, 95% CI 1.09 to 1.10), but a reduced relative risk from years two to five. Similarly, vulnerable children had a significant greater relative risk of ED service use in the first and second years of life (year 1: 1.20, 95% CI 1.19 to 1.20; year 2: 1.06, 95% CI 1.05 to 1.06), but a reduced relative risk from years 3 to 5.

Differences between the average number of services being used by vulnerable children compared with non-vulnerable children is illustrated in [figure 2](#). Similar to the relative risk ratio trends, vulnerable children had a significantly greater ratio of inpatient service use in the first year of life compared with non-vulnerable children (1.22, 95% CI 1.21 to 1.24) ([table 3](#)). This reduced significantly from years 2 to 5. Vulnerable children also had a significantly higher ratio of ED service use in years 1 and 2 compared with non-vulnerable children (year 1: 1.36, 95% CI 1.34 to 1.37; year 2: 1.10, 95% CI 1.09 to 1.12), but this too significantly decreased from years 3 to 5. Vulnerable children consistently had a significantly lower ratio of GP, specialist, pathology and diagnostic imaging service use compared with non-vulnerable children from birth to age 5.

[Table 4](#) depicts the average costs to different funders for vulnerable and non-vulnerable children's health service use between birth and 5 years of age. Overall, vulnerable child health service use incurred 57% higher costs from public hospital funders over the first 5 years of life compared with non-vulnerable children. This was most prominent in the first year of life, where vulnerable children incurred 73% more than non-vulnerable children in public health funder costs. Conversely, vulnerable children incurred 60% less in out-of-pocket costs,

41% less in private health insurer costs and 16% less in Medicare costs compared with non-vulnerable children across the first 5 years of life.

## DISCUSSION

This study sought to quantify the type of health service use, costs and funding distribution for children born into vulnerable families in Queensland, Australia. Despite a recognised greater need for access to healthcare services, vulnerable children were significantly less likely to use primary and secondary care services—GP, specialist, pathology and diagnostic imaging services—during the first 5 years of life compared with non-vulnerable children. Instead, a higher proportion of vulnerable children used tertiary inpatient and ED services, particularly in the first and second years of life. These patterns of health service use among vulnerable children correlated with significantly higher costs to public hospital funders, and significantly lower out-of-pocket, Medicare and private health insurance costs.

The disparate patterns of health service use between vulnerable and non-vulnerable children in this study suggests inequitable access to primary and secondary healthcare for vulnerable Australian children, aligning with the Inverse Care Law (ie, that the availability of quality healthcare is inversely related to the need for it).<sup>33</sup> Children from families of socioeconomic disadvantage are known to have a greater need for primary and secondary care services as they experience poorer health, therefore requiring greater health management and maintenance.<sup>34–36</sup> The higher utilisation of inpatient and ED services in the first 2 years of life by vulnerable children demonstrated in this study is consistent with this indication of a high need for primary and secondary healthcare. Moreover, as health is a key capability associated with improving educational outcomes, economic resources and labour force participation, vulnerable children also require greater access to primary care services to break intergenerational cycles of poverty. Consequently, the results from this study present critical systems planning and policy implications that are both nationally and internationally relevant.

The patterns of health service use in the current study have been evidenced in other literature. One Australian study quantified the health service use and costs to different healthcare funders for children up to 2 years of age with chronic health conditions. Children with chronic conditions from families of greater socioeconomic disadvantage reported a higher average number of inpatient admissions and ED presentations than more advantaged children, and less use of primary care services.<sup>37</sup> Further, children with chronic conditions and of greatest disadvantage incurred a median cost of \$A31 052 (IQR \$35 163) to public hospital funders compared with children with chronic conditions and of greatest advantage (\$A16 889, IQR \$23 017).<sup>37</sup> Research from Catalonia, Spain—whose healthcare system is similar to

that of Australia's—also demonstrated that children from families of lower socioeconomic status were more likely to present to EDs and be hospitalised than children of higher socioeconomic status.<sup>38</sup> Similar patterns of access to health services have been evidenced in the UK,<sup>39</sup> Nordic countries<sup>40</sup> and low-income and middle-income countries such as Bangladesh<sup>41</sup> and Ethiopia.<sup>42</sup> Thus, though varying in severity and deterministic factors, inequity in children's use of and access to primary and secondary healthcare continues to be a global problem.

Given the importance of the first 1000 days of life,<sup>26 43 44</sup> supporting equitable access to healthcare for children is critical. Globally, maternal and child health (MCH) services have emerged as a means of supporting children's development until they start school, and supporting parents to achieve their parenting goals.<sup>45 46</sup> The USA has a nation-wide programme governed by the Health Resources and Services Administration. In 2019, over US\$408 million was expended in support of the health of children less than 1 year of age, close to US\$1 billion to support children between ages 1 and 21, and over US\$290 million to support pregnant women.<sup>47</sup> In Australia, MCH services are funded by state and local governments and available to all families (not just low-income families).<sup>48</sup> For example, Right@home is one service being implemented in some Australian states, which sees the delivery of relationship-based sustained nurse home visiting to support parents facing adversity in their capacity to provide safe, responsive care in a home environment that supports children's learning.<sup>28 49</sup> However, there is wide variation in the availability of MCH services across Australia.<sup>45 50–53</sup> New South Wales has over 400 MCH services compared with Queensland's 33 (despite being Australia's second largest state by land mass).<sup>50</sup> Further, the uptake and cost-effectiveness of MCH services in Australia is unclear. Given the barriers to accessibility that many vulnerable families face (including geographical and cultural),<sup>54–56</sup> uncertainty surrounds whether MCH services are alleviating the equity gap between vulnerable and non-vulnerable families, or widening it. Consequently, the uptake, cost-effectiveness and accessibility of MCH services across Australia warrants greater investigation.

### Limitations

One limitation of the current study was that the dataset only comprised data from Queensland and therefore may not present findings generalisable to all of Australia. Additionally, the dataset does not allow for identification of participant migration from the birth cohort (eg, due to moving states or death), which may mean that patterns of inpatient and ED (in the case of interstate migration) health service use and costs over time under-represent the extent of inequity. Another limitation is that socioeconomic status was based on a woman's postcode of residence reported at birth. While data regarding household income and wealth would have provided a more robust measure of socioeconomic status, this was not available.

Finally, data regarding children's public hospital outpatient service use was unavailable for the entire duration of the dataset. This includes public-hospital funded early childhood health clinics, which provide general health check-ups such as weight and growth measurement; and public hospital funded specialist clinics and allied health services. The inclusion of these data may provide a more comprehensive overview of health service use and costs between vulnerable and non-vulnerable Australian children.

### CONCLUSION

Multidimensional poverty is a predictor of poor health, educational and social outcomes for children that can have significant impacts on their progression through childhood, adolescence and adulthood. This study demonstrates that vulnerable Australian children use a greater average number of inpatient and ED services compared with non-vulnerable children, costing public hospital funders substantially more across the first 5 years of life. Further, significantly fewer vulnerable children use fewer preventive care services, such as GPs and specialists. Future research should aim to examine the uptake and cost-effectiveness of MCH services in Australia, as these services foster greater access to healthcare for children and support their development in the critical first 1000 days of life.

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