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Universal child health and early education service use from birth through Kindergarten and developmental vulnerability in the Preparatory Year (age 5 years) in Tasmania, Australia

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Abstract

This study investigated patterns of universal health and education service use from birth through Kindergarten (age 4 years) and estimated associations between cumulative risk and service use patterns, and between service use patterns and children's developmental vulnerability in the Preparatory Year (age 5 years). The study used population-wide linkage of health and education administrative data records for 5168 children who had a 2018 AEDC instrument collected in Tasmania and were born in Tasmania (2011–2013). Latent class analysis (LCA) identified three service use patterns: Regular (72.2 per cent of children; reference group), Low (15.6 per cent of children) and High service use (12.2 per cent of children). The patterns of Regular, Low and High service use were consistent across health and education services used at different ages and stages of child development. Membership of the Low and High service use groups was associated with higher cumulative risk and increased odds of developmental vulnerability, relative to the Regular

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service use group. This population-wide view of universal service use can be used by the health and education sectors to explore ways in which their specialist expertise, resources and referral processes can be further integrated within and across services to meet the developmental needs of children and families.

KEYWORDS

Australian Early Development Census, child development, child health services, cumulative risk, early education services

1 | INTRODUCTION

Never in history has more been known about the importance of early childhood in establishing a strong foundation for children's futures. In high-income countries, this evidence drives government investments in universal child health services (Spencer et al., 2019; Wood & Blair, 2014) and early childhood education and care services (ECEC) (Early Learning: Everyone benefits, 2019; Melhuish et al., 2015; Organization for Economic Co-operation & Development, 2018).

The core principles of universal early childhood service provision are that the services are accessible for all children, free-of-charge to caregivers, delivered flexibly according to the child's and family's service needs and articulated with other universal, specialist and targeted services within and across sectors (Asaria et al., 2016; Australian Institute of Health & Welfare, 2020; Organization for Economic Co-operation & Development, 2018; World Health Organization, 2015).

The health and education sectors share the same universal service population and the common goal of supporting all children to achieve their developmental potential (Black et al., 2019; Homel et al., 2021; Richter et al., 2017). This non-experimental study addresses a knowledge gap about: (1) How universal early childhood health and education services are used in combination at different ages and stages of children's development; (2) the individual and cumulative risks associated with different patterns of service use; and (3) the associations between different patterns of service use and developmental vulnerability in the first year of full-time school.

1.1 | Universal child health and early education services in Australia

Universal community-based child health services are provided in all Australian states and territories. Child health services are led by child health nurses and service delivery, and practice is guided by the National Framework for Universal Child and Family Health Services. The framework outlines the core child health services available for all children from birth to age 8 years. Core elements of universal child health services include health and developmental surveillance and monitoring, health promotion, early identification of family need and risk, and responding to identified need. The delivery of child health services is flexible and responsive to the needs of children and families. Caregivers are encouraged to access child health services at any time they require information, advice and support. Ideally, initial contact with universal child health services occurs within the first 2 weeks of a child's life and is offered as a home visit. Child health services are delivered through a recommended schedule of regular contacts

with caregivers and children at key ages and stages of development. The recommended schedule offers more frequent contacts in the first 12 months of a child's life and less frequent ongoing contacts between age 2 years and age 5 years (Australian Health Ministers' Advisory Council, 2011).

In all Australian states and territories, 600 hours of universal ECEC is also provided for children in school settings, in the year before they start full-time school (i.e. Preschool, Kindergarten). This equates to 15 hours of play-based education per week for 40 weeks of the year (Australian Institute of Health & Welfare, 2020; Early Learning: Everyone benefits, 2019). The sessions are planned and delivered by early childhood teachers and programme delivery, and practice is guided by the National Early Years Learning Framework (Department of Education Employment & Workplace Relations for the Council of Australian Governments, 2009).

1.2 | Universal child health and early education services: The evidence

Previous studies that have used population-wide administrative data to examine universal child health service use (Gibb et al., 2019; Wood et al., 2012) and universal early childhood education and care use (Goldfeld et al., 2016; O'Connor et al., 2020) have reported lower service use for children with higher exposure to early life course risk factors, compared to children with lower exposure to early life course risk factors. In the studies of child health service use conducted in New Zealand (Gibb et al., 2019) and Scotland (Wood et al., 2012), evidence about children's service needs was inferred from the presence or absence of risk factors with known associations with developmental vulnerability, without a measure of children's developmental status. In the studies of early childhood education and care use in Australia (Goldfeld et al., 2016; O'Connor et al., 2020), the evidence about children's service needs was inferred from the presence or absence of risk factors as well as children's developmental status on the Australian Early Development Census (AEDC).

In the Australian studies, children with higher exposure to risk factors had lower participation in ECEC and increased risk of developmental vulnerability, compared to their less developmentally disadvantaged counterparts. A recent study that used data from Growing up in Australia, The Longitudinal Study of Australian Children, reported that the inverse care law operates for children aged 4–5 years in Australia. That is, children who were not developmentally vulnerable and not socioeconomically disadvantaged (lowest need for services) had higher odds of using primary healthcare services than children who were developmentally vulnerable and socioeconomically disadvantaged (highest need for services). Children who were developmentally vulnerable and not socioeconomically disadvantaged also had higher odds of using specialist services compared to children who were developmentally vulnerable and socioeconomically disadvantaged (Woolfenden et al., 2020). While causal inferences cannot be drawn from these non-experimental studies, the associations between higher exposure to early life course risk factors, lower ECEC participation, and increased risk of developmental vulnerability suggest that the inverse care law (Marmot, 2018) is in play and that children with the highest service needs are less likely to have access to and participate in early childhood services compared to more developmentally advantaged children (Gibb et al., 2019).

1.3 | Universal child health and early education services: The evidence gap

The health and education sectors provide universal services for the same population of children, albeit at different points in time and for different purposes. The sectoral division between child health and early education services and their respective data systems has worked

against a shared view of children's universal health and education service pathways and has perpetuated a siloed view of universal early childhood service use and outcomes (Homel et al., 2021; Pillas et al., 2014):

There are currently no national indicators to measure how children transition through major development stages, or how children interact with services and move through different systems. While data may be available for specific services or stages of a child's life; for example, data from hospitals, education or early childhood assessments, there is limited ability to track children through different data sources to assess their outcomes.

(Australian Institute of Health & Welfare, 2020 p. 379)

There is a strong imperative to view universal early childhood service use and outcomes through a cross-sectoral lens because child health and early education services are intended to be complimentary (Black et al., 2019; Homel et al., 2021; Richter et al., 2017) and to articulate with each other and to other services (Australian Health Ministers' Advisory Council, 2011).

Identifying patterns of universal early childhood service use across different types of services and at different ages and stages of child development is an important first step in understanding how universal services are used across the population. Identifying the risk factors associated with different patterns of service use permits a view of the developmental circumstances that shape children's access to and participation in services (Munari et al., 2021). The extent to which different patterns of service use are associated with individual and cumulative risks and developmental vulnerability permits some insights into the service needs of different population groups, defined primarily by their pattern of universal service use over time.

1.4 | Research aims

The aims of this study were to (1) identify patterns of universal early childhood health and education service use from birth through Kindergarten (age 4 years); (2) estimate the associations between cumulative risk and service use patterns; and (3) estimate the associations between service use patterns and children's developmental vulnerability in the Preparatory Year (age 5 years).

2 | METHODS

2.1 | Data sources

The study used de-identified, unit-record-linked administrative data collected by the Tasmanian Department of Health (Tasmanian Perinatal Data Collection, Child Health and Parenting Service), Tasmanian Department of Education (Launching into Learning, Kindergarten) and the Commonwealth Department of Education and Training (AEDC). Record linkage was conducted by the Tasmanian Data Linkage Unit (TDLU) (Stokes et al., 2020) following the National Health and Medical Research Council principles for using publicly funded data for health research (National Health & Medical Research Council, 2016). The TDLU was provided with identified unit-record-level data from the data custodians and created a linkage key map using probabilistic linkage methods (Kelman et al., 2002). First, linkage probability weights were calculated to identify possible matches among individuals in the five datasets. Match weight scores were calculated for each linkage field, based on field agreements, disagreements and missing data. The TDLU uses a combination of fields including source system

identifier, full name, date of birth, gender and residential address. Matches, possible matches and non-matches were calculated using total weight score thresholds then record pairs/groups identified as potential matches were checked manually. The TDLU then returned the source identifiers, with the addition of the unique project linkage keys, to the data custodians. The data custodians combined the identifiable dataset and the unique linkage key with their complete dataset. Each data custodian extracted a de-identified research dataset that contained the selected variables and the unique linkage keys and released the research dataset to the researchers. The researchers linked unit-record-level variables across the five datasets, using the unique linkage key, to create the dataset for analysis. The TDLU took no part in the analysis of the research dataset.

2.2 | Study population

The study population comprised 5168 children who had a Tasmanian 2018 AEDC instrument collected in the first year of full-time school (i.e. Preparatory Year) and a Tasmanian Perinatal Baby Record. The AEDC collection includes all Tasmanian government, Catholic, and independent schools, and the Perinatal collection includes all live births and stillbirths of at least 20 weeks gestation or weighing at least 400 g at birth, in all Tasmanian public and private hospitals (Department of Health, 2019).

National reporting of AEDC results includes the number of children with AEDC instruments collected in each Australian state/territory in their first year of full-time school. The child participation rate is reported for each state/territory, based on the estimated child population in their first year of full-time school (Department of Education & Training, 2019). The Tasmanian Data Linkage Unit identified 6147 children with a 2018 AEDC instrument with a Tasmanian postcode, compared to 6151 children in the AEDC National Report 2018 (Department of Education & Training, 2019), which equates to 99 per cent of the estimated child population in the first year of full-time school in Tasmania. Of these 6147 children, our study cohort comprised the 5168 children who had a Tasmanian Perinatal Baby record. The 979 children with a 2018 AEDC instrument collected in Tasmania who did not have a Tasmanian Perinatal Baby record were likely to have migrated to Tasmania from interstate or overseas.

Most children were born in 2012 (98.0 per cent) with some born in 2011 (1.6 per cent) and 2013 (0.4 per cent). All children in this cohort commenced full-time school in 2018, and the study focused on use of universal services from birth up to the first of January 2018. The mean age of the children on 1 January 2018 was 5 years and 6 months (range 4;8 to 6;11 years), and 50.6 per cent of the children were males.

2.3 | Outcome measure: The Australian Early Development Census

The AEDC is a national census of early childhood development in children's first year of full-time school. Since 2009, AEDC data collection has taken place every 3 years in all states and territories and in all government, independent and Catholic schools. There have been four AEDC data collections (2009, 2012, 2015 and 2018). The AEDC is a valid and reliable teacher-report measure that comprises 96 licenced items across five developmental domains: physical health and well-being, social competence, emotional maturity, language and cognitive skills (school-based) and communication skills and general knowledge. The AEDC also collects school and demographic variables from state/territory governments, independent and Catholic schools (Atelier Learning Solutions, 2010; Department of Education & Training, 2019).

Children who score below the 10th percentile on one or more AEDC domain(s) are classified as developmentally vulnerable (DVI). This was the outcome measure used in this study.

Cut-off scores are based on all children who participated in the first national AEDC data collection in 2009, excluding children with special needs, and apply to all AEDC data collections. Children with special needs are those who require special assistance due to a medical diagnosis, a diagnosis of a chronic medical, physical or intellectually disabling condition. Children with special needs are not included in the calculation of the results and do not receive a domain category (e.g. developmentally on track, at risk or vulnerable). The number of children with special needs is reported in each AEDC collection. Children who are younger than 4 years receive a domain score, but are not assigned to a category as their age cannot be validated and cut-offs are age-dependent. Children whose teachers have answered <75 per cent of the items in any domain will not receive a score at all. If the teacher indicated that a child had been in their class for <1 month and they did not know the child well enough to complete the AEDC instrument, then that child will have no instrument data. Detailed information about how the AEDC is scored is available at: <https://www.aedc.gov.au/researchers/faqs-for-researchers>.

2.4 | Risk factors

The study used a set of nine child, maternal, paternal and geographic area-based risk variables from the Tasmanian Perinatal Data Collection and the AEDC Data Collection. These risk variables have been systematically shown to be associated with developmental vulnerability in previous studies using population-wide linkage of administrative data (Chittleborough et al., 2016; Guthridge et al., 2016; Santos et al., 2012, Taylor et al., 2020).

Our intention in modelling the associations between risk factors and service use patterns was to draw attention to service system changes that might improve access to and use of services for priority population groups (Goodman et al., 2019; Munari et al., 2021). Risk variables from the Tasmanian Perinatal Data Collection were collected at the child's birth, and risk variables from the AEDC Data Collection were obtained in the child's first year of full-time school (Table 1).

2.4.1 | Child risks

The child risk variable was low birthweight (<2500 g). This variable was obtained from the Perinatal Baby Records collected at the child's birth.

TABLE 1 Risk variables from the Tasmanian Perinatal Data Collection and the Tasmanian 2018 AEDC data collection

Perinatal baby record (collected at the birth of the child)	Perinatal mother record (collected at the birth of the child)	2018 AEDC (collected in the child's first year of full-time school at age 5 years)
Low birthweight (<2500 g)	Maternal age (<20 years) (40 years or older)	Parent 1 Education (less than Year 11)
SEIFA IRSD Quintile 1 (most disadvantaged)	Maternal age 40 years or older Indigenous mother 3 or more previous pregnancies Smoking in pregnancy	Parent 2 Education (less than Year 11) Outer remote and regional Tasmania

2.4.2 | Maternal risks

The 3 maternal risk variables were as follows: maternal age (<20 years at the birth of the child (teenage mother) and maternal age 40 years or older at the birth of the child); Indigenous mother; three or more previous pregnancies; and smoking in pregnancy. These variables were obtained from the Perinatal Mother Records collected at the child's birth.

2.4.3 | Parental risks

The two parental risk variables were Parent 1 education less than Year 11 and Parent 2 education less than Year 11. These variables were obtained from the AEDC Data Collection in the child's first year of full-time school.

2.4.4 | Geographic area-based risks

The two geographic area-based risks were Outer Remote and Regional Tasmania and Socio-economic Indexes for Areas (SEIFA) Index of Relative Socio-economic Disadvantage (IRSD) Quintile 1 (Most Disadvantaged) (Australian Bureau of Statistics, 2016). These variables were obtained from the AEDC collection in the child's first year of full-time school and the Perinatal Data Collection at the child's birth, respectively.

2.4.5 | Cumulative risk index

A cumulative risk index was computed by summing the number of risk exposures (0–9). Children were coded with “1” if the risk factor was present and “0” if the risk factor was not present. Cumulative risks were reported as 0, 1, 2, 3 and 4 or more risks.

2.5 | Universal child health and early education services in Tasmania

The Tasmanian Government provides universal services for pregnant women, infants, young children and families. This study investigated the use of three universal early childhood services in the period from birth through Kindergarten: The Child Health and Parenting Service (CHaPS), Launching into Learning (LiL) and Kindergarten. We included all service contacts recorded for each child between birth and 1 January 2018 (i.e. prior to the 2018 AEDC collection). Where possible, we quantified three aspects of service use: intensity, timing and duration. For each service, we created categories of service intensity that were based on the observed population distributions of service use within each service type. In Australia, there is an a priori threshold for recommended use of Child Health Assessments (eight CHAs) (Australian Health Ministers' Advisory Council, 2011) and Kindergarten (15 h per week for 40 weeks of the calendar year) (Early Learning: Everyone benefits, 2019). There is no a priori threshold for recommended use of the Child Health and Parenting Service and LiL. There is no a priori threshold for the use of universal child health and early education services in combination. The distributions of service intensity and the cut-points used to create categories of service intensity for each service type are reported in Figure S1.1–S1.4.

TABLE 2 Categories of service intensity for each service

Service	Measure of service use	Categories		
Child Health Assessments (CHAs)	Contacts (0–10)	Low (0–3)	Regular (4–10)	N/A
	<i>n</i> (%)	817 (15.8%)	4351 (84.2%)	N/A
Child Health and Parenting Service (CHaPS)	Contacts (0–60)	Low (0–3)	Regular (4–12)	High (13–60)
	<i>n</i> (%)	596 (11.5%)	3935 (76.1%)	637 (12.3%)
Launching into Learning (LiL)	Total hours (0–534) 0–290 contacts × 0–44 h per contact = 0–534 total hours	No use (0)	Regular (1–36)	High (37–534)
	<i>n</i> (%)	2056 (39.8%)	2185 (42.3%)	927 (17.9%)
Kindergarten	Average number of hours per week for the school year (0–33)	Low (0–14)	Regular (15–33)	N/A
	<i>n</i> (%)	1283 (24.8%)	3885 (75.2%)	

2.5.1 | Child health and parenting service

In Tasmania, the CHaPS is provided by the Department of Health. The service is primarily for children from birth to age 5 years (Tasmanian Department of Health and Human Services, n.d.). The CHaPS provides health, development and well-being assessment for children; perinatal mental health screening and well-being support for caregivers; parenting information, advice and support; and CHAs at recommended ages for screening and surveillance related to developmental milestones. Child health nurses work across a range of settings including standalone child health clinics, clinics based in community health centres, Child and Family Centres and government schools.

The CHAs offered by the CHaPS are scheduled at recommended ages for screening and surveillance in line with nationally accepted child health screening and surveillance guidelines (Australian Health Ministers' Advisory Council, 2011). In Tasmania, the CHAs follow a recommended schedule of 8 contacts but may include additional contacts scheduled at parental request. The number of other Child Health and Parenting Service contacts is flexible and proportionate to the service needs of individual children and their caregivers.

2.5.1.1 | Child health assessment use

Child Health Assessments are scheduled at 2 weeks, 4 weeks, 8 weeks, 4 months, 6 months, 12 months, 2 years and 4 years. The 2-week CHA is offered as a home visit, and subsequent CHAs are usually provided at child health centres. Home visiting can be provided beyond the 2-week CHA. It is recommended that all children complete the recommended schedule of eight CHAs. Child health nurses may schedule review or repeat CHAs where indicated by a developmental assessment result. CHA contact dates were used to calculate the total number of CHA contacts for each child. The child's date of birth and the dates of the child's first and last CHA contact were used to calculate the timing and duration of CHA use, from birth to 1 January 2018.

Children recorded 0–10 CHA contacts, with 5087 children (98.4 per cent of our cohort) having at least one contact (Figure S1.1). Based on the observed population distribution of CHAs, CHA use was dichotomised into low (0–3 contacts) and regular (4–10 contacts) use categories (Table 2). Only 59 children had more than eight CHA contacts. The decision not to create a high use category was based on the observed population distribution and the recommended schedule of 8 CHAs in the period from birth to age 4 years.

2.5.1.2 | *Child health and parenting service use*

All CHaPS contact dates, excluding CHAs, were used to calculate the total number of CHaPS contacts for each child. The child's date of birth and the dates of the child's first and last CHaPS contact were used to calculate the timing and duration of CHaPS use from birth to 1 January 2018.

Children recorded 0–60 CHaPS contacts from birth to 1 January 2018, with 5107 children (98.8 per cent of children) having at least one contact (Figure S1.2). Based on the observed population distribution of CHaPS contacts, CHaPS use was trichotomised into low (0–3 contacts), regular (4–12 contacts) and high (13–60 contacts) use categories (Table 2).

2.5.2 | Launching into learning

Launching into learning is a parent-child early education programme for children from birth to age 4 years that was developed by the Tasmanian Department of Education and implemented universally in government schools from 2012 (Tasmanian Department of Education, 2017a). LiL is led by early childhood teachers, and its delivery is guided by the Commonwealth Department of Education and Training Family-School Partnerships Framework (Australian Government Department of Education and Training, 2018) and Early Years Learning Framework (Department of Education Employment & Workplace Relations for the Council of Australian Governments, 2009). LiL provides opportunities for parents and children to participate in play-based early learning activities for children and provide support for parents in their parenting roles, including early learning at home. The number of LiL sessions available each week of the school term is determined by the school.

2.5.2.1 | *Launching into learning use*

The total number of hours of use recorded for each child was used to calculate the total hours of LiL contact. The child's date of birth and the dates of the child's first and last LiL contact were used to calculate the timing and duration of LiL use from birth to 1 January 2018.

Children recorded 0–534 h of LiL contact, with 3112 children (60.2 per cent) recording at least 1 h of LiL contact and 39.8 per cent of children recording no LiL hours (Figure S1.3). Based on the observed population distribution of LiL contacts, LiL use was trichotomised into non-use (0 h), regular use (1–36 h contacts) and high use (37–534 h) categories (Table 2).

2.5.3 | Kindergarten

In Tasmania, the Department of Education provides Tasmanian children with a Kindergarten year of pre-compulsory part-time ECEC in a government school in the year before the Preparatory Year.

Kindergarten is a school-based programme that provides 15 h a week of play-based learning for 4-year-old children in a classroom setting for 40 weeks of the calendar year. The sessions are planned and delivered by early childhood teachers. There is no legislative requirement for families to enrol 4-year-old children in Kindergarten and participation is voluntary (Tasmanian Department of Education, 2017b).

2.5.3.1 | *Kindergarten use*

Kindergarten use comprised the average number of hours of attendance per week recorded for each child over 40 weeks of the school year. The child's date of birth and Kindergarten enrolment date were used to calculate the age of each child at the start of Kindergarten. The dataset for this study included the Kindergarten start date but not the end date, so duration of Kindergarten use was not calculated.

Children recorded 0–33 average number of hours of attendance per week for the school year (Figure S1.4). Based on the observed population distribution of the average number of hours of attendance per week for the school year, children were dichotomised into low (0–14 h) and regular (15–34 h) use categories (Table 2). Only 83 children (1.6 per cent of the sample) had no recorded Kindergarten enrolment, and these children were included in the Low service use category.

2.6 | Statistical analysis

The analysis was conducted in 3 steps. First, we used a LCA to identify and describe service use patterns and to assign each child to a service use group. LCA is a person-centred approach suited to (1) harmonising records of service contacts measured in different ways in different service settings and (2) reducing the heterogeneity of observed service use into meaningful groupings/patterns of service use. Service use in this study population was heterogenous across the four service types (Figures S1.1–S1.4). There were 36 ($2 \times 3 \times 3 \times 2$) possible combinations of categories of service use, of which 30 combinations were observed in this study population (Table 2). There was no evidence to guide superordinate groupings of service use categories across different service types. This was a necessary step in identifying main groupings of service use in the study population for subsequent analysis of risk factors associated with different service use patterns and associations between service use patterns and developmental vulnerability. The “value add” of LCA is that it offers a way of addressing the tremendous heterogeneity in service use, without having to address 30 different patterns of service use. LCA is a model-based technique that provides fit statistics. This is useful when there are no a priori recommended thresholds of service use (Lindly et al., 2020; Petersen et al., 2019). LCA was used to reduce the heterogeneity of service use patterns to a meaningful number of different patterns. Within each of the latent classes of service use, children had a specific probability of being at that level of service use.

Second, we used multinomial logistic regression to estimate the unadjusted odds (Table S2.1) and adjusted odds (Table S2.2) of service use group membership associated with cumulative risks, relative to the reference group. Third, we used multivariable logistic regression to estimate the adjusted odds of developmental vulnerability on one or more AEDC domain(s) associated with service use group membership, relative to the reference group. All LCA analyses were conducted in SAS PROC LCA V1.3.2 (Lanza et al., 2015). The multinomial logistic regression and the multivariable logistic regression analyses were conducted in SAS V.9.4 (SAS Institute Inc., 2013).

The proportions of missing data for risk factors ranged from 0 per cent to 27 per cent (Table S3.1). Missing values for risk factors were imputed using PROC MI in SAS V.9.4 (Rubin, 1987; SAS Institute Inc., 2013). We generated 25 imputed datasets, with results averaged according to Rubin's rule (Rubin, 1987), using PROC MIANALYZE. To account for arbitrary patterns of missingness, we used the fully conditional specification method (van Buuren, 2007). AEDC outcomes were not imputed. The prevalence of developmental vulnerability on one or more AEDC domain(s) (DVI) and individual risk factors for children with observed and imputed data is reported in Table S3.1).

3 | RESULTS

3.1 | Service use groups

Latent class analysis describes a series of distinct classes (i.e. groups) and assigns an item-response probability within each class. Entropy, Akaike's information criterion (AIC) and BIC (Bayesian information criterion) were used as the statistical measures of model fit. Table 3

TABLE 3 Statistical criteria for latent class models with 2–5 latent classes ($n = 5168$)

Number of classes	AIC	BIC	Entropy
2	78.47	163.62	0.97
3	61.72	192.72	0.8
4	64.72	241.57	0.63
5	74.32	297.03	0.51

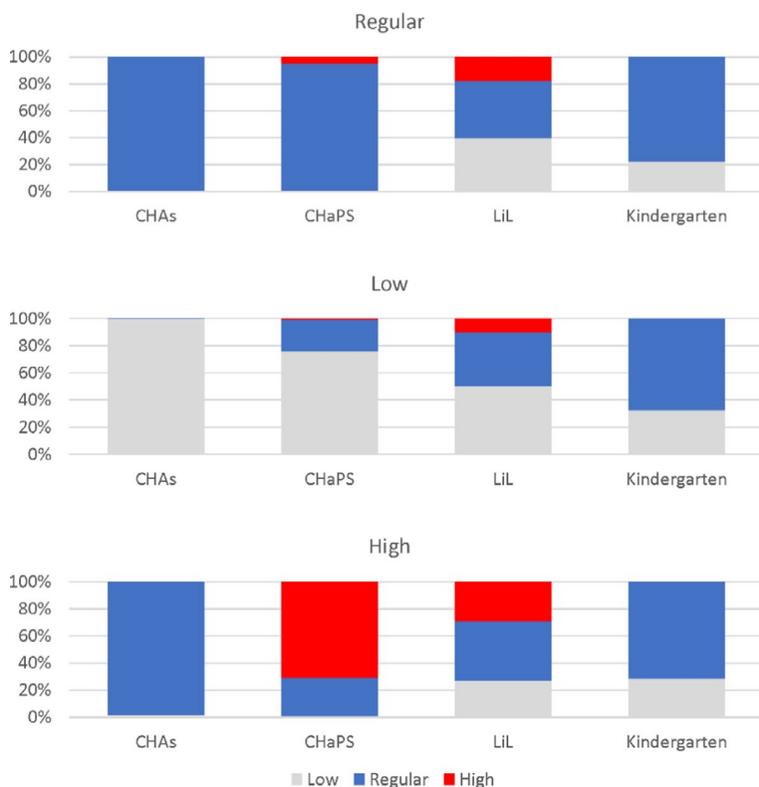


FIGURE 1 Probability of different levels of service intensity in the Regular, Low and High service use groups

reports the fit statistics for service use latent class models with 2–5 classes. Models with more than 5 classes failed to converge. Based on the fit criteria and assessment of the latent class membership, a 3-class solution was selected as the best model.

The 3-class model produced a clear distinction between classes, all classes were substantial in size, and each class could be assigned a meaningful descriptive label. Information from the LCA model was used to assign children to service use groups. Individuals were assigned to latent classes based on their maximum posterior probability (their “best” class membership) (Nagin & Tremblay, 2005). The three latent classes were given descriptive labels based on the observed patterns of service use across the four service types. The service use groups were labelled as follows: Regular service use, Low service use and High service use. Figure 1 shows the probability of service use for each service type by latent class.

TABLE 4 Intensity of service use in each service use group ($n = 5168$)

Service use group	Child Health Assessments (CHAs) median number of contacts per child (IQR)	Child Health and Parenting Service (CHaPS) median number of contacts per child (IQR)	Launching into Learning (LiL) median number of hours per child (IQR)	Kindergarten median number of average hours per week per child (IQR)
Regular service use	6 (5–7)	8 (6–9)	20 (8–44)	17 (15–18)
Low service use	2 (2–3)	3 (2–4)	14 (5–30)	15 (13–18)
High service use	7 (6–8)	16 (14–20)	25 (10–54)	17 (14–18)
Population average	6 (4–7)	7 (6–10)	19.5 (8–44)	17 (15–18)

Abbreviation: IQR, interquartile range.

3.1.1 | Regular service use

3.1.1.1 | Intensity of regular service use

The Regular service use group (72.2 per cent of the cohort) was defined by a consistent pattern of median service use at or above the population average for this cohort. The median service use for this group was 6 CHA contacts; eight CHaPS contacts, 20 h of LiL in total and 17 h per week of Kindergarten for the school year (Table 4). Children in the Regular service use group had a more than 99.5 per cent likelihood of regular CHA use, a 95.0 per cent likelihood of regular CHaPS use, a 42.5 per cent likelihood of regular LiL use and a 77.4 per cent likelihood of regular Kindergarten use (Table 5).

3.1.1.2 | Timing and duration of regular service use

Children in the Regular service group had their first CHA contact at a median of 12 days of age, their first CHaPS contact at a median of 12 days of age, were 2 years and 8 months of age at their first LiL contact, and were 4 years and 6 months of age at their first contact with Kindergarten (Table 6). Children in the Regular service use group had a median duration of 2 years and 4 months between their first and last CHA contacts, a median duration of 2 years and 1 month between their first and last CHaPS contacts, and a median duration of 1 year and 2 months between their first and last LiL contacts (Tables 6–8, Figure 2). The Regular service use group was the reference group for this study.

3.1.2 | Low service use

3.1.2.1 | Intensity of low service use

The Low service use group (15.6 per cent of cohort) was defined by a consistent pattern of lower than the population average median service use across all service types. The median service use for this group was two CHA contacts, three CHaPS contacts, 14 h of LiL in total and 15 h per week of Kindergarten for the school year (Table 4). Children in the Low service use group had a 99.9 per cent likelihood of low CHA use, 77.5 per cent likelihood of low CHaPS use, a 50.0 per cent likelihood of no LiL use and a 32.5 per cent likelihood of low Kindergarten use (Table 5).

3.1.2.2 | Timing and duration of low service use

Children in the Low service use group used the CHaPS and LiL later (Table 6), less frequently (Table 4) and over a shorter period of time, compared to children in the Regular service use

TABLE 5 Conditional probabilities and distributions of service intensity, three-class latent class model ($n = 5168$)

	Regular service use	Low service use	High service use	Population average
Class membership probability	0.727	0.153	0.121	n/a
Best class membership %	72.2	15.6	12.2	n/a
Item response probabilities				
Low child health assessment use	0.005	0.999	0.017	0.158
Regular child health assessment use	0.995	0.001	0.983	0.842
Low child health and parenting service use	0.000	0.775	0.000	0.115
Regular child health and parenting service use	0.950	0.236	0.291	0.761
High child health and parenting service use	0.50	0.009	0.709	0.123
No launching into learning use	0.398	0.500	0.267	0.398
Regular launching into learning use	0.425	0.397	0.441	0.423
High launching into learning use	0.177	0.103	0.293	0.179
Low Kindergarten use	0.226	0.325	0.283	0.248
Regular Kindergarten use	0.774	0.675	0.717	0.752

TABLE 6 Children's age at first contact with each service by service use group ($n = 5168$)

Service use group	Median age in days (IQR) at first Child Health Assessment (CHA) contact ^a	Median age in days (IQR) at first Child Health and Parenting Service (CHaPS) contact ^b	Median age in years ^c (IQR) at first Launching into Learning (LiL) contact ^d	Median age in years ^c (IQR) at first Kindergarten contact ^e
Regular service use	12 (10–15)	12 (9–15)	2;8 (1;11–3;10)	4;6 (4;3–4;9)
Low service use	14 (11–26)	14 (10–24)	3;4 (2;1–4;0)	4;6 (4;3–4;9)
High service use	13 (10–17)	12 (9–15)	2;4 (1;11–3;7)	4;6 (4;4–4;10)
Population average	13 (10–16)	16 (9–16)	2;9 (1;11–3;10)	4;6 (4;3–4;9)

Abbreviation: IQR, interquartile range.

^a $n = 5087$.

^b $n = 5107$.

^cYears; months.

^d $n = 3150$.

^e $n = 5085$.

group. Children in the Low service use group had their first CHA contact at a median of 14 days of age, their first CHaPS contact at a median of 14 days of age, were 3 years and 4 months of age at their first LiL contact and were 4 years and 6 months of age at their first contact with Kindergarten (Table 6). Their Kindergarten attendance was 80 h less than the other groups over the course of the school year. Children in the Low service use group had a median duration of 2 months between their first and last CHA contacts, a median duration of 3 months between their first and last Child Health and Parenting Service contacts, and a

median duration of 8 months between their first and last LiL contacts (Tables 6–8, Figure 3). The intensity and duration of service use was lowest for this group.

3.1.3 | High service use

3.1.3.1 | Intensity of high service use

The High service use group (12.2 per cent of the cohort) was defined by a consistent pattern of higher than the population average median service use across all service types, except Kindergarten. The median service use for this group was seven CHA contacts, 16 CHaPS contacts, 25 h of LiL in total and 17 h per week of Kindergarten for the school year (Table 4). Children in this group had a 98.3 per cent likelihood of regular CHA use, 70.9 per cent likelihood of high CHaPS use, a 29.3 per cent likelihood of high LiL use and a 71.7 per cent likelihood of regular Kindergarten use (Table 5). The intensity (Table 4) and duration (Table 8, Figure 4) of service use were highest for this group.

3.1.3.2 | Timing and duration of high service use

Children in the High service use group had their first CHA contact at a median of 13 days and their first CHaPS contact at a median of 12 days of age, were 2 years and 4 months of age at their first LiL contact and were 4 years and 6 months of age at their first contact with Kindergarten (Table 6). Children in this group had a median duration of 3 years and 5 months between their first and last CHA contacts, a median duration of 3 years and 11 months between their first and last CHaPS contacts, and a median duration of 1 year and 8 months between their first and last LiL contacts. Children in the High service use group used LiL 4 months earlier than the Regular service use group (Table 6) and had a median duration of contact with CHAs and CHaPS more than a year longer than the Regular service use group, and 6 months more contact with LiL (Tables 6–8, Figure 4) than the Regular service use group.

3.2 | Associations between cumulative risk and service use group membership

In this cohort, the total number of risks per child varied from 0 to 7 risks. The distribution of cumulative risks differed between the service use groups, with risk exposures lower in the Regular service use group, and higher in both the Low and High service use groups. 49.7 per cent of children in the Regular service use group were exposed to 0 or 1 risks, compared with 27.6 per cent of children in the Low service use group, and 36.7 per cent of children in the High service use group (Table 9). 14.0 per cent of children in the Regular service use group were exposed to 4 or more risks, compared with 32.0 per cent of children in the Low service use group, and 23.8 per cent of children in the High service use group.

Children in the Regular service use group were exposed to an average of 1.76 risks (95% CI: 1.71–1.81), children in the Low service use group were exposed to an average of 2.68 risks (95% CI: 2.56–2.80), and children in the High service use group were exposed to an average of 2.23 risks (95% CI: 2.11–2.36).

Multinomial logistic regression was used to examine the associations between cumulative risk (0–4 or more risks) and service use group membership (Table 10). The Regular service use group was the reference category. The odds ratios for membership of the Low and High service use groups after exposure to one risk were 2.25 (95% CI: 1.63–3.10) and 1.30 (95% CI: 0.97–1.73), the odds ratios after two risks were 3.02 (95% CI: 2.22–4.12) and 1.77 (95% CI: 1.32–2.37), the odds ratios after three risks were 3.71 (95% CI: 2.69–5.11) and 1.67 (95% CI: 1.20–2.31), and the

TABLE 7 Children's age at last contact with each service type by service use group ($n = 5168$)

Service use group	Median age in years ^a (IQR) at last CHA contact ^b	Median age in years ^a (IQR) at last CHaPS contact ^c	Median age in years ^a (IQR) at last LiL contact ^d	Median age in years ^a (IQR) at last Kindergarten contact
Regular service use	2;1 (1;1–4;0)	2;2 (1;3–4;0)	4;3 (4;0–4;8)	n/a
Low service use	0;2 (0;1–0;7)	0;4 (0;2–1;3)	4;3 (4;0–4;7)	n/a
High service use	3;6 (2;0–4;1)	4;0 (2;3–4;2)	4;4 (4;0–4;8)	n/a
Population average	2;0 (1;0–3;11)	2;1 (1;1–4;0)	4;4 (4;0–4;4)	n/a

Abbreviation: IQR, interquartile range.

^aYears; months.

^b $n = 5087$.

^c $n = 5107$.

^d $n = 3150$.

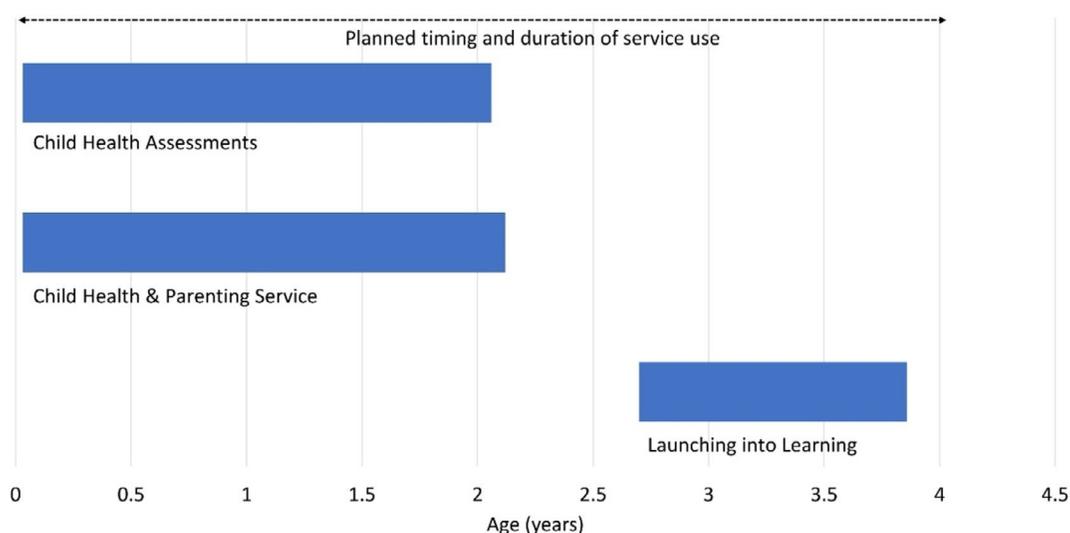


FIGURE 2 Regular service use group: Median timing and duration of service use (birth to 1 January 2018)

odds ratios after four or more risks were 6.51 (95% CI: 4.83–8.77) and 2.58 (95% CI: 1.95–3.43), respectively.

3.3 | Associations between individual risk factors and service use group membership

There were notable differences between the service use groups in the patterns of individual risk factors (Table S3.2). The Regular service use group contained the lowest percentage of children with each risk factor, except for maternal age more than 39 years. The percentage of children in the Regular service use group whose mothers were more than 39 years was slightly higher (4.8 per cent) than the population average (4.7 per cent). The individual risk factors associated with increased odds of membership of the Low service use group were, in order of descending magnitude, as follows: mothers who had three or more pregnancies (aOR: 2.63, 95% CI: 2.22–3.11); teenage mothers (aOR: 2.17, 95% CI: 1.49–3.16); Indigenous mothers (aOR: 2.09, 95% CI:

TABLE 8 Duration between children's first and last contact with each service type by service use group ($n = 5168$)

Service use group	Median duration in years ^a (IQR) between first and last Child Health Assessment (CHA) contacts ^b	Median duration in years ^a (IQR) between first and last Child Health and Parenting Service (CHaPS) contacts ^c	Median duration in years ^a (IQR) between first and last Launching into Learning (LiL) contacts ^d
Regular service use	2;4 (1;5–3;11)	2;1 (1;3–4;0)	1;2 (0;5–2;6)
Low service use	0;2 (0;0–0;5)	0;3 (0;1–1;0)	0;8 (0;3–1;9)
High service use	3;5 (2;0–4;0)	3;11 (2;3–4;2)	1;8 (0;6–2;8)
Population average	2;0 (1;0–3;10)	2;1 (1;0–4;0)	1;1 (0;5–2;6)

Abbreviation: IQR, Interquartile range.

^aYears; months.

^b $n = 5087$.

^c $n = 5107$.

^d $n = 3150$.

1.55–2.81); smoking in pregnancy (aOR: 1.73, 95% CI: 1.44–2.09); low birthweight (aOR: 1.57, 95% CI: 1.18–2.08); most disadvantaged SEIFA quintile (aOR: 1.32, 95% CI: 1.03–1.70); Parent 2 education less than Year 11 (aOR: 1.26, 95% CI: 1.03–1.54); and Parent 1 education less than Year 11 (aOR: 1.22, 95% CI: 1.01–1.48). Membership of the Low service use group was associated with decreased odds of living in Outer Remote and Regional Tasmania (aOR: 0.73, 95% CI: 0.60–0.88; Table S2.2).

The individual risks associated with membership of the High service use group were, in order of descending magnitude, as follows: teenage mothers (aOR: 4.96, 95% CI: 3.61–6.81); most disadvantaged SEIFA quintile (aOR: 2.15, 95% CI: 1.60–2.88); low birthweight (aOR: 1.75, 95% CI: 1.29–2.38); and Outer Remote and Regional Tasmania (aOR: 1.26, 95% CI: 1.04–1.53). Membership of the High service use group was associated with decreased odds for mothers who had three or more pregnancies (aOR: 0.77, 95% CI: 0.61–0.97; Table S2.2).

3.4 | Developmental vulnerability on one or more AEDC domain(s) (DV1)

In this study cohort, 21.2 per cent of children were classified as developmentally vulnerable on one or more AEDC domain(s) (DV1) in their first year of full-time school, compared to 21.7 per cent of children nationally. The percentage of children classified as DV1 was 27.5 per cent in the Low service use group; 26.1 per cent in the High service use group; and 19.1 per cent in the Regular service use group (Table 11). The Regular service use group had the lowest percentage but highest number of children classified as DV1. Children with special needs are not included in the calculation of the AEDC results and do not receive a domain category (e.g. developmentally on track, at risk or vulnerable). In this cohort, 4 per cent of children in the Tasmanian 2018 AEDC data collection were identified as children with special needs. The percentage of children identified with special needs in the Tasmanian 2018 AEDC data collection was 3.7 per cent in the Regular service use group, 5.7 per cent in the Low service use group and 9.7 per cent of children in the High service use group.

3.5 | Associations between service use group membership and developmental vulnerability on one or more AEDC domain(s) (DVI)

The logistic model in Table 12 shows the adjusted odds of classification as developmentally vulnerable on one or more AEDC domain(s) associated with service group membership, after adjusting for cumulative risks. The Regular service use group was the reference group. Membership of the Low and High service use groups, adjusted for cumulative risk, was associated with increased odds of developmental vulnerability, relative to the Regular use group. Membership of the Regular service use group, adjusted for cumulative risks, was associated with decreased odds for developmental vulnerability, relative to the other groups (Table 13).

4 | DISCUSSION

This study sought to identify patterns of universal child health and early education service use from birth through Kindergarten (age 4 years), estimate associations between cumulative risk and service use patterns, and associations between service use patterns and children's developmental vulnerability in the Preparatory Year (age 5 years).

Three patterns of service use were identified: Regular service use (72.2 per cent of children), Low service use (15.6 per cent of children) and High service use (12.2 per cent of children). These service use patterns were established early in children's lives and were consistent across services and over time.

Children in the Regular service use group had regular contact with the Child Health and Parenting Service, LiL and Kindergarten. Frequent and regular contact with universal services is desirable for developmental monitoring, prevention and intervention, and timely referrals from universal services to specialist and targeted services (Australian Health Ministers' Advisory Council, 2011, 2017; Goodman et al., 2019; Richter et al., 2017). The children in this cohort, born 2011–2013, were the first children in Tasmania to have access to the universal LiL, which was implemented in government schools in 2012. In this early period of implementation, 60 per cent of children in the Regular service use group used LiL.

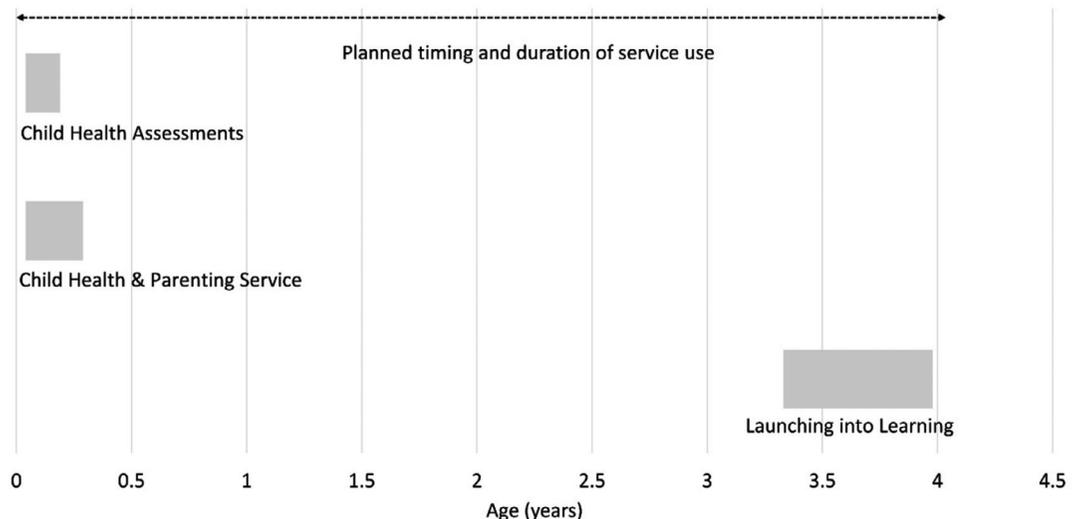


FIGURE 3 Low service use group: Median timing and duration of service use (birth to 1 January 2018)

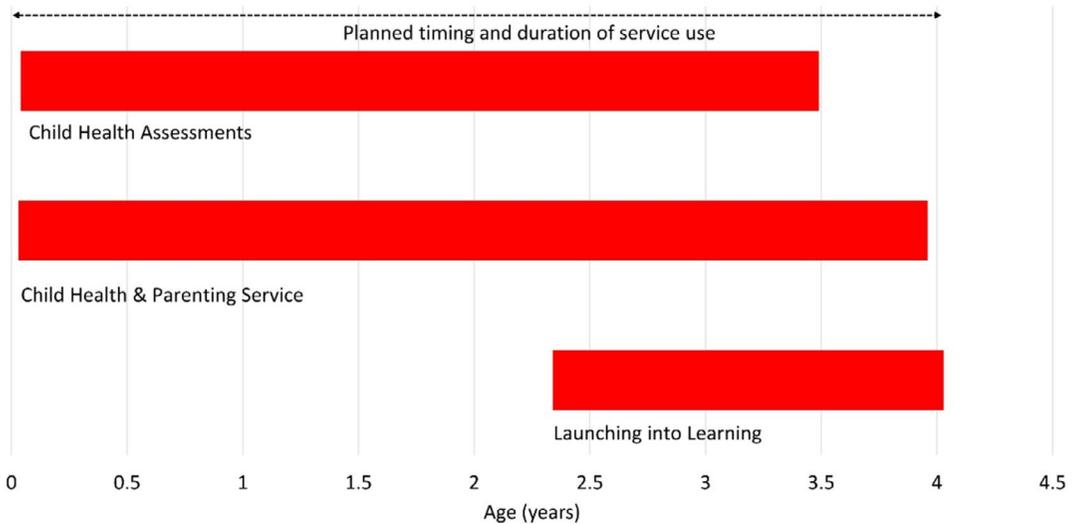


FIGURE 4 High service use group: Median timing and duration of service use (birth to 1 January 2021)

A Regular service use pattern was more likely for children with low exposure to risk factors for child development. This finding is consistent with previous studies that have shown that service use is higher for groups of children with lower exposure to risk factors (Campbell et al., 2018; Gibb et al., 2019; O'Connor et al., 2020; Spencer et al., 2019; Wood et al., 2012). The determination of “regular” service use in this study was based on the population distributions of service use in this cohort. Therefore, the extent to which “regular” service use is “optimal” service use needs to be considered in relation to the level of developmental vulnerability in the Regular service use group. While the level of developmental vulnerability (19.1 per cent) in the Regular service use group was the lowest of the three service use groups, this was only 2.1 percentage points lower than the population average (21.2 per cent) for this cohort. This finding suggests that even higher thresholds of participation in universal services may be required to address the service needs of children with a Regular service use pattern. For example, earlier, longer and more frequent use of LiL would enhance the continuity and complementarity of service use between child health and early education services and provide additional opportunities for primary prevention, developmental monitoring and referrals to other services and supports, as needed.

Universal early childhood services play a critical role in facilitating children's access to specialist (e.g. allied health) and targeted services; however, if demand exceeds supply, children will not have timely access to these services or will miss out on these services. There is an under-supply of specialist and targeted services for children in Australia, especially in rural and remote Australia (Arefadib & Moore, 2017; Australian Institute of Health & Welfare, 2020; O'Connor et al., 2017). This is likely to be a contributing factor to developmental inequalities in this population.

The Low service use group was defined by a consistent pattern of low intensity and short duration of service use, starting with the use of the Child Health and Parenting Service. Only half of the children in this group used LiL and did so later than children in the other service use groups. For children who did not use LiL, there was a gap of more than 4 years between their last contact with the Child Health and Parenting Service and their enrolment in Kindergarten. Children in the Low service use group started Kindergarten at the same age as children in the other service use groups, but their attendance was 80 h less than the other groups over

TABLE 9 Cumulative risks by service use group ($n = 5168$)

Cumulative risks	Regular service use	Low service use	High service use	Population average
0	24.5%	8.3%	15.7%	20.9%
1	25.2%	19.3%	21.0%	23.8%
2	21.1%	21.7%	23.8%	21.5%
3	14.7%	18.6%	15.7%	15.4%
4	9.4%	16.3%	14.2%	11.1%
5	3.8%	10.6%	7.1%	5.3%
6	1.0%	4.5%	2.3%	1.7%
7	0.2%	0.6%	0.2%	0.3%

TABLE 10 Associations between cumulative risks and membership of the Low and High service use groups, relative to the Regular service use group ($n = 5168$)

Cumulative risks	Regular service use OR	Low service use OR (95% CI)	p -value	High service use OR (95% CI)	p -value
0	1.00 (ref)	1.00 (ref)		1.00 (ref)	
1	1.00 (ref)	2.25 (1.63–3.10)	<.0001	1.30 (0.97–1.73)	.0755
2	1.00 (ref)	3.02 (2.22–4.12)	<.0001	1.77 (1.32–2.37)	.0002
3	1.00 (ref)	3.71 (2.69–5.11)	<.0001	1.67 (1.20–2.31)	.0021
4 or more	1.00 (ref)	6.51 (4.83–8.77)	<.0001	2.58 (1.95–3.43)	<.0001

the course of the school year. The level of developmental vulnerability in the Low service use group was 27.5 per cent, which was 6.3 percentage points higher than the population average of 21.2 per cent for this study cohort. These findings represent a significant shortfall in the uptake of developmental opportunities across the whole of early childhood and a potential contribution to widening developmental inequalities between children.

The Low service use group had the highest cumulative risks of all the groups. Children in the Low service use group were exposed to combinations of these individual risk factors: mothers who had three or more pregnancies; teenage mothers; Indigenous mothers; smoking in pregnancy; low birthweight; most disadvantaged SEIFA IRSD quintile; and parental education less than Year 11. Children's exposure to combinations of these risk factors, measurable from birth, and low participation in the Child Health and Parenting Service, evident in first weeks and months of life, identifies children and families who may benefit from outreach to facilitate access and use of universal services (Jose et al., 2020); targeted services such as sustained nurse home visiting (Goldfeld et al., 2019; Molloy et al., 2021) and ECEC in the year before children start Kindergarten. In Tasmania, Working Together offers up to 400 h of play-based early learning for eligible children at age 3 years (Tasmanian Council of Social Service Inc., 2020).

The High service use group was defined by a consistent pattern of higher than the population average service use across all service types, except Kindergarten. Children in the High service use group had greater continuity of service use due to longer use of the Child Health and Parenting Service and earlier and longer use of LiL, compared to the other service use groups. This was the only group whose use of the Child Health and Parenting Service and LiL overlapped.

A High service use pattern was more likely for children with higher cumulative risk, comprising combinations of these individual risk factors: teenage mothers; most disadvantaged SEIFA IRSD quintile; low birthweight; and living in Outer Remote and Regional Tasmania. The level of developmental vulnerability in the High service use group was 26.1 per cent, 4.9 percentage points above the population average of 21.2 per cent for this cohort. So, the extent to which “high” service use is indicative of optimal thresholds of service use, needs to be considered in relation to the level of developmental vulnerability in the High service use group and their exposure to cumulative risk. The high level of developmental vulnerability in the High service use group may indicate that even higher thresholds of participation in universal services may be required to address the developmental needs of children with a High service use pattern. These findings may also signal the need for targeted services such as sustained nurse home visiting (Goldfeld et al., 2019; Molloy et al., 2021), ECEC in the year before children start Kindergarten (Campbell et al., 2018), and specialist services (e.g. allied health) (Arefadib & Moore, 2017; Goodman et al., 2019).

Across the three most recent AEDC data collections, the percentage of Tasmanian children classified as developmentally vulnerable has been relatively stable (21.5 per cent in 2012, 21 per cent in 2015 and 21.5 per cent in 2018) (Department of Education & Training, 2019). These results invite asking, what will it take to improve children's developmental circumstances, opportunities and outcomes?

Australian early childhood universal health and education policy frameworks (Australian Health Ministers' Advisory Council, 2011; Department of Education Employment & Workplace Relations for the Council of Australian Governments, 2009) are grounded in a bioecological model of child development (Bronfenbrenner & Morris, 2006). These frameworks recognise that addressing the social determinants of health and education equalities in early childhood is beyond the remit of the health and education universal service systems and will require whole-of-government policies and coordinated actions to improve children's developmental circumstances and outcomes across the population (Caspi et al., 2016; Richter et al., 2017).

4.1 | Strengths and limitations

The use of data linkage methodology enabled child health and early education service records from multiple datasets to be integrated into a service pathway for each child at different ages and stages of development and across different types of services (Boyd et al., 2015). The risk of selection bias was reduced by using a population sampling frame that included children who were enrolled in their first year of full-time school in Tasmania and were born in Tasmania. Coverage of the 2018 AEDC Data Collection in Tasmania was 99 per cent of the estimated child population. In the linked research dataset, the percentage of children classified as

TABLE 11 Number and percentage of children who were classified as developmentally vulnerable on one or more AEDC domains (DV1) in each service use group ($n = 4898$)^a

Service use group	Regular service use	Low service use	High service use	Population average
Percentage of children DV1	19.1%	27.5%	26.1%	21.2%
Children (n)	685	208	147	1040

Abbreviation: DV1, developmentally vulnerable on 1 or more AEDC domains.

^a270 cases were excluded from the analysis (244 children with special needs and 26 children whose AEDC scores were flagged as invalid).

TABLE 12 Adjusted Odds Ratios for DVI in Low and High service use groups, relative to the Regular service use group ($n = 4898$)^{a,b}

Service use group	Regular service use	Low service use	High service use
aOR (95% CI)	1.00 (ref)	1.27 (1.05–1.53)	1.33 (1.08–1.64)
<i>p</i> -value		.0131	.0083

Abbreviation: DVI, developmentally vulnerable on 1 or more AEDC domains.

^aAdjusted for cumulative risks.

^b270 cases were excluded from the analysis (244 children with special needs and 26 children whose AEDC scores were flagged as invalid)

TABLE 13 Adjusted odds ratios for DVI in the regular service use group compared to the other groups ($n = 4898$)^{a,b}

Service use group	aOR	<i>p</i> -value
All other groups (27.8%)	1	
Regular use group (72.2%)	0.77 (0.66–0.90)	.001

Abbreviation: DVI, developmentally vulnerable on 1 or more AEDC domain(s).

^aAdjusted for cumulative risks.

^b270 cases were excluded from the analysis (244 children with special needs and 26 children whose AEDC scores were flagged as invalid)

developmentally vulnerable was 21.2 per cent, which is comparable to 21.5 per cent of children classified as developmentally vulnerable in Tasmania, in the 2018 AEDC National Report (Department of Education & Training, 2019). The service use measures were derived from administrative data records which reduced the risk of recall bias. A limitation of this study is that there was no external reference data on service use that could be used to compare to service use in the linked research dataset (Harron et al., 2017). LCA is a data-driven technique that carries the risk of the results being sample-dependent. Class membership for a given child is probabilistic, and a child may possess characteristics of one or more classes. It is important to not reify these classes (Lanza & Rhoades, 2011). The dataset for analysis only included Child Health and Parenting Service contacts relating to the child and did not include contacts relating to parents and caregivers. This Tasmanian cohort, born between 2011 and 2013, was the first to have universal access to LiL, which was implemented in 2012. We acknowledge that using a risk framework can obfuscate the structural causes of inequalities in service use (Munari et al., 2021) and that risk variables from administrative data records only provide a superficial view of children's developmental circumstances. Qualitative research is needed to understand the circumstances that shape caregivers' decisions about when and how they use services for their children (Gibb et al., 2019).

5 | CONCLUSIONS

The study contributes evidence about the empirical classification of child health and early education service use using a person-centred approach. Levels of cumulative risks and developmental vulnerability varied by service use group membership. The evidence about the consistency of service use patterns across health and education services, cumulative risks and developmental vulnerability could be used by the health and education sectors to explore ways in which their specialist knowledge, expertise, resources and referral processes could be

further integrated so that the most appropriate service is engaged at the most appropriate time and in the most appropriate way to meet the developmental needs of children and families.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

DATA AVAILABILITY STATEMENT

The linked administrative data are owned by the government departments who approved the linkage and use of the data for this study. Use of the study data is restricted to named researchers. The current Human Research Ethics Committee approval was obtained for public sharing and presentation of data on group level only, meaning the data used in this study cannot be shared by the authors. Collaborative research may be conducted according to the ethical requirements and relevant privacy legislations. Potential collaborators should contact the first author with an expression of interest. The steps involved in seeking permission for linkage and use of the data used in this study are the same for all researchers.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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