

The built environment and children's development in different urban contexts of Melbourne

Early Data to Decisions project report

April 2025

Acknowledgement of Country

The Social Equity Research Centre acknowledges the people of the Woi wurrung and Boon wurrung language groups of the Eastern Kulin Nation as the Traditional Owners of the lands on which we conduct our transformative research, teaching and other business. We pay deep respect to Ancestors and Elders, past and present, and honour the enduring connection that Traditional Custodians have to Country, including land, air and waterways. We stand in solidarity with First Nations peoples, whose sovereignty has never been ceded. The Social Equity Research Centre is committed to upholding the knowledge and perspectives of First Nations people and communities with whom we collaborate. Through our research relationships, we seek to transform our partners and ourselves, guided by principles of reflection, reciprocity, and reconciliation. We aspire to co-create knowledge in ways that honour Indigenous people and Country.



Research team

- Dr Karen Villanueva, Social Equity Research Centre, RMIT University
- Prof Hannah Badland, Social Equity Research Centre, RMIT University
- Prof Gavin Turrell, Centre for Urban Research, RMIT University
- Dr Amanda Alderton, Social Equity Research Centre, RMIT University
- Prof Melanie Davern, Centre for Urban Research, RMIT University
- Prof Sally Brinkman, Education Futures, University of South Australia
- Prof Lise Gauvin, Department of Social & Preventive Medicine, School of Public Health of the Université de Montréal
- Prof Sharon Goldfeld, Murdoch Children's Research Institute, Royal Children's Hospital, University of Melbourne.

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Ethics

Approvals from the Royal Children's Hospital (RCH) Human Research Ethics Committee (HREC) (#30016), RMIT University HREC (#20749 and #26371), AEDC data custodians (DESE/SRC; 180130C) and the authorised data linkage agency (Australian Institute of Family Studies) were obtained for this work.

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Data availability and sharing

The data used in this study is subject to external licensing agreements and ethics, and data custodian approvals. Requests to access these data for research purposes should be made to the lead author, karen.villanueva@rmit.edu.au, or the lead chief investigator, hannah.badland@rmit.edu.au

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Executive summary

Early childhood is a period when children spend more time close to home. Young children are therefore sensitive to opportunities and resources available in their neighbourhood. Children who are exposed to positive, stimulating environments in their first eight years of life experience optimal foundations for their ongoing physical, social, emotional, and cognitive development.

Growth area suburbs on the urban fringe might lack essential services and infrastructure, raising concerns about how health-promoting these settings are for young children. Moreover, a child's development may (or may not) be better supported living in an inner city versus outer and growth areas. This research has been designed to understand the influence of different neighbourhood features on equitable early childhood development and health and wellbeing outcomes across different geographic contexts, including established neighbourhoods and urban growth corridors.

This report describes the Early Data to Decisions project, which aimed to inform the development of supportive neighbourhood built environments that close the equity gap in young children's developmental outcomes. We used a mixed-methods approach to identify the most critical child neighbourhood built environment indicators and understand the lived experiences of families with young children in different urban areas of Melbourne, Victoria. Using a large dataset of built environment indicators linked to early childhood development outcomes, we explored the effects of urbanicity and "double disadvantage"—living in outer growth areas and highly disadvantaged neighbourhoods—on children's developmental vulnerability. We also conducted research with parents of young children living in growth areas to better understand their lived experiences of their neighbourhoods and the built and social infrastructure that supports their family.

Key takeaway messages for policy and practice

Neighbourhood disadvantage matters: Continued investment in policy interventions and place-based initiatives are needed in the most disadvantaged areas across cities, regardless of urbanicity.

Housing, public open space, and access to early childhood education and care were consistently related to developmental vulnerability and should be priority areas of focus for federal and state government, local community planning, and urban planning policies.

Planning for better child development outcomes requires tailored place-based approaches in different urban settings. Place-specific case studies still need to be examined for better contextual understanding, as our findings showed:

- The poorest child development outcomes were found in the most disadvantaged inner city neighbourhoods.
- Built environment associations with developmental vulnerability differed depending on where children lived.

Car access is essential for families in growth areas that lack locally available built environment infrastructure: the perceived importance of physical 'accessibility' via car, rather than 'walkability,' may reflect high car ownership in car-dependent neighbourhoods and family preferences.

Quality of local amenities matters: The quality of urban amenities might have a distinct contribution to developmental outcomes beyond accessibility. The delivery of high-quality amenities (e.g., public open space, early childhood education and care services, libraries) should be a priority in more disadvantaged neighbourhoods.

Social and community infrastructure is important to families of young children. Places and activities like libraries, parent groups, and playgroups encourage early childhood development and increase social capital encouraging families to connect and build supportive local relationships.

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Abbreviations

ABS	Australian Bureau of Statistics
ACECQA	Australian Children's Education & Care Quality Authority
AEDC	Australian Early Development Census
AIFS	Australian Institute of Family Studies
BE	Built environment
CrI	Credible Interval
DV1	Developmentally vulnerable on one or more AEDC domains
ECEC	Early childhood education and care
GIS	Geographic information systems
HREC	Human Research Ethics Committee
LGA	Local Government Area
MCMC	Markov chain Monte Carlo
MCRI	Murdoch Children's Research Institute
MQL	Maximum Quasi Likelihood
NHSD	National Health Services Directory
NQS	National Quality Standard
OR	Odds Ratio
POS	Public Open Space
PPGIS	Public Participation Geographic Information Systems
PQL	Penalized Quasi Likelihood
PT	Public transport
RCH	Royal Children's Hospital
RMIT	Royal Melbourne Institute of Technology
SA1	Statistical Area 1 (from ABS)
SA2	Statistical Area 2 (from ABS)
SEIFA-IRSD	Socio-economic Index for Areas - Index of Relative Socio-economic Disadvantage
SD	Standard deviation
SRC	Social Research Centre

Glossary

Lived experiences: ways that individuals interpret and experience the built environment in their daily lives and the meaning or role of these experiences in these individuals' lives.

Urbanicity: the presence of conditions that are particular to urban areas or present to a much greater extent than in nonurban areas (e.g., pollution, congestion, motor vehicle accidents). A proxy for distance from CBD.

Neighbourhood double disadvantage was conceptualised as the interaction between neighbourhood disadvantage and degree of urbanicity, e.g., living in the most disadvantaged neighbourhood furthest from the central business district (i.e., growth area).

Neighbourhood self-selection: where individuals choose to live in certain neighbourhoods based on their preferences, needs, and socioeconomic characteristics.



Part 1 Background

In 2022, RMIT University received funding from the Victorian Health Promotion Foundation (VicHealth) to:

1. Investigate and develop built environment indicators to improve early childhood outcomes and address developmental inequities across Melbourne's diverse urban neighbourhoods.
2. Engage families with young children to understand their lived experiences of their neighbourhoods and the aspects of their neighbourhoods that they feel are important to their development, mental health, and wellbeing.

1.1 Place matters for early childhood development

Early childhood (0-8 years) is a crucial period for human development,(1) setting lifelong trajectories for future growth.(2) Developmental inequities in early childhood often persist into adulthood, leading to disparities in educational attainment, income, and mental and physical health.(3, 4) Addressing these inequities is essential to reducing societal costs to health, education, and service systems and ensuring better outcomes.(5)

Where we live can influence early childhood and lifelong development.(6, 7) Neighbourhoods are an important social determinant of health.(8) The social determinants of health are defined as the 'conditions in which people are born, grow, work, live, and age, and the wider set of forces and systems shaping the conditions of daily life'.(9) In this context, neighbourhoods are typically defined using geographic administrative boundaries of locations (e.g., postcodes, local government areas). These bounded geographic areas are typically treated as 'containers' of individuals, and areas are often classified as 'advantaged' or 'disadvantaged' according to the clustered characteristics (e.g., income, levels of educational attainment, employment) of the individuals living there.(9)

Socio-economically disadvantaged neighbourhoods tend to have more children with poor developmental outcomes.(10-12) The most recent Australian Early

Development Census (AEDC), a population measure of early childhood development, shows a higher proportion (33.2%) of children living in the most disadvantaged communities in Australia, are developmentally vulnerable on at least one or more AEDC domains (i.e., Physical health and wellbeing, Social competence, Emotional maturity, Language and cognitive skills (school-based), and Communication skills and general knowledge), compared with children living in the least disadvantaged Australian communities (14.9%).(13)

1.2 Geographic inequities

Disadvantaged neighbourhoods represent social and economic contexts that are often resource-poor, isolated, or excluded from opportunities needed to support good developmental outcomes, especially when resource allocation and service provision occur without an explicit focus on addressing inequity.

Actions on the social determinants of health, such as the neighbourhood built and social environment, are viewed as a way to narrow early childhood development inequities at the population level.(14) Disadvantaged neighbourhoods may lack 'child-friendly' and 'liveable' destinations and services like parks, libraries, quality education, and early childhood services.(15, 16) Children living in these areas may disproportionately miss out on access to essential high-quality services and amenities required to meet their needs.

Urbanicity may also be seen as a geographic inequity. Urbanicity refers to "the presence of conditions that are particular to urban areas or present to a much greater extent than in nonurban areas" (e.g., pollution, congestion, motor vehicle accidents).(17) The degree of 'urbanicity' might be very different for a child growing up in established city areas compared to established suburbs, new suburban developments, or rural areas.(18) Urban 'growth areas' are commonly defined as greenfield sites on undeveloped land on the outskirts of cities.(19, 20)

Australia's rapid urbanisation is leading to population growth in outer suburbs; Many young families are moving to outer and growth area suburbs because of relative housing affordability and more space (e.g., larger houses, backyards).(21) For example, over 25% of the population living in growth areas in Victoria are couples with young children.(22) However, families may have limited access to essential services and infrastructure as these areas typically lack educational, social, health,

and transport services compared with inner city areas.(23, 24) Delayed infrastructure delivery may deprive children of opportunities for optimal development in the early years, and there are increasing concerns about how healthy these settings are for young children.

1.2.1 Gaps in the evidence base

1. The role of urbanicity (variations in urban versus suburban or rural settings) in child development has not been explored. Specifically, there is limited empirical research on how urbanicity is related to early childhood development.
2. There is a limited understanding of which local environmental factors should be prioritised for promoting child development, how they vary geographically, and whether they contribute to widening early childhood development inequities. While there is increasing policy momentum and emerging evidence, there remains a lack of robust research to guide urban policies for creating 'child-friendly' neighbourhoods.
3. Little is known about how young children and their primary caregivers experience their neighbourhoods and how this relates to child development, mental health, and wellbeing. There is a lack of studies incorporating young children's perspectives, which are essential to designing environments that reflect their needs and lived experiences.

1.3 Foundational work program

This report builds on a longstanding "child liveability" program informed by earlier reviews (15, 16, 25, 26) and the Kids in Communities Study.(27) The Kids in Communities Study explored community-level influences on early childhood development in 25 communities across five Australian states and territories. Factors in five key community environment domains were examined: Governance, Physical (built) environment, Services, Social, and Socioeconomic environments. We identified a list of Foundational Community Factors that plausibly lay the foundations of an optimal community for young children. Built environment factors (e.g., parks, public transport, traffic safety, walkability, and housing) were identified as important for child development but lacked quantitative testing. A core recommendation from the Kids in Communities Study was to develop quantitative indicators for built environment factors. For more information, read the report [here](#).(27)

In 2020, the Australian Federal Government Department of Education, Skills, and Employment (now Australian Government Department of Education) funded the pilot testing of a world-first linked national dataset to test the relationship between built environment indicators and early childhood development outcomes. The linked dataset is called the 'Australian Early Development Census – Built Environment' (AEDC-BE). The AEDC-BE dataset contains children's developmental outcomes and socio-economic/demographic details from the 2015 Australian Early Development Census, linked to built and social environment spatial indicators (e.g., walkability, public open space, destinations, services). This AEDC-BE linked dataset covered children across Australia's 21 most populous cities, as included in the National Cities Performance Framework.(28) The methodology for data linkage and strengths and limitations of the dataset, (29) and indicator framework,(16) have been published in full elsewhere. Read the report [here](#).(28)

This report uses the same 2015 AEDC-BE linked dataset but is limited to Melbourne, Australia's second largest and fastest growing capital city. It has an urban population of approximately 6.5 million in the most recent 2021 Census.(30) We investigated and developed built environment indicators for early childhood outcomes across Melbourne and talked with families in a Melbourne growth area to better understand their experiences and perceptions of supportive neighbourhood built environments for families with young children.

Part 2 Built environment and early childhood development

2.1 Overview

What did we do?

Using a nationally representative linked dataset (AEDC-BE) of neighbourhood spatial indicators hypothesised to be relevant for early childhood development outcomes, we examined relationships to respond to the following objectives.

Objective 1: Investigate associations between urbanicity (inner city, middle ring, outer ring, growth area) and early childhood development.

Objective 2: Examine whether the interaction of neighbourhood disadvantage and urbanicity (i.e., 'neighbourhood double disadvantage') was associated with early childhood development.

Objective 3: Determine built environment indicators associated with early childhood development, adjusting for neighbourhood double disadvantage.

What measures did we use?

- **Developmentally vulnerable on one or more domains** of the Australian Early Development Census (AEDC) domains (www.aedc.gov.au) was the main outcome of interest.
- **Child and family characteristics** from the AEDC.
- **Urbanicity:** inner city, middle ring, outer ring, and growth areas. Based on Local Government Area location.
- **Neighbourhood disadvantage** quintiles from most to least disadvantaged. Based on ABS Census data.
- **Neighbourhood double disadvantage:** 20-category variable combining urbanicity and neighbourhood disadvantage (e.g., high disadvantage, growth areas).
- **Built environment measures:** 18 built environment measures in eight domains (traffic, walkability, public transport, housing, public open space, early childhood education and care, family-friendly destinations, and food outlets).
- See **Table 1** for variable descriptions.



Table 1. Description of measures used in this study

Measure	Description
1 Developmentally vulnerable on one or more AEDC domains ¹ (<i>DV1</i>)	Developmentally vulnerable on one or more of the five AEDC domains (no, yes): Physical health and wellbeing, Social competence, Emotional maturity, Language and cognitive skills (school-based) (e.g., academic learning), and Communication skills and general knowledge. AEDC scores are invalid for children who are less than 4 years old, with special needs, where teachers have completed less than 75% of the items in any given domain and where the teacher has known the child for less than one month and feels as though they do not know the child well enough to complete the instrument.
2 Neighbourhood disadvantage ¹ (<i>seifacategory</i>)	Socio-Economic Indexes For Areas (SEIFA) - Index of Relative Socio-economic Disadvantage (IRSD) scores were quintiled (Quintile 1= most disadvantaged; Quintile 5= least disadvantaged), as recommended by the ABS.
3 Child's sex ¹ (<i>gender</i>)	Sex of the child (male, female)
4 Child's language background other than English ¹ (<i>lbote</i>)	Child has a language background other than English (no, yes)
5 Indigenous status ¹ (<i>atsi</i>)	Child is of Aboriginal or Torres Strait Islander descent (no, yes)
6 Child's age group ²	Age group of the child. Age group (≤ 5 years, ≥ 6 years) was derived from the original 15 age categories (in 'AgeCat'). The ' ≤ 5 years' age group includes some children slightly less than 5 years old (ages 4 years and older) and the '6 years and older' age group includes children aged 5 years 10 months and older.
7 Highest level of maternal education for child's parent ²	Following previous studies,(34, 35), Maternal education (< Year 12, Year 12, Bachelor's degree or higher) was based on the variables ' <i>Parent1School</i> ' and ' <i>Parent1PostSchool</i> ' (highest level of schooling completed, post-school qualification) where parent 1 was the main contact for the child (treated as the mother as Australian data shows that 'Parent 1' is approximately 99% the child's biological mother).(36, 37)
8 Urbanicity	Urbanicity variable (4 categories): inner city, middle ring, outer ring, and growth areas of Melbourne, based on their LGA of

Measure	Description
	residence. Urbanicity was based on a classification produced by Buxton et al. 2016(39).
9 Neighbourhood double disadvantage	As neighbourhood disadvantage was measured at small areas (SA1) and urbanicity was measured at larger areas (LGA), we derived a 20-category 'neighbourhood double disadvantage' variable for each SA1 in the sample (n=9,461 SA1s) using a matrix of the SEIFA-IRSD quintiles and urbanicity cross-tabulation (see Figure 1).
10 Built environment measures	18 built environment measures in eight domains. Details are presented further below in Table 11 .

Key: ABS: Australian Bureau of Statistics. AEDC: Australian Early Development Census; ¹Original variable: These variables are further described in the AEDC data dictionary.(38) The original AEDC variable names are italicised in the table; ²Derived variable based on original AEDC variable. LGA: Local Government Area. SA1: Statistical area level 1. More information is found here: www.aedc.gov.au.

Analysis

- **47,743 children** living in 9,461 SA1s in 36 LGAs (4 inner city, 13 middle ring, 9 outer ring, and 10 growth LGAs).
- We examined associations between urbanicity, neighbourhood disadvantage, neighbourhood double disadvantage, and developmental vulnerability (**Objectives 1, 2**). Then, we examined associations between built environment measures and developmental vulnerability, accounting for neighbourhood double disadvantage (**Objective 3**).



What did we find?

- Child development outcomes were not statistically different in Melbourne's inner city, compared to the middle ring, outer ring, or growth area suburbs.
- Children living in the most disadvantaged areas had higher odds of developmental vulnerability regardless of urbanicity.
- Outer ring and growth area suburbs have fewer amenities and infrastructure compared with inner city suburbs. However, the most disadvantaged areas seem to have more amenities and infrastructure compared with the least disadvantaged areas.
- Built environment domains of housing, public open space, and access to early childhood education and care were consistently related to developmental vulnerability and should be priority areas for policy focus (**Table 2**). There was some evidence that the relationship varied by the level of neighbourhood double disadvantage.
- Walkability was associated with developmental vulnerability, with the relationship being different for the most disadvantaged inner city areas. Here, an increase in walkability was associated with greater odds of developmental vulnerability, compared with children living in the least disadvantaged inner city areas.

Table 2. Summary of built environment associations with developmental vulnerability

Built environment domain and measure	Main effect ^a ?	Interaction effect ^b ?
Traffic		
Traffic exposure to busy roads ¹	N	Y-
Housing		
Housing affordability stress ¹ (per 10%)	Y+	Y+
Dwelling density ³ (per 10 dwellings)	N+	Y, mixed
Walkability		
Local living scores ³	N+	Y, mixed
Walkability scores ³	Y+	Y, mixed
Public transport		
Number of public transport stops with frequent weekday service ³	N+	Y+
Distance to closest public transport stop with frequent service (per 100m)	N-	Y, mixed
Family-friendly destinations		
Family-friendly destinations scores	N+	Y, mixed
Public open space		
Number of POS in 800m ²	Y-	Y-
Mix of POS ²	Y-	Y-
Distance to closest POS (m) (per 100m)	N+	N
Distance to closest child-friendly POS (m) (per 100m)	Y+	Y
Presence of child-friendly POS in 800m	N-	Y, mixed
Food outlets		
Percentage of healthier food outlets ⁵ (per 10%)	N-	N-
Early childhood education and care		
Number of childcare centres exceeding national standards ⁴	Y-	Y+
Distance to closest childcare centre exceeding national standards (per 100m)	N-	Y, mixed
Number of preschools exceeding national standards ⁴	Y-	Y+
Distance to closest preschool exceeding national standards (per 100m)	N-	Y-

Key: ¹Spatial unit is Statistical Area Level 1 (SA1); ²800m, ³1,600m, ⁴3,000m, or ⁵3,200m street network distance around child's home. The count of child-friendly POS is not available in the dataset. For information on each built environment measure, see **Table 11**. DV1= Developmentally vulnerable on one or more domain of the AEDC.

^aMain effects=association between the built environment and developmental vulnerability, adjusting for child/family characteristics and neighbourhood double disadvantage. In this context, a main effect is the effect of the built environment variable on developmental vulnerability. The results are shown in Model 2 in **Table 14**.

^bInteraction effects=built environment interaction with neighbourhood double disadvantage. In this context, an interaction effect occurs when the influence of the built environment on developmental vulnerability significantly *changes* depending on the level of neighbourhood double disadvantage. Neighbourhood double disadvantage is a 20-level variable that combines urbanicity (inner city, middle ring, outer ring, growth area) and neighbourhood disadvantage (quintiles where Q1 is most disadvantaged and Q5 is least disadvantaged). The results are shown in Model 3 graphs (Figures 3-20).

N=not significantly associated with developmental vulnerability (DV1) at p<0.05. Y=significantly associated with developmental vulnerability (DV1) at p<0.05. +=greater odds of developmental vulnerability, - = lower odds of developmental vulnerability, mixed= both positive and negative direction depending on neighbourhood double disadvantage category.



2.2 Methods

Child development measures

The AEDC is an internationally validated and reliable Australian child population measure of early childhood development. It provides teacher-reported national data on five key child development domains for all children in their first year of formal full-time school (approximately aged five years) (see **Table 3**). The AEDC is the most comprehensive collection of this kind in the world, with an overall participation rate of 96.5% of children at school entry.(32) The AEDC measures used in this study are in **Table 1**.

Table 3. Descriptions of developmental domains in the AEDC

Domain	Domain description
1 Physical health and wellbeing	Children’s physical readiness for the school day, physical independence, and fine motor skills.
2 Language and cognitive skills (school-based)	Children’s basic literacy, interest in literacy, numeracy and memory, advanced literacy and basic numeracy.
3 Emotional maturity	Children’s pro-social and helping behaviours and absence of anxious and fearful behaviour, aggressive behaviour, hyperactivity, and inattention.
4 Social competence	Children’s overall social competence, responsibility and respect, approach to learning, and readiness to explore new things.
5 Communication skills and general knowledge	Children’s communication skills and general knowledge based on broad developmental competencies and skills.

Key: AEDC: Australian Early Development Census. Notes: Reproduced directly from the source.(13) More information found here: www.aedc.gov.au.

Every child in the AEDC is scored between zero and 10 on each of the five domains; higher scores indicate better developmental status.(32) Each domain is subsequently categorised as: ‘developmentally vulnerable’ ($\leq 10^{\text{th}}$ centile), ‘developmentally at risk’ (11^{th} to 25^{th} centile), or ‘developmentally on track’ ($\geq 26^{\text{th}}$ centile) based on cut-off scores established in 2009. The cut-off scores provide a reference point against which later AEDC results can be compared and have

remained consistent across all collection cycles.(32) Developmentally vulnerable on one or more AEDC domains was the main outcome of interest (**Table 1**).

Neighbourhood measures

Urbanicity: inner city, middle ring, outer ring, and growth area. Urbanicity refers to “the presence of conditions that are particular to urban areas or present to a much greater extent than in nonurban areas” (e.g., pollution, congestion, motor vehicle accidents)(17). For Melbourne, urbanicity is a proxy for the presence or absence of built environment infrastructure and distance from the Central Business District (CBD). Distance from Melbourne’s CBD was not available in the linked dataset, thus, urbanicity was based on a classification produced by Buxton et al. 2016(39). Based on the classification of neighbouring LGAs, researchers manually classified 3,002 children (5.6% of Melbourne cohort)(34) who lived in seven LGAs that were unclassified in Buxton et al.’s original typology.

Neighbourhood disadvantage quintiles from most to least disadvantaged. The Socioeconomic Index for Areas Index of Relative Socio-economic Disadvantage (SEIFA-IRSD) is a composite area-level measure of disadvantage available for the Statistical Area Level 1 (SA1) of the child’s residential address in the linked dataset. The Australian Bureau of Statistics (ABS) produces the SEIFA-IRSD every five years using Australian Census data. The SEIFA-IRSD is a scale of high to low disadvantage, where only markers of disadvantage are used in the index e.g., low income, low education.(33)

Neighbourhood double disadvantage: 20-category variable combining urbanicity and neighbourhood disadvantage (e.g. high disadvantage, growth area) (**Figure 1**). ‘Neighbourhood double disadvantage’ was conceptualised as the interaction between neighbourhood disadvantage and degree of urbanicity, e.g., living in the most disadvantaged neighbourhood furthest from the central business district (i.e., growth area). We hypothesised that children and families living in these areas may experience ‘double disadvantage’ regarding limited exposure to essential neighbourhood amenities and resources.

		Neighbourhood disadvantage				
		Most disadvantaged → Least disadvantaged				
		Q1	Q2	Q3	Q4	Q5
Urbanicity category	Inner city	1	5	9	13	17
	Middle ring	2	6	10	14	18
	Outer ring	3	7	11	15	19
	Growth area	4	8	12	16	20

Figure 1. Neighbourhood double disadvantage 20-category variable

Key: Q=Quintile. Q1=most disadvantaged, Q5=Least disadvantaged. 1 through 20 =categories of the neighbourhood double disadvantage variable.

Built environment measures: 18 built environment measures in eight domains (traffic, walkability, public transport, housing, public open space, early childhood education and care, family-friendly destinations, food outlets). Details are presented further below in **Table 11**.

Spatial boundaries

1. **Local Government Area (LGA)** (municipality): an administrative division that a local government (third tier of government in Australia) is responsible for.
2. **Statistical Area Level 1 (SA1)**: an Australian Bureau of Statistics (ABS) administrative unit for a geographic area of approximately 400 persons on average.
3. **Built environment measures** were calculated around **individual network buffers** linked to children's home addresses. Buffers ranged from 800-3200m, depending on the destination.

Data preparation

Missing data and plausible range values were checked. The original national linked AEDC-BE dataset contained 235,631 children. To obtain the Melbourne sample, we removed:

- Children living in other Australian states and territories (n=175,570)
- Children with missing data on the urbanicity variable (i.e., those classified as regional Victoria) (n= 6,073)
- Children with missing data on key AEDC variables of interest (e.g., maternal education, neighbourhood disadvantage, DV1) (n=6,245)

The final analytic AEDC-BE Melbourne dataset used for complete case analysis comprised **47,743 children** living in 9,461 SA1s in 36 LGAs (4 inner city, 13 middle ring, 9 outer ring, and 10 growth LGAs).

Data analysis

We examined associations between urbanicity, neighbourhood disadvantage, neighbourhood double disadvantage, and developmental vulnerability (**Objectives 1, 2**). Then, we examined associations between built environment measures and developmental vulnerability, accounting for neighbourhood double disadvantage (**Objective 2**).

- Descriptive statistics for the sample were computed using Stata v18.
- The binary outcome variable was developmentally vulnerable on one or more domains (DV1).
- Models were fitted using Stata v18 and MLwiN v3.13 statistical software.
- We used the runmlwin command to execute MLwiN within Stata. (53) Model parameters were estimated using Markov chain Monte Carlo (MCMC) simulations for randomisation optimisation, after starting values from Maximum Likelihood estimates (MQL), followed by Penalized Quasi-likelihood (PQL).
- All model results were reported as Odds Ratios (ORs) with their 95% Credible Intervals (CrIs).
- Specific details on analysis models are found in **Section 2.4**, and **Section 2.5**.

2.3 Sample characteristics

Table 4 shows the sample characteristics (n=47,743 children) across urbanicity categories.

- Most children lived in middle ring areas (n=17,523) followed by growth areas (n=15,892) and outer ring areas (n=12,054). Few children lived in the inner city (n=2,274).
- In inner city areas, most children lived in the least disadvantaged neighbourhoods (53.5%).
- The patterning of neighbourhood disadvantage within each urbanicity category was inconsistent except for the middle ring areas, which showed a clear social gradient where there were more children with each step down in disadvantage (i.e., becoming less disadvantaged).
- Outer ring and growth areas were similarly patterned for maternal education; most mothers had the highest level of schooling of Year 12 (or other tertiary). This contrasts with inner city and middle ring areas where most mothers had a bachelor's degree or higher.
- Overall, 19.2% of children in the sample were developmentally vulnerable on one or more AEDC domains (n=9,169).



Table 4. Sociodemographic characteristics of children in the sample

	Urbanicity category				
	Inner city (n=2,274)	Middle ring (n=17,523)	Outer ring (n=12,054)	Growth area (n=15,892)	Total (n=47,743)
	%	%	%	%	%
Age group					
≤5 years	60.2	59.9	59.1	64.7	61.3
≥ 6 years	39.8	40.1	40.9	35.3	38.7
Sex					
Female	47.6	49.5	50.0	50.0	49.7
Male	52.4	50.5	50.0	50.0	50.3
Indigenous status					
No	99.3	99.5	98.8	98.7	99.1
Yes	0.7	0.5	1.2	1.3	0.9
Language background other than English					
No	74.1	73.4	73.1	66.2	71.0
Yes	25.9	26.6	26.9	33.8	29.0
Maternal education (Highest level of schooling)					
Bachelor degree or higher	67.6	60.5	31.9	29.3	43.2
Other tertiary and/or Year 12	27.1	34.8	54.1	56.3	46.5
Less than Year 12	5.3	4.6	14.0	14.4	10.3
Neighbourhood disadvantage quintile					
Q5 (least disadvantaged)	53.5	30.4	20.4	15.7	24.1
Q4	23.8	32.2	20.5	23.5	26.0
Q3	8.1	18.8	19.8	26.6	21.1
Q2	3.5	11.8	16.0	19.7	15.1
Q1 (most disadvantaged)	11.1	6.7	23.3	14.5	13.7
Developmentally vulnerable*					
No	82.4	85.1	79.0	77.3	80.8
Yes	17.6	14.9	21.0	22.7	19.2

Key: *Developmentally vulnerable on one or more domains. See **Table 1** for variable descriptions.

Table 5 shows the proportion of developmentally vulnerable (DV1) by neighbourhood double disadvantage. The inner city most disadvantaged quintile had the highest proportion of children with DV1 (45.8%), followed by the most disadvantaged areas in outer ring (31.5%), growth areas (31.2%), and middle ring areas (29.2%).



Table 5. Distribution of developmental vulnerability by neighbourhood double disadvantage

	Developmentally vulnerable*	Full sample
	n (%)	n
Neighbourhood double disadvantage (area-level)		
Q5 (least disadvantaged)		
Inner city	143 (11.8)	1,213
Middle ring	627 (11.7)	5,333
Outer ring	317 (12.9)	2,464
Growth area	405 (16.1)	2,510
Q4		
Inner city	83 (15.1)	548
Middle ring	724 (12.8)	5,642
Outer ring	373 (15.3)	2,434
Growth area	728 (19.6)	3,717
Q3		
Inner city	42 (22.7)	185
Middle ring	512 (15.5)	3,301
Outer ring	462 (19.3)	2,399
Growth area	938 (22.2)	4,218
Q2		
Inner city	17 (21.8)	78
Middle ring	416 (19.9)	2,082
Outer ring	503 (26.1)	1,928
Growth area	820 (26.2)	3,134
Q1 (most disadvantaged)		
Inner city	115 (45.8)	251
Middle ring	340 (29.2)	1,164
Outer ring	882 (31.5)	2,799
Growth area	722 (31.2)	2,313

Key: Q: quintile. *Developmentally vulnerable on one or more domains.

2.4 Geographic disadvantage and developmental vulnerability

We examined associations between urbanicity (inner city, middle ring, outer ring, growth area) and developmental vulnerability (**Objective 1**) and whether the interaction of neighbourhood disadvantage and urbanicity (i.e., 'neighbourhood double disadvantage') was associated with developmental vulnerability (**Objective 2**). A summary of the analysis models is in **Table 6**.

Table 6. Analysis summary for examining geographic disadvantage and developmental vulnerability

Outcome measure	Developmentally vulnerable on one or more domain (DV1)
Model specification	<p><i>Model 1: Urbanicity and DV1;</i></p> <p><i>Model 2: Model 1 plus adjustment for neighbourhood disadvantage;</i></p> <p><i>Model 3: Model 2 adjusted for child/family confounder variables.</i></p> <p><i>Models 1, 2, and 3 were repeated for neighbourhood disadvantage and neighbourhood double disadvantage as the independent variable.</i></p>
Reference categories	<p><i>Urbanicity: inner city (category 1)</i></p> <p><i>Neighbourhood disadvantage: least disadvantaged (quintile 5)</i></p> <p><i>Neighbourhood double disadvantage: least disadvantaged inner-city area (category 17; n=376 SA1s, n= 1,213 children)</i></p> <p>Our rationale for selecting these reference categories was that children living in these areas may be the least deprived due to living in the least disadvantaged socioeconomic neighbourhoods alongside having the greatest access to built and social environment infrastructure.</p>
Notes	From the first set of analyses, we concluded that there was no significant relationship between urbanicity and early childhood development, and we cannot ignore neighbourhood disadvantage when looking at the effects of urbanicity and built environment on early childhood development. Thus, further analyses (for Objective 2) accounted for 'neighbourhood double disadvantage'.

Key: SA1: Statistical area 1

Table 7 shows associations between urbanicity category (measured at LGA) and DV1, adjusted for neighbourhood disadvantage (measured at SA1) and child/family characteristics. After full adjustment (Model 3), children living in the middle ring areas were associated with decreased odds (OR 0.78) of developmental vulnerability (95%CrI 0.66-0.93) compared with children living in the inner city areas. Living in the outer ring and growth areas was not associated with developmental vulnerability.

Table 7. Urbanicity and odds of developmental vulnerability (DV1) across Melbourne

	Model 1 OR (95%CrI)	Model 2 OR (95%CrI)	Model 3 OR (95%CrI)
Urbanicity category			
Inner city	1.0	1.0	1.0
Middle ring	0.84 (0.62-1.14)	0.78 (0.65-0.93)**	0.78 (0.66-0.93)**
Outer ring	1.20 (0.86-1.69)	0.95 (0.79-1.16)	0.86 (0.73-1.04)
Growth area	1.30 (0.92-1.76)	1.08 (0.88-1.29)	0.93 (0.78-1.11)

Key: CrI: Credible Interval. DV1: Developmentally vulnerable on one or more AEDC domains. OR: Odds ratio. Model 1: Urbanicity category (LGA) and DV1. Model 2: Model 1 plus adjustment for neighbourhood disadvantage. Model 3: Model 2 plus adjustment for child/family characteristics. See **Table 1** for variable descriptions. **Significant at $p < 0.01$.

Table 8 shows associations between neighbourhood disadvantage and DV1, adjusted for urbanicity and child/family characteristics. After full adjustment, children living in the most disadvantaged neighbourhoods had 1.90 times higher odds of being developmentally vulnerable (95%CrI 1.73-2.08), compared with children living in the least disadvantaged areas. A social gradient pattern existed across quintiles, with each step of increasing neighbourhood disadvantage (i.e., becoming more disadvantaged), the odds of developmental vulnerability increased. Adjustment for urbanicity made almost no contribution to the association between neighbourhood disadvantage and developmental vulnerability.

Table 8. Neighbourhood disadvantage and odds of developmental vulnerability (DV1) across Melbourne

	Model 1	Model 2	Model 3
	OR (95%CrI)	OR (95%CrI)	OR (95%CrI)
Neighbourhood disadvantage quintile			
Q5 (Least disadvantaged)	1.0	1.0	1.0
Q4	1.18 (1.09-1.27)***	1.18 (1.10-1.28)***	1.12 (1.04-1.21)***
Q3	1.47 (1.36-1.60)***	1.47 (1.36-1.59)***	1.32 (1.22-1.43)***
Q2	1.95 (1.78-2.13)***	1.94 (1.79-2.11)***	1.61 (1.47-1.76)***
Q1 (Most disadvantaged)	2.73 (2.49-2.99)***	2.71 (2.48-2.95)***	1.90 (1.73-2.08)***

Key: CrI: Credible Interval. DV1: Developmentally vulnerable on one or more AEDC domains. OR: Odds ratio. Q: Quintile. Model 1: Neighbourhood disadvantage quintile and DV1. Model 2: Model 1 plus adjustment for urbanicity. Model 3: Model 2 plus adjustment for child/family characteristics. See **Table 1** for variable descriptions. ***Significant at $p < 0.001$

Table 9 shows the ‘neighbourhood double disadvantage’ associations with DV1. Children who lived in the most disadvantaged inner city areas were associated with 3.86 higher odds of developmental vulnerability compared with children living in the least disadvantaged inner city areas (95%CrI 2.73-5.29). Children living in the most disadvantaged middle ring, outer ring, and growth areas were around twice as likely to be developmentally vulnerable compared with their least disadvantaged peers. Except for inner city areas, a social gradient pattern held across neighbourhood

disadvantage quintiles in each urbanicity category: each step of increasing neighbourhood disadvantage was associated with increasingly higher odds of DV1.

Table 9. Neighbourhood double disadvantage and odds of developmental vulnerability (DV1)

Neighbourhood disadvantage quintile	Urbanicity category	Model 2 OR (95%CrI)
Q5 (Least disadvantaged)	Inner city	1.0
	Middle ring	1.05 (0.84-1.28)
	Outer ring	1.06 (0.83-1.32)
	Growth area	1.16 (0.92-1.44)
Q4	Inner city	1.40 (1.03-1.85)*
	Middle ring	1.05 (0.86-1.29)
	Outer ring	1.20 (0.94-1.49)
	Growth area	1.41 (1.12-1.72)**
Q3	Inner city	2.00 (1.29-2.92)**
	Middle ring	1.25 (1.00-1.52)*
	Outer ring	1.48 (1.17-1.83)***
	Growth area	1.58 (1.28-1.93)***
Q2	Inner city	1.89 (0.98-3.26)*
	Middle ring	1.54 (1.21-1.89)***
	Outer ring	1.94 (1.54-2.40)***
	Growth area	1.82 (1.47-2.22)***
Q1 (Most disadvantaged)	Inner city	3.86 (2.73-5.29)***
	Middle ring	2.14 (1.65-2.67)***
	Outer ring	1.99 (1.58-2.46)***
	Growth area	2.06 (1.66-2.54)***

Key: CrI: Credible Interval. DV1: Developmentally vulnerable on one or more AEDC domains. OR: Odds ratio. Q: Quintile. Neighbourhood area type combines neighbourhood disadvantage quintiles and urbanicity category for each Statistical area level 1, with an average of 400 persons. Model 1 (Neighbourhood area type and DV1) results are not presented. Model 2: Model 1 plus adjustment for child/family variables. See **Table 1** for variable descriptions. All adjustment variables were significant with DV1 at $p < 0.001$. ***Statistically significant at $p < 0.001$; ** $p < 0.01$; * $p < 0.05$.

2.5 Built environment and developmental vulnerability

We examined built environment indicators of early childhood development, adjusting for neighbourhood double disadvantage (**Objective 3**). We also examined whether the association between the built environment and developmental vulnerability differed for levels of neighbourhood double disadvantage. A summary of the analysis models is in **Table 10**.

Table 10. Analysis summary for examining built environment and developmental vulnerability

Outcome measure	Developmentally vulnerable on one or more domain (DV1)
Model specification	<p>Model 1: Built environment measure and DV1, adjusting for child/family characteristics;</p> <p>Model 2: Model 1 + adjustment for neighbourhood double disadvantage;</p> <p>Model 3: Model 1 + built environment x neighbourhood double disadvantage.</p> <p><i>Models 4, 5, 6: were repeated for each built environment measure separately (18 built environment measures in total).</i></p>
Reference categories	<p>Urbanicity: inner city (category 1)</p> <p>Neighbourhood disadvantage: least disadvantaged (quintile 5)</p> <p>Neighbourhood double disadvantage: least disadvantaged inner-city area (category 17; n=376 SA1s, n= 1,213 children)</p> <p>Our rationale for selecting these reference categories was that children living in these areas may be the least deprived due to living in the least disadvantaged socioeconomic neighbourhoods alongside having the greatest access to built and social environment infrastructure.</p>
Notes	For multilevel models, ‘distance to closest’ built environment measures were scaled to 100m to enhance interpretability. Other ‘proportion or percentage’ built environment measures were scaled to 10% to enhance interpretability.

Built environment measures that align with children’s health and wellbeing outcomes in previous literature and published previously,(16, 40) have been

described in **Table 11**. The data sources for these measures are in **Appendix A**. Metadata are available via the Australian Urban Observatory (<https://auo.org.au/portal/metadata>).

Using GIS software and Python scripts, existing spatial datasets were used to compute built environment measures at the parcel level (i.e. child’s residential address) in most cases, to limit bias due to aggregating geographic scales, and ecological fallacy (i.e. assumption that correlations observed for aggregated group data can be transferred to the individual)(41) that are associated with larger geographic units typically used in child place-based research (e.g., cities, suburbs/postcodes). Street network analyses were used to calculate the count (number) of each destination type up to 3,200m and the distance to the closest destination (e.g., distance to the closest public open space). Different scales (e.g., 800m, 1,600m, 3,000m, 3,200m) were used for different built environment measures. Scales of 800m and 1,600m network buffers are most frequently used to represent a youth’s local neighbourhood.(42)



Table 11. Built environment measures used in this study

Measure	Spatial unit	Description	Interpretation
Traffic			
Traffic exposure	SA1	Length of higher volume roads/length of lower volume roads (km). It is based on 2017 PSMA Transport and Topography data (see Appendix A). The calculation includes the length (km) of road types ((301 + 302 + 303 + 304)/ (305 + 309 + 400)). (301=national state highway; 302=arterial road; 303=sub-arterial road; 304=collector road; 305=local road; 309=access road; 400=pedestrian thoroughfare). Previous research has used traffic exposure ratios.(45)	Greater ratio = higher road volume exposure in SA1.
Housing			
Housing affordability stress	SA1	Housing affordability stress is % of people in the lowest 2 quintiles of income (bottom 40%) nationally paying more than 30% of household income on rent/mortgage (based on ABS 2016 Census data). This is a standard measure of Housing affordability stress used by the ABS and other Australian research.(46, 47)	Higher number = higher percentage of people experiencing housing affordability stress in SA1.
Dwelling density	1,600m service area	Dwelling density / Ha for a 1,600m street network distance. Note: also a component of housing. Dwelling density is calculated as the total number of dwellings located in Mesh Blocks intersecting each participant's local walkable neighbourhood, divided by the neighbourhood size in hectares.	Higher number = higher dwelling density within 1,600m of the child's home.
Walkability			
Local living score	1,600m	Local living destination access score for a 1,600m street network distance. It refers to neighbourhood destinations a person may walk to daily. Presence or absence is 0 or 1 for the following 11 destinations within 1,600m, and summed to provide a 'local living score' between 0-11: 1) Convenience store, supermarket; 2) PT stop; 3) speciality food (e.g., fruit, veggie, meat, fish); 4) post-office; 5) bank; 6) pharmacy; 7) GP/med centre; 8) dentist; 9) community centre/hall; 10) child care facility; 11) public library.(48)	Higher number = higher local living score.
Walkability score	1,600m service area	Walkability index for a 1,600m service area, relative to the study region. Traditionally, it combines land use mix (LUM), street connectivity, and residential density. LUM is difficult to calculate at a national level due to a lack of data. There have been issues with the LUM entropy measure; hence, the 'daily living score' is used as a replacement. This means that the walkability score was calculated as the sum of standardised scores of local neighbourhood attributes, including street connectivity, dwelling density, and the index of access to services of daily living described above.(48)	Higher number = more walkable within 1,600m.
Public transport			
Count of public transport stops with a frequent weekday service	1,600m	Count of public transport stops (i.e., ferry, tram, train, bus) with a frequent weekday service (at least 30 min, 7 am-7 pm) within a 1,600m street network distance	Higher number = more public transport stops with a frequent weekday timetable service within 1,600m of the child's home.

Measure	Spatial unit	Description	Interpretation
Distance (m) to closest public transport stop with a frequent weekday service	1,600m	Distance to closest public transport stop (i.e., ferry, tram, train, bus) with a frequent weekday service (at least 30 min, 7 am–7 pm) within a 1,600m street network distance	Higher number = closest public transport stop with a frequent weekday timetable service within 1,600m is further away from the child's home.
Public open space* (POS)			
Count of POS	800m	Count of any POS type of any type and size, within an 800m street network distance	Higher number = more POS of any type and size within 800m.
Distance (m) to closest POS	800m	Distance to the closest POS of any type and size, within an 800m street network distance	Higher number = the closest POS of any type and size is further away from the child's home
Mix of public open space	800m	Presence or absence of five POS of sizes within an 800m street network distance (<0.4 Ha (pocket park), >0.4 to <1ha (local park), >1 to ≤5 Ha (neighbourhood park), >5 to ≤20 Ha (district park), ≥20 Ha (regional park) summed to produce a 'POS mix score' between 0 and 5.	Higher number = higher mix of POS of any type and size within 800m.
Presence of child-friendly POS	800m	Presence or absence of 'child-friendly POS' (a POS with a toilet and playground) within an 800m street network distance.	Presence = 1, absence = 0.
Distance (m) to closest child-friendly POS	800m	Distance to the closest 'child-friendly POS', a POS with a toilet and playground (a POS with a toilet and playground) within an 800m street network distance.	Higher number = closest child-friendly POS (one with a toilet and playground) to the child's home is further away.
Early childcare and education services^{†*}			
Count of childcare centres exceeding national standards	3,000m	Count of childcare centres (any type exceeding the national quality standard) within a 3,000m street network distance. See above for childcare included.	Higher number = more childcare centres of any type exceeding the national quality standard within 3,000m of the child's home.
Distance (m) to closest childcare centre exceeding national standards	3,000m	Distance to the closest childcare centre (any type exceeding the national quality standard) within a 3,000m street network distance. See above for childcare included.	Higher number = closest childcare centre of any type exceeding the national quality standard within 3,000m of the child's home is further away.
Count of preschool services exceeding national standards	3,000m	Count of preschool services exceeding national quality standards within a 3,000m street network distance. See above for preschool service included.	Higher number = more preschool services exceeding the national quality standard within 3,000m of the child's home.
Distance (m) to closest preschool service exceeding national standards	3,000m	Distance to the closest preschool service exceeding the national quality standard within a 3,200m street network distance. See above for preschool service included.	Higher number = closest preschool service exceeding the national quality standard within 3,000m of the child's home is further away.
Family-friendly destinations			
Family-friendly destinations score	3,200m	Family living destination access score refers to destinations families are likely to access in their local areas (at 3,200m street network distance). Presence or absence is 0 or 1 for 5 destinations and summed to provide a 'family-friendly destinations' score	Higher number = more family-friendly destinations within 3,200m of the child's home.

Measure	Spatial unit	Description	Interpretation
		between 0-5: 1) Sport facilities; 2) public swimming pools; 3) public libraries; 4) community centres; 5) activity centres.	
Food outlets			
Percentage of healthier food outlets	3,200m	Percentage of food outlets within 3,200m street network distance that provide healthier food options. Supermarkets, green grocers, and fruit and vegetable vendors were included. Unhealthy options were those classified as fast food and takeaway, regardless of whether they offered healthier food options (e.g., McDonald's was considered unhealthy even though they have healthier options on the menu, and vice versa for supermarkets selling unhealthy food options).	Higher number = greater percentage of healthier food outlets within 3,200m of child's home.

Key: Ha: hectare; m: metre. ABS: Australian Bureau of Statistics. NQS: National Quality Standard.(49) POS: public open space. PT: public transport. SA1: Statistical Area Level 1, 400 persons on average.(50)

Notes about data: *Many preschool services (e.g., standalone preschool services not part of a centre-based childcare service) in Tasmania and Western Australia were not within the scope of the National Quality Standard at the time of data harvesting. Hence, for early childhood education and care service measures, children in Tasmania (n=2,800 children) and Western Australia (n=22,111 children) were excluded due to these preschool services being beyond the scope of the NQS data. ^Based on NQS data provided by The Australian Children's Education & Care Quality Authority.

*Public open spaces of these sizes were used in previous research; different-sized public open spaces have been associated with different physical activity behaviours.(51) See **Appendix A** for data sources. Refer to the Australian Urban Observatory for more information(52): <https://auo.org.au/portal/metadata>

Notes about spatial scales: 800m or 1,600m were used for most built environment measures. A 3,200m was used for destinations such as public libraries and swimming pools to better represent the likely presence of these destinations at larger area scales (e.g., it is less common that children have social infrastructure within 1,600m of home).

A 3,000m buffer was used for ECEC services because a previous study found that families tend to travel short distances to use ECEC services (within 3km on average),(43) and others have used this distance to investigate ECEC quantity and quality measures.(44) SA1 neighbourhood characteristics were also examined as administrative data were available at this geographic scale.


An aerial photograph of a suburban neighborhood. In the foreground, there's a large pond with a wooden bridge crossing it. The bridge has a small wooden platform at its end. The pond is surrounded by lush green trees and grass. In the middle ground, there are several houses with dark roofs and light-colored walls. Some houses have swimming pools. There are also parking lots with several cars. In the background, there's a road with a crosswalk and more trees. The overall scene is a typical suburban residential area.

Table 12 has descriptive statistics (mean (standard deviation), and range) for each built environment measure by urbanicity category:

- Children living in the inner city, on average, lived in more walkable areas with better street connectivity and higher dwelling densities and increased traffic exposure (busier roads) compared with the other urbanicity contexts. Walkability was much higher in inner city areas (5.2) compared to middle ring (0.9), outer ring, and growth areas (both negative walkability).
- Housing affordability stress was similar for inner city and growth areas (44.1% and 48.2%, respectively), and similar for middle ring and outer ring areas (31.5% and 33.6%, respectively).
- Children living in inner city areas also had the best access (i.e., more and closer) to local destinations and services on average. For example, the inner city children had more public transport stops, family-friendly destinations, public open space, playgrounds, and more early childhood education and care services (childcare and preschools), exceeding national quality standards near home.
- The pattern across urbanicity was similar for most built environment destination measures (except for healthier food outlets); as distance from the central business district increased (i.e., from inner city through to growth areas), children on average had fewer destinations and services available and longer distances to travel to their closest destination. The daily living score (presence of three neighbourhood destinations that people might frequent regularly) also followed this pattern, but the results were similar across urbanicity categories (2.9 for inner city vs. 2.1 for growth areas).

Table 12. Descriptive built environment characteristics by urbanicity category

	Urbanicity category				
	Inner city (n=2,274)	Middle ring (n=17,523)	Outer ring (n=12,054)	Growth area (n=15,892)	All areas (n=47,743)
	Mean (SD) Range	Mean (SD) Range	Mean (SD) Range	Mean (SD) Range	Mean (SD) Range
Traffic					
Traffic exposure to busy roads ¹	0.4 (0.3) 0.0-1.4	0.3 (0.3) 0.0-1.4	0.3 (0.3) 0.0-1.4	0.2 (0.2) 0.0-1.4	0.2 (0.3) 0.0-1.4
Housing					
Housing affordability stress ¹	44.3 (17.0) 0.0-107.1	31.5 (13.4) 0.0-83.6	33.6 (14.5) 0.0-92.0	48.2 (18.6) 0.0-150.0	38.2 (17.4) 0.0-150.0
Dwelling density ³	32.4 (12.0) 10.2-78.2	15.9 (4.1) 0.8-64.9	11.2 (3.3) 0.2-22.3	10.9 (2.8) 0.1-28.0	13.8 (6.4) 0.1-78.2
Walkability					
Local living score ³	9.9 (0.8) 4.6-10.9	8.2 (1.6) 0.2-10.9	5.7 (2.4) 0.0-10.8	4.9 (2.1) 0.0-10.9	6.6 (2.5) 0.0-10.9
Walkability score ³	5.2 (2.5) -1.5-12.4	0.9 (1.4) -6.7-6.7	-0.8 (1.5) -7.1-1.9	-0.4 (1.5) -7.8-2.3	0.2 (2.0) -7.8-12.4
Public transport					
Number of public transport stops with frequent weekday service ³	79.7 (39.9) 0-223.0	37.6 (26.7) 0-139.0	8.1 (12.0) 0-101.0	7.9 (11.0) 0.0-65.0	22.3 (27.9) 0.0-223.0
Distance to closest public transport stop with frequent service (m)	275.6 (190.6) 0-1227.0	517.5 (470.5) 0-6132.0	3,641.7 (6909.2) 0-40746.0	3,456.7 (6694.5) 0.0-56111.0	2,273.1 (5414.0) 0.0-56111.0
Family-friendly destinations					
Family-friendly destinations score ⁵	4.7 (0.4) 4.0-5.0	4.4 (0.8) 1.0-5.0	3.2 (1.3) 0.0-5.0	2.8 (1.1) 0.0-5.0	3.6 (1.3) 0.0-5.0
Public open space* (POS)					
Number of POS ²	9.3 (4.4) 0.0-14.0	5.5 (3.1) 0.0-14.0	3.8 (2.7) 0.0-14.0	5.5 (3.9) 0.0-14.0	5.6 (4.9) 0.0-68.0
Mix of POS ²	3.3 (1.0) 0.0-5.0	2.8 (1.0) 0.0-5.0	2.3 (1.2) 0.0-5.0	2.7 (1.3) 0.0-5.0	2.6 (1.2) 0.0-5.0
Distance to closest POS (m)	218.1 (165.6) 0-1,034.0	279.9 (189.8) 0-1839.0	347.4 (296.0) 0-3,087.0	287.4 (305.1) 0.0-3,193.0	296.5 (262.0) 0.0-3,193.0
Distance to closest child-friendly POS (m)	509.6 (310.2) 0-1,769.0	893.9 (591.7) 0-3,194.0	1,203.9 (772.6) 0-3,199.0	1,483.0 (851.7) 0.0-3,200.0	1,111.8 (761.9) 0.0-3,200.0

	Urbanicity category				
	Inner city (n=2,274)	Middle ring (n=17,523)	Outer ring (n=12,054)	Growth area (n=15,892)	All areas (n=47,743)
Food outlets					
Percentage of healthier food outlets ⁵	36.5 (9.5) 16.7-62.5	42.4 (12.2) 10.0-100.0	41.8 (20.8) 0.0-100.0	44.0 (18.7) 0.0-100.0	42.5 (16.8) 0.0-100.0
Early childhood education and care services					
Number of childcare centres exceeding national standards ⁴	19.4 (5.9) 3.0-39.0	10.0 (5.7) 0.0-39.0	4.6 (3.2) 0.0-17.0	3.7 (2.4) 0.0-12.0	7.0 (5.8) 0.0-39.0
Distance to closest childcare centre exceeding national standards (m)	595.0 (304.3) 0.0-2,006.0	914.5 (544.5) 0.0-4,019.0	1,495.3 (1,701.6) 2.0-24,319.0	1,825.9 (2,356.0) 0.0-22,823.0	1,349.3 (16,93.9) 0.0-24,319.0
Number of preschools exceeding national standards ⁴	6.1 (3.6) 0.0-16.0	4.5 (2.6) 0.0-14.0	2.8 (2.0) 0.0-10.0	2.2 (1.6) 0.0-9.0	3.4 (2.5) 0.0-16.0
Distance to closest preschool exceeding national standards (m)	1,178.1 (680.3) 0.0-3,236.0	1,293.3 (785.4) 0.0-4,817.0	1,839.5 (1922.9) 2.0-24,860.0	2,428.5 (3217.4) 0.0-27,855.0	1,803.6 (2,207.2) 0.0-27,855.0

Key: ¹Spatial unit is Statistical Area Level 1 (SA1); ²800m, ³1,600m, ⁴3,000m, or ⁵3,200m street network distance around child's home. Count of child-friendly POS is not available in the dataset. For information on each built environment measure, see **Table 11**.

Table 13 reports detailed descriptive statistics (mean (standard deviation), and range) for each built environment measure by neighbourhood double disadvantage. Only the least and most disadvantaged areas are presented for comparative purposes given neighbourhood disadvantage follows a strong social gradient; the highest proportion of developmentally vulnerable children live in the most disadvantaged neighbourhoods, and the lowest proportion is in the least disadvantaged neighbourhoods.

When neighbourhood disadvantage and urbanicity are considered together (neighbourhood double disadvantage) (**Table 13**), there was a social gradient for each urbanicity category, but it appears to be in the opposite direction than expected: compared with the most disadvantaged areas, a higher proportion of children living in the least disadvantaged areas had poorer access to local destinations and services. Children living in the most disadvantaged inner city areas had the best built environment access on almost all built environment indicators.

Table 13. Built environment descriptives for the most (Q1) and least disadvantaged areas (Q5) by urbanicity

	<i>Inner city</i>		<i>Middle ring</i>		<i>Outer ring</i>		<i>Growth area</i>	
	<i>Most disadvantaged</i>	<i>Least disadvantaged</i>	<i>Most disadvantaged</i>	<i>Least disadvantaged</i>	<i>Most disadvantaged</i>	<i>Least disadvantaged</i>	<i>Most disadvantaged</i>	<i>Least disadvantaged</i>
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
	Range	Range	Range	Range	Range	Range	Range	Range
Traffic exposure								
Traffic exposure to busy roads ¹	0.5 (0.5) 0.0-1.4	0.3 (0.3) 0.0-1.4	0.3 (0.2) 0.0-1.4	0.3 (0.3) 0.0-1.4	0.3 (0.3) 0.0-1.4	0.2 (0.2) 0.0-1.4	0.3 (0.3) 0.0-1.4	0.2 (0.2) 0.0-1.4
Housing								
Housing affordability stress ¹	53.3 (11.3) 30.2-91.7	40.3 (16.2) 0.0-107.1	39.5 (11.8) 3.1-81.0	27.5 (14.1) 0.0-80.6	39.7 (10.7) 0.0-67.4	23.7 (14.0) 0.0-81.3	43.2 (13.2) 6.1-80.8	45.7 (21.9) 0.0-113.3
Dwelling density ³	34.9 (9.5) 12.0-64.7	29.7 (10.1) 12.4-64.8	15.2 (4.1) 5.7-30.4	15.2 (4.1) 2.5-36.5	13.8 (2.7) 0.8-22.3	9.4 (2.8) 0.2-16.4	12.1 (2.0) 4.9-17.9	9.5 (3.0) 0.7-21.2
Walkability								
Local living score ³	10.3 (0.6) 7.7-10.9	9.7 (0.8) 4.6-10.8	8.4 (1.3) 4.9-10.8	7.9 (1.8) 0.2-10.9	7.3 (2.1) 0.0-10.8	4.1 (2.1) 0.0-9.9	6.3 (2.2) 1.1-10.9	4.0 (2.1) 0.0-9.8
Walkability score ³	6.8 (1.9) 1.7-10.8	4.5 (2.2) -1.5-11.4	0.9 (1.4) -1.6-6.2	0.5 (1.3) -6.7-6.6	0.0 (1.0) -5.2-1.9	-1.9 (1.7) -7.0-1.6	-0.1 (0.8) -3.3-2.1	-1.1 (2.0) -7.3-2.2
Public transport								
Number of public transport stops with frequent weekday service ³	89.7 (33.2) 28.0-206.0	71.4 (32.6) 4.0-194.0	44.1 (29.6) 0.0-137.0	29.7 (20.8) 0.0-115.0	16.4 (17.3) 0.0-101.0	4.2 (6.0) 0.0-29.0	20.4 (16.6) 0.0-65.0	1.7 (3.4) 0.0-24.0
Distance to closest public transport stop with frequent weekday service (m)	219.8 (128.9) 1.0-568.0	297.3 (196.4) 0.0-1,204.0	448.8 (401.4) 0.0-2,066.0	620.5 (568.4) 0.0-6,132.0	2,807.0 (6,678.5) 0.0-39,600.0	2,881.6 (4,339.8) 1.0-30,717.0	1,179.3 (2,562.8) 1.0-26,990.0	5,722.3 (8,282.2) 28.0-42,236.0
Family-friendly destinations								
Family-friendly destinations score ⁵	4.9 (0.3) 4.0-5.0	4.7 (0.5) 4.0-5.0	4.7 (0.6) 2.0-5.0	4.2 (0.9) 1.0-5.0	3.9 (1.0) 1.0-5.0	2.7 (1.1) 0.0-5.0	3.8 (1.1) 1.0-5.0	2.6 (1.2) 0.0-5.0
Public open space (POS)								
Number of POS ²	15.3 (10.7) 3.0-62.0	11.0 (8.8) 0.0-68.0	5.7 (3.1) 1.0-20.0	5.8 (3.6) 0.0-22.0	3.5 (2.2) 0.0-15.0	3.5 (2.9) 0.0-20.0	5.5 (4.1) 0.0-30.0	6.5 (5.8) 0.0-37.0
Mix of POS ²	3.3 (0.9) 2.0-5.0	3.2 (1.1) 0.0-5.0	3.1 (1.0) 1.0-5.0	2.8 (1.1) 0.0-5.0	2.3 (1.0) 0.0-5.0	2.2 (1.2) 0.0-5.0	2.7 (1.1) 0.0-5.0	2.6 (1.3) 0.0-5.0
Distance to closest POS (m)	110.7 (122.4) 0.0-452.0	238.1 (170.1) 0.0-1034.0	233.6 (151.0) 0.0-793.0	278.8 (206.4) 0.0-1,839.0	345.9 (229.2) 0.0-2,917.0	352.8 (331.4) 0.0-3,070.0	276.7 (218.6) 0.0-1,447.0	298.5 (350.7) 0.0-3,169.0
Distance to closest child-friendly POS (m)	437.9 (235.9) 1.0-1,077.0	511.3 (314.4) 4.0-1,576.0	947.7 (613.7) 2.0-3,185.0	872.0 (575.0) 0.0-3,194.0	1,255.7 (795.5) 0.0-3,199.0	1,263.2 (772.3) 0.0-3,190.0	1,294.4 (841.7) 3.0-3,198.0	1,579.5 (828.1) 0.0-3,199.0

	<i>Inner city</i>		<i>Middle ring</i>		<i>Outer ring</i>		<i>Growth area</i>	
	<i>Most disadvantaged</i>	<i>Least disadvantaged</i>	<i>Most disadvantaged</i>	<i>Least disadvantaged</i>	<i>Most disadvantaged</i>	<i>Least disadvantaged</i>	<i>Most disadvantaged</i>	<i>Least disadvantaged</i>
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
	Range	Range	Range	Range	Range	Range	Range	Range
Food outlets								
Percentage of healthier food outlets ⁵	30.7 (7.6) 16.7-57.1	38.5 (9.3) 18.2-62.5	42.7 (12.7) 14.3-78.3	44.2 (12.5) 10.0-100.0	46.3 (14.8) 0.0-100.0	47.6 (28.0) 0.0-100.0	45.2 (12.7) 9.1-100.0	47.8 (20.6) 0.0-100.0
Early childhood education and care								
Number of childcare centres exceeding national standards ⁴	17.8 (5.3) 3.0-27.0	19.4 (5.7) 4.0-38.0	6.0 (4.4) 0.0-32.0	11.6 (6.3) 0.0-39.0	5.1 (2.8) 0.0-15.0	4.5 (3.3) 0.0-17.0	4.0 (2.4) 0.0-10.0	3.0 (2.2) 0.0-9.0
Distance to closest childcare centre exceeding national standards (m)	488.0 (224.5) 3.0-1,351.0	627.3 (316.6) 9.0-2,006.0	1,174.5 (750.2) 25.0-3,754.0	849.9 (460.0) 6.0-3,004.0	1,056.2 (729.6) 4.0-16,740.0	1619.6 (1,628.8) 12.0-19,302.0	1,511.1 (1,406.7) 12.0-14,903.0	2,104.5 (2,021.6) 71.0-14,002.0
Number of preschools exceeding national standards ⁴	4.4 (3.4) 1.0-15.0	6.7 (3.8) 0.0-16.0	2.2 (1.9) 0.0-10.0	5.8 (2.7) 0.0-14.0	2.8 (1.7) 0.0-10.0	2.7 (1.9) 0.0-10.0	2.5 (1.7) 0.0-8.0	1.8 (1.4) 0.0-6.0
Distance to nearest preschool exceeding national standards (m)	1,440.9 (768.6) 111.0-2,994.0	1,151.7 (705.5) 9.0-3,236.0	1,997.9 (1,084.4) 57.0-4,817.0	1,108.4 (619.8) 6.0-4,347.0	1457.1 (1,094.4) 19.0-17,595.0	1,862.7 (1,659.5) 12.0-19,302.0	1,778.0 (1,617.5) 12.0-14,903.0	2604.0 (2,715.9) 120.0-20,173.0

Key: ¹Statistical Area Level 1 (SA1); ²800m, ³1,600m, ⁴3,000m, or ⁵3,200m street network distance around child's home. Count of child-friendly POS is not available in the dataset. Q: Quintile. *Measures were calculated up to 3,200m only, therefore maximum range does not exceed 3,200m. For information on each built environment measure, see **Table 11**.

Table 14 shows the built environment associations with DV1 for 18 built environment measures in eight built environment domains. After adjustment for child/family characteristics and neighbourhood double disadvantage, more housing affordability stress (OR 1.01, 95%CrI 1.00-1.01) and children living in areas with higher walkability (OR 1.02, 95%CrI 1.01-1.04) were associated with greater odds of developmental vulnerability. Lower odds of developmental vulnerability were associated with children who were exposed to more public open space (OR 0.99, 95%CrI 0.99-1.00), a greater mix of public open space sizes (OR 0.98, 95%CrI 0.96-1.00), lived closer to child-friendly public open space (OR 1.00, 95%CrI 1.00-1.00), and had more high quality childcare centres (OR 0.99, 95%CrI 0.99-1.00) and preschools (OR 0.98, CrI 0.97-1.00) exceeding national standards.

Table 14. Built environment measures and odds of developmental vulnerability (DV1)

	Model 1 (DV1)	Model 2 (DV1)
Built environment domain and measure	OR (95% CrI)	OR (95% CrI)
Traffic		
Traffic exposure to busy roads ¹	1.11 (1.01-1.21)*	1.05 (0.96-1.15)
Housing		
Housing affordability stress ¹ (per 10%)	1.08 (1.07-1.10)***	1.05 (1.03-1.07)***
Dwelling density ³ (per 10 dwellings)	1.02 (0.98-1.06)	1.04 (0.98-1.11)
Walkability		
Local living score ³	1.00 (0.99-1.01)	1.01 (0.99-1.02)
Walkability score ³	1.02 (1.01-1.03)**	1.02 (1.01-1.04)**
Public transport		
Number of public transport stops with frequent weekday service ³	1.00 (1.00-1.00)	1.00 (1.00-1.00)
Distance to closest public transport stop with frequent service (per 100m)	1.00 (1.00-1.00)	1.00 (1.00-1.00)
Family-friendly destinations		
Family-friendly destinations score ⁵	1.00 (0.98-1.03)	1.02 (0.99-1.05)
Public open space (POS)		
Number of POS in 800m ²	1.00 (0.99-1.00)*	0.99 (0.99-1.00)*
Mix of POS ²	0.98 (0.96-1.00)	0.98 (0.96-1.00)*
Distance to closest POS (m) (per 100m)	1.00 (0.99-1.01)	1.00 (0.99-1.01)

	Model 1 (DV1)	Model 2 (DV1)
Built environment domain and measure	OR (95% CrI)	OR (95% CrI)
Distance to closest child-friendly POS (m) (per 100m)	1.01 (1.00-1.01)***	1.00 (0.99-1.00)*
Presence of child-friendly POS in 800m	0.92 (0.87-0.97)**	0.96 (0.90-1.01)
Food outlets		
Percentage of healthier food outlets ⁵ (per 10%)	1.00 (0.98-1.01)	1.00 (0.98-1.01)
Early childhood education and care		
Number of childcare centres exceeding national standards ⁴	0.99 (0.98-0.99)***	0.99 (0.99-1.00)*
Distance to closest childcare centre exceeding national standards (per 100m)	1.00 (1.00-1.00)	1.00 (1.00-1.00)
Number of preschools exceeding national standards ⁴	0.96 (0.95-0.97)***	0.98 (0.97-1.00)**
Distance to closest preschool exceeding national standards (per 100m)	1.00 (1.00-1.00)*	1.00 (1.00-1.00)

Key: ¹Spatial unit is Statistical Area Level 1 (SA1); ² 800m, ³1,600m, ⁴3,000m, or ⁵3,200m street network distance around child's home. Count of child-friendly POS is not available in the dataset. For information on each built environment measure, see **Table 11**. DV1: Developmentally vulnerable on one or more AEDC domains. CrI = credible intervals; m = metres; OR = odds ratios. Model 1: Built environment plus child/family variables: child sex, child age group, child language background other than English, child Indigenous status, maternal education. Model 2: Model 1 plus adjustment for neighbourhood double disadvantage. See **Table 1** for variable descriptions. All adjustment variables significant with DV1 at p<0.001. ***Statistically significant at p<0.001; **p<0.01; *p<0.05.

Table 2 earlier summarised the main effects (Models 1 and 2) and interaction effects (Model 3) for built environment associations with DV1 for the 18 built environment measures. We wanted to investigate whether the association between the built environment measure and developmental vulnerability differed depending on the level of (category) neighbourhood double disadvantage (Model 3). Associations between the built environment measures and DV1 varied by neighbourhood double disadvantage level for almost all measures except for distance to closest public open space and percentage of healthy food outlets. For the other built environment measures tested, the association with DV1 is different for some levels of neighbourhood double disadvantage (e.g., the effect could be greater or less in some areas, or the association is in a different direction). The built environment and neighbourhood double disadvantage interaction results (**Model 3**) are presented in more detail as graphs, one graph for each built environment measure. Associations are further summarised visually in **Figure 2**. Red cells = no significant interaction, green cells = significant interaction.

	Q5 (least disadvantaged)				Q4				Q3				Q2				Q1 (most disadvantaged)			
Built environment domain and measure	Inner	Middle	Outer	Growth	Inner	Middle	Outer	Growth	Inner	Middle	Outer	Growth	Inner	Middle	Outer	Growth	Inner	Middle	Outer	Growth
Traffic																				
Traffic exposure to busy roads ¹																				
Housing																				
Housing affordability stress ¹ (per 10%)																				
Dwelling density ³ (per 10 dwellings)																				
Walkability																				
Local living score ³																				
Walkability score ³																				
Public transport																				
Number of public transport stops with frequent weekday service ³																				
Distance to closest public transport stop with frequent service (per 100m)																				
Family-friendly destinations																				
Family-friendly destinations score ⁵																				
Public open space																				
Number of public open space in 800m ²																				
Mix of public open space ²																				
Distance to closest public open space (m) (per 100m)																				
Distance to closest child-friendly POS (m) (per 100m)																				
Presence of child-friendly POS in 800m																				
Food outlets																				
Percentage of healthier food outlets ⁵ (per 10%)																				
Early childhood education and care																				
Number of childcare centres exceeding national standards ⁴																				
Distance to closest childcare centre exceeding national standards (per 100m)																				
Number of preschools exceeding national standards ⁴																				
Distance to closest preschool exceeding national standards (per 100m)																				

Figure 2. Visual summary of built environment and neighbourhood double disadvantage interactions

Key: ¹Spatial unit is Statistical Area Level 1 (SA1); ² 800m, ³1,600m, ⁴3,000m, or ⁵3,200m street network distance around child's home. For information on each built environment measure, see **Table 11**. Red cell=not significantly associated with developmental vulnerability (DV1) at p<0.05. Green cell=significantly associated with developmental vulnerability (DV1) at p<0.05.

2.5.1 Traffic

Traffic exposure was not significantly associated with developmental vulnerability in the final model (Model 2). There was a significant interaction by neighbourhood double disadvantage for growth area Q2 (**Figure 3**).

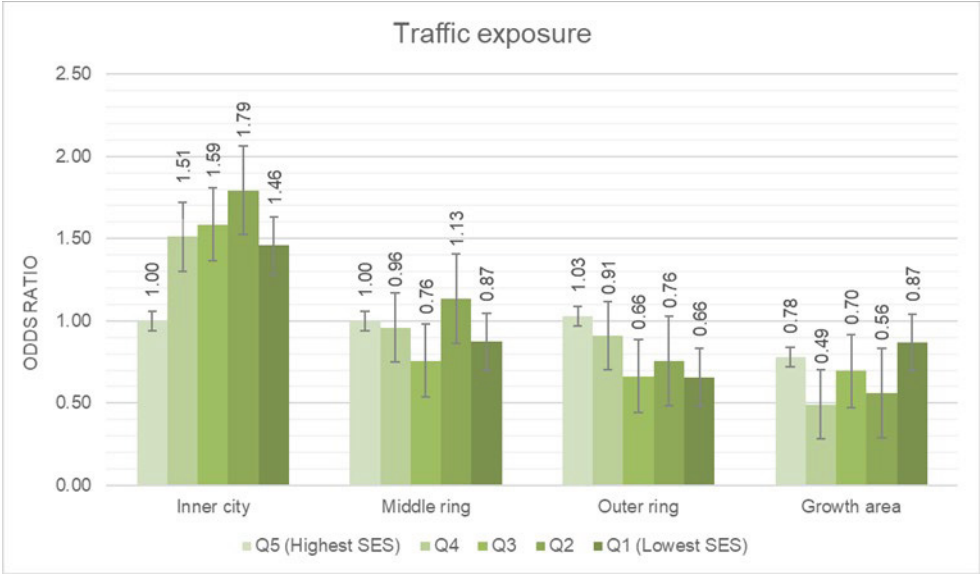


Figure 3. Traffic exposure and developmental vulnerability by neighbourhood double disadvantage

Key: Q=Quintile. SES= Socio-economic status. Lowest SES=most disadvantaged. Highest SES=least disadvantaged.



2.5.2 Housing

A 10% increase in the proportion of people in an SA1 under housing affordability stress was associated with a 5% increase in the odds of developmental vulnerability (OR 1.05, CrI 1.03-1.07). This association differed for some levels of neighbourhood double disadvantage (**Figure 4**). Compared with children living in the least disadvantaged inner city areas, children living in the most disadvantaged growth area (OR 1.01, 95%CrI 1.00-1.03) and middle disadvantaged (Q3) outer ring areas (OR 1.02, CrI 1.01-1.03) had higher odds of developmental vulnerability.



Figure 4. Housing affordability and developmental vulnerability by neighbourhood double disadvantage

Key: Q=Quintile. Per 10% unit increase in housing affordability. SES=Socio-economic status. Lowest SES = most disadvantaged. Highest SES=least disadvantaged.

Overall, dwelling density was not associated with DV1 (OR 1.04, 95%CrI 0.98-1.11) (**Table 14**). The interaction results show mixed findings (**Figure 5**); dwelling density is positively associated with DV1 in some levels of neighbourhood double disadvantage but negatively associated with DV1 in other areas. For example, children living in the most disadvantaged inner city areas are at greater odds of being developmentally

vulnerable, but the opposite occurs for children living in the most disadvantaged middle and outer ring areas; children in these areas are at reduced odds of DV1 compared with children in the least disadvantaged inner city.

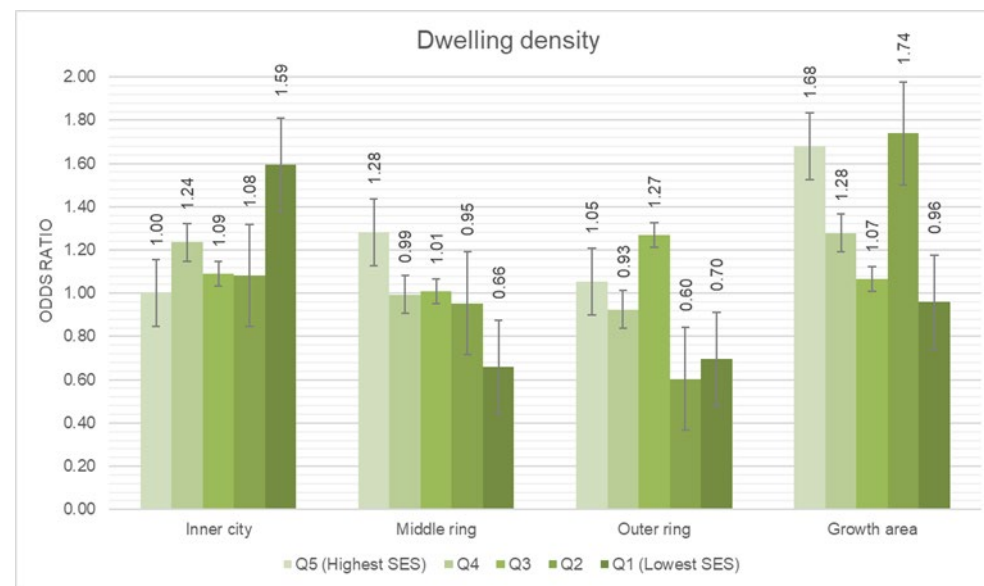


Figure 5. Dwelling density and developmental vulnerability by neighbourhood double disadvantage

Key: Q=Quintile. Per 10 unit increase in dwelling density. SES=Socio-economic status. Lowest SES=most disadvantaged. Highest SES=least disadvantaged.

2.5.3 Walkability

The local living score was not associated with DV1 overall (OR 1.01, 95%CrI 0.99-1.02) (**Table 14**). The interaction results point to potential differences by neighbourhood double disadvantage. A one-unit increase in local living score (i.e., one extra destination) increases the odds of DV1 by more than twice in the most disadvantaged inner city areas, compared with the least disadvantaged inner city areas (**Figure 6**).



Figure 6. Local living score and developmental vulnerability by neighbourhood double disadvantage

Key: Q=Quintile. SES=Socio-economic status. Lowest SES=most disadvantaged. Highest SES=least disadvantaged.

Overall, walkability was associated with DV1; a one unit increase in the walkability score was associated with 2% greater odds of developmental vulnerability (**Table 14**). The interaction results show differences by neighbourhood double disadvantage. The effect size of the association increases for more disadvantaged quintiles. For example, the association is greater for children living in the most disadvantaged inner

city areas, who are at greater odds of developmental vulnerability compared with those living in the least disadvantaged inner city (OR 1.30, 95%CrI 1.10-1.54) (**Figure 7**).

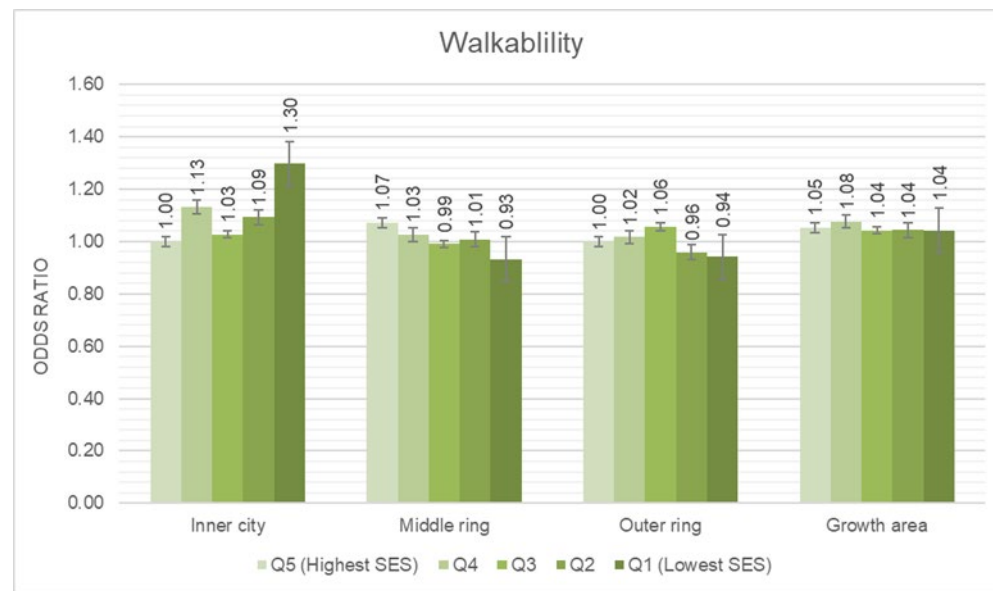


Figure 7. Walkability and developmental vulnerability by neighbourhood double disadvantage

Key: Q=Quintile. SES=Socio-economic status. Lowest SES=most disadvantaged. Highest SES=least disadvantaged.

2.5.4 Public transport

Overall, the count of public transport stops was not associated with DV1 (Table 14), but the interaction results show slight marginal effects (Figure 8). Compared with children living in the least disadvantaged inner city areas, children living in the most disadvantaged inner city areas were marginally at greater odds of developmental vulnerability (OR 1.01, 95%CrI 1.01-1.02). This trend was also present for children living in growth areas at neighbourhood disadvantage quintiles 1-4.

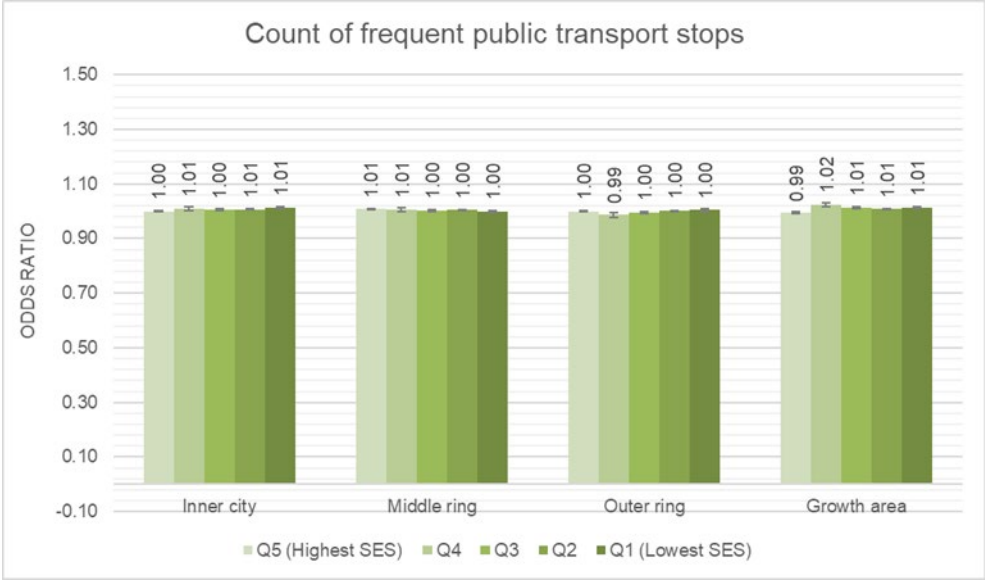


Figure 8. Frequent public transport and developmental vulnerability by neighbourhood double disadvantage

Key: Q=Quintile. SES=Socio-economic status. Lowest SES=most disadvantaged. Highest SES=least disadvantaged.

Distance to the closest public transport stop with a frequent service was not associated with DV1 (Table 14). The interaction results (Figure 9) show differences by neighbourhood disadvantage quintile within the inner city areas; developmental vulnerability decreased with each step down in neighbourhood disadvantage. For example, a 100m increase in distance to the closest public transport stop (further away) was associated with lower odds of developmental vulnerability in Q4 (OR

0.89, 95%CrI 0.76-1.03), Q3 (OR 0.72, 95%CrI 0.54-0.91), and Q2 (OR 0.49, 95%CrI 0.2-0.88).



Figure 9. Closest distance to frequent public transport and developmental vulnerability by neighbourhood double disadvantage

Key: Q=Quintile. Per 100m unit increase in distance to public transport. SES=Socio-economic status. Lowest SES=most disadvantaged. Highest SES=least disadvantaged.

2.5.5 Family-friendly destinations

Family-friendly destination scores were not associated with DV1 (Table 14). For middle ring, outer ring, and growth areas Q1 (most disadvantaged) to Q4 (less disadvantaged), there were lower odds of DV1 with each destination increase in the family-friendly destinations score (Figure 10). While not significant, the inner city results show the reverse trend; developmental vulnerability increases with each extra family-friendly destination present.

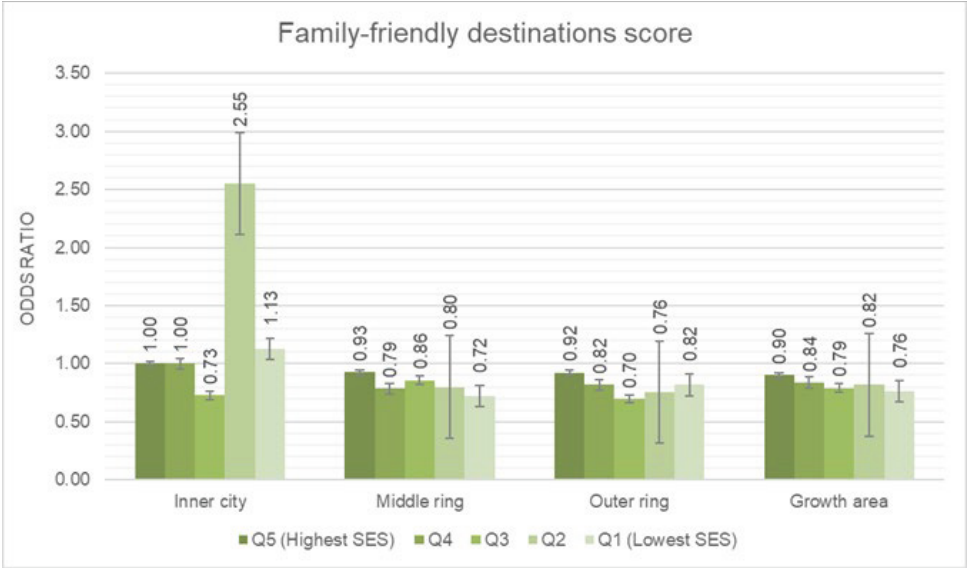


Figure 10. Family-friendly destinations score and developmental vulnerability by neighbourhood double disadvantage

Key: Q=Quintile. SES=Socio-economic status. Lowest SES=most disadvantaged. Highest SES=least disadvantaged.



2.5.6 Public open space

One extra public open space within a child’s 800m neighbourhood was associated with 1% reduced odds in DV1 (OR 0.99, 95%CrI 0.99-1.00) (**Table 14**). The interaction results (**Figure 11**) reveal differences by the level of neighbourhood double disadvantage. For the most disadvantaged areas, children living in the inner city and middle ring had lower odds of DV1 (3% and 6%, respectively) compared with those living in the least disadvantaged inner city areas. For children living in the least disadvantaged areas, children living in the middle and growth area suburbs had 3% lower odds of developmental vulnerability than their inner city counterparts.

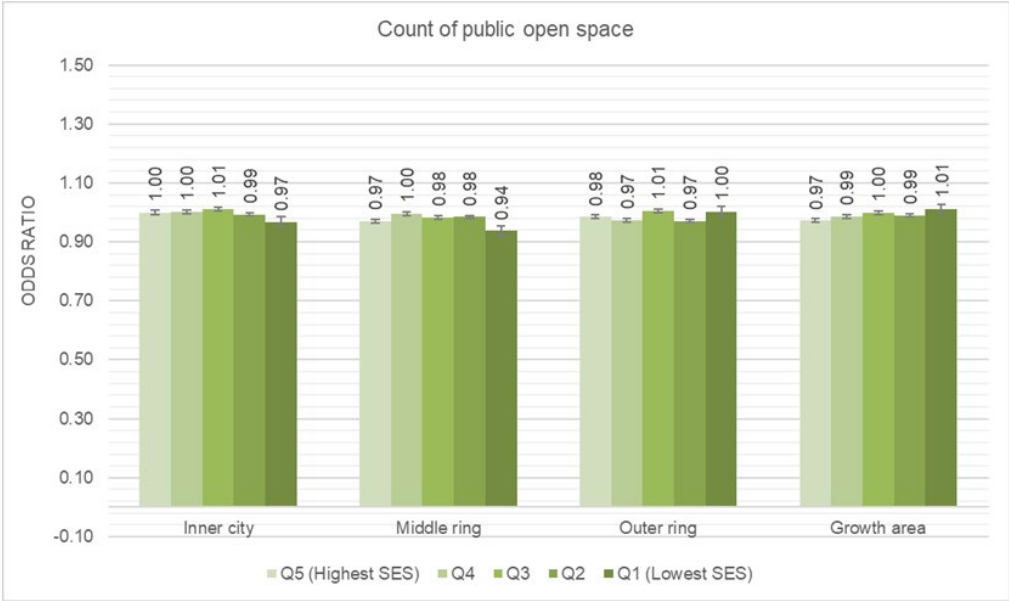


Figure 11. Count of public open space and developmental vulnerability by neighbourhood double disadvantage

Key: Q=Quintile. SES=Socio-economic status. Lowest SES=most disadvantaged. Highest SES=least disadvantaged.

Overall distance to the closest public open space was not associated with DV1 (**Table 14**). There were no significant differences by neighbourhood double disadvantage (**Figure 12**).

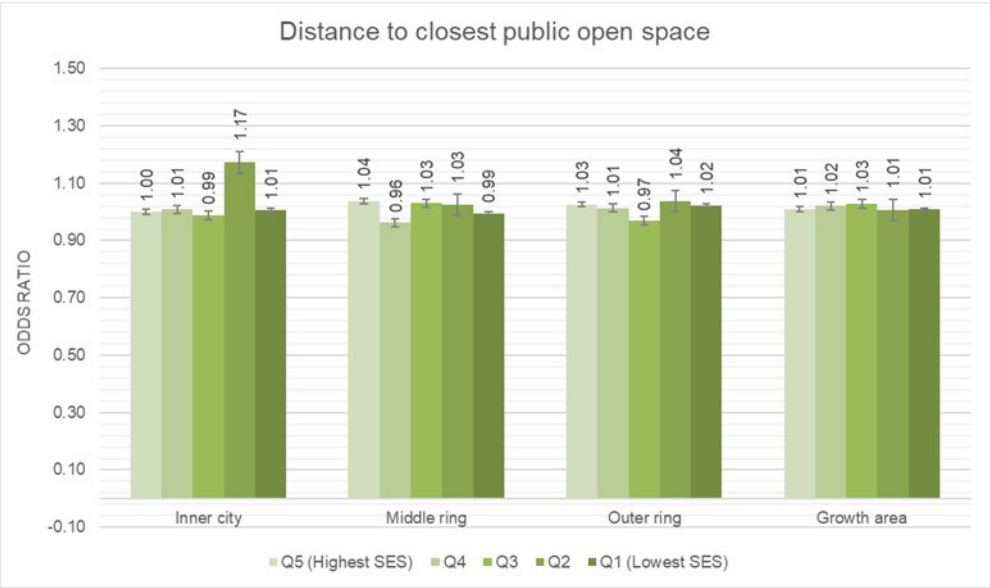


Figure 12. Distance to closest public open space and developmental vulnerability by neighbourhood double disadvantage

Key: Q=Quintile. Per 100m unit increase in distance to public open space. SES=Socio-economic status. Lowest SES=most disadvantaged. Highest SES=least disadvantaged.

A greater mix of public open space (i.e., different-sized public open spaces) within 800m of a child’s home was associated with a 2% decrease in DV1 (**Table 14**). The results were significant for most levels of neighbourhood double disadvantage, and the findings show larger effect sizes for most neighbourhood double disadvantage categories.

For example, compared with those living in the least disadvantaged inner city areas, a greater mix of public open space was associated with almost 20% lower odds of developmental vulnerability for children living in growth areas across all neighbourhood disadvantage quintiles. Children living in the most disadvantaged inner city areas had 37% reduced odds of developmental vulnerability if they were exposed to a greater mix of public open space types (**Figure 13**).

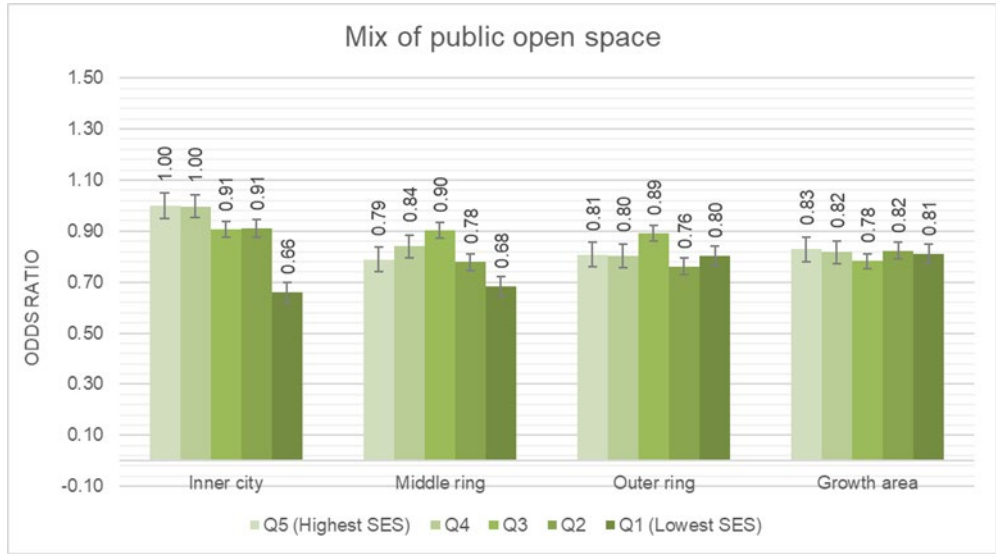


Figure 13. Mix of public open space and developmental vulnerability by neighbourhood double disadvantage

Key: Q=Quintile. SES=Socio-economic status. Lowest SES=most disadvantaged. Highest SES=least disadvantaged.

Overall, a child-friendly public open space (toilet and playground) was associated with a 4% decrease in odds of DV1 (**Table 14**). The interaction results also show differences by neighbourhood double disadvantage area (**Figure 14**). Compared with children living in the least disadvantaged inner city areas, those living in middle ring, outer ring, and growth area suburbs generally had lower odds of developmental vulnerability if they had a public open space with a playground and a toilet. This association was reversed for three inner city neighbourhood disadvantage quintiles (Q2, 3, and 4); a child-friendly POS increased the odds of children’s developmental vulnerability in these areas.

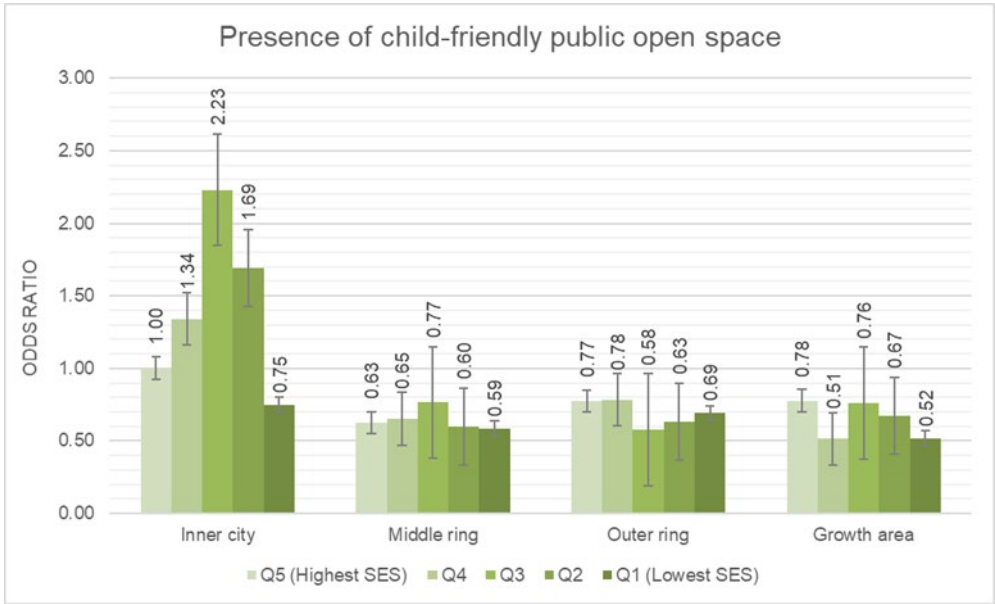


Figure 14. Presence of child-friendly public open space and developmental vulnerability by neighbourhood double disadvantage

Key: Q=Quintile. SES=Socio-economic status. Lowest SES=most disadvantaged. Highest SES=least disadvantaged.

Overall, children living further away from a child-friendly public open space were at slightly increased odds of DV1, but the effect size was marginal (OR 1.00, 95%CrI 0.99-1.00) (Table 14). Compared with children in the least disadvantaged inner city areas, children living in middle ring, outer ring, and growth areas at almost all neighbourhood disadvantage quintiles had 4-8% greater odds of developmental vulnerability for living every 100m further away from a child-friendly public open space (Figure 15).

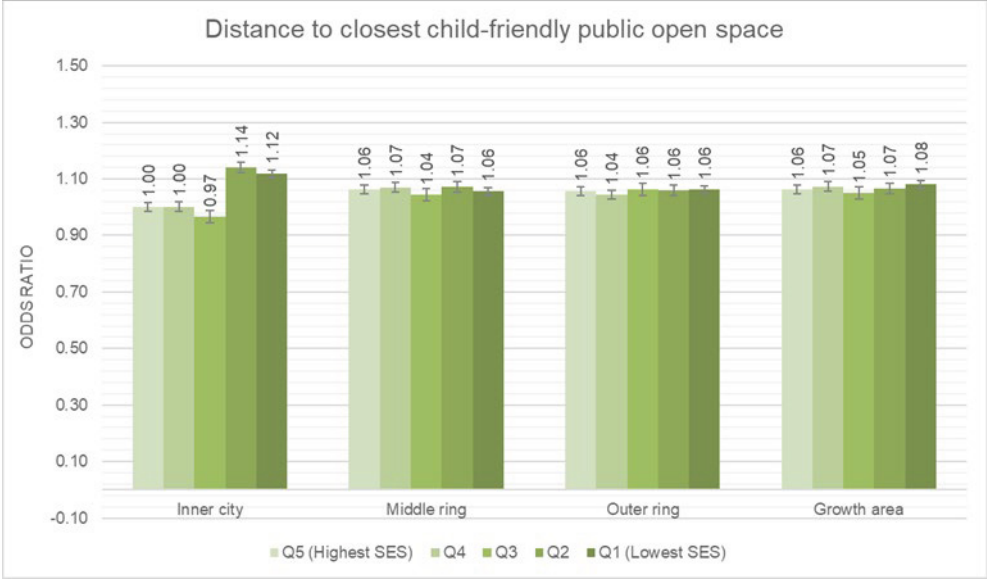


Figure 15. Distance to closest child-friendly public open space and developmental vulnerability by neighbourhood double disadvantage

Key: Q=Quintile. Per 100m unit increase in distance to child-friendly public open space.
SES=Socio-economic status. Lowest SES=most disadvantaged. Highest SES=least disadvantaged.



2.5.7 Food outlets

The percentage of healthy food outlets available locally was not significantly related to developmental vulnerability overall (**Table 14**). There appeared to be no differences by neighbourhood double disadvantage area (**Figure 16**). While not significant, children living in middle ring, outer ring, and growth areas had lower odds of DV1 (compared to children living in the least disadvantaged inner city) for every 10% increase in healthy food outlets within 3200m of their home.

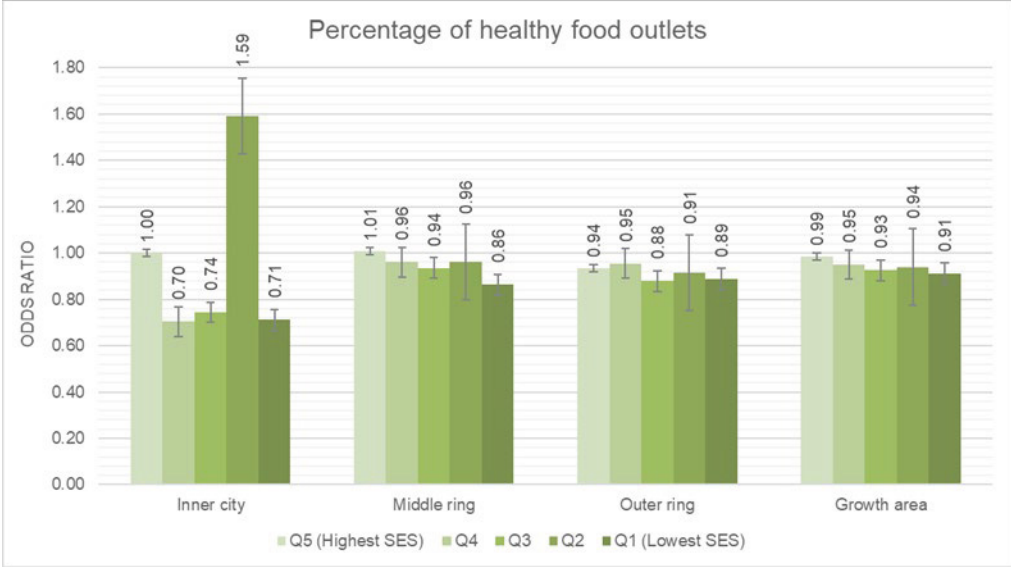


Figure 16. Percentage of healthy food outlets and developmental vulnerability by neighbourhood double disadvantage

Key: Q=Quintile. Per 10% unit increase in healthy food outlets. SES=Socio-economic status. Lowest SES=most disadvantaged. Highest SES=least disadvantaged.



2.5.8 Early childhood education and care

Overall, for every childcare centre within 3km that had an exceeding national standard rating, children had 1% lower odds of DV1 (**Table 14**). The interaction results showed a social gradient in the opposite direction for inner city children; those living in the most disadvantaged inner city areas had 8% higher odds of developmental vulnerability for every additional high quality childcare centre present (**Figure 17**) compared with children living in the least disadvantaged inner city areas.

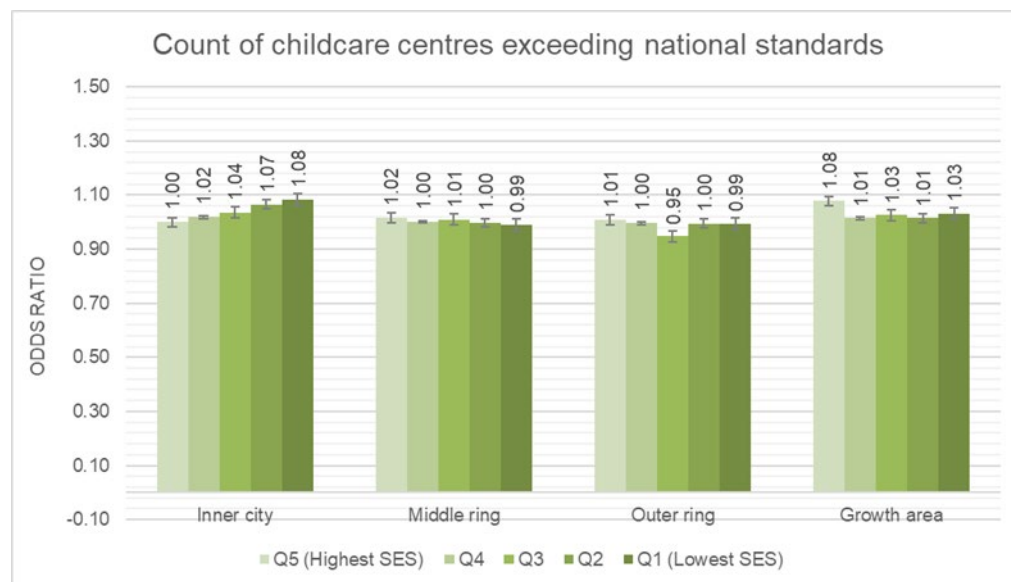


Figure 17. Count of quality early childhood education and care centres and developmental vulnerability by neighbourhood double disadvantage

Key: Q=Quintile. SES=Socio-economic status. Lowest SES=most disadvantaged. Highest SES=least disadvantaged.

Distance to the closest childcare with an exceeding national standard rating was not associated with DV1 (**Table 14**). The interaction results show marginal significant differences for children living in middle ring, outer ring, and growth area suburbs at all quintiles, but not for inner city children (**Figure 18**). Every additional local childcare centre exceeding national standards present was associated with a 1-5% decrease in DV1.

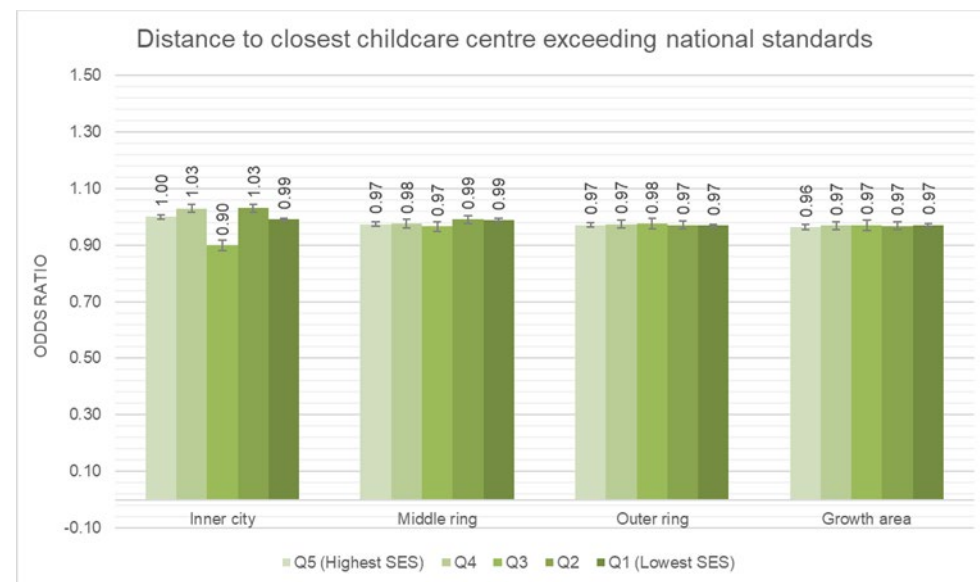


Figure 18. Distance to closest quality early childhood education and care centres and developmental vulnerability by neighbourhood double disadvantage

Key: Q=Quintile. Per 100m unit increase in distance to childcare centre exceeding national standards. SES=Socio-economic status. Lowest SES=most disadvantaged. Highest SES=least disadvantaged.



Overall, every additional preschool located within 3km with an exceeding national standard rating was associated with 2% lower odds of DV1 (**Table 14**). The interaction results showed potentially counterintuitive results. For example, children living in the most disadvantaged inner city and growth areas had higher odds of DV1 (compared with least disadvantaged inner city children) if they had more high quality preschools in their area, and this association was also present for children in the least disadvantaged growth areas (**Figure 19**).

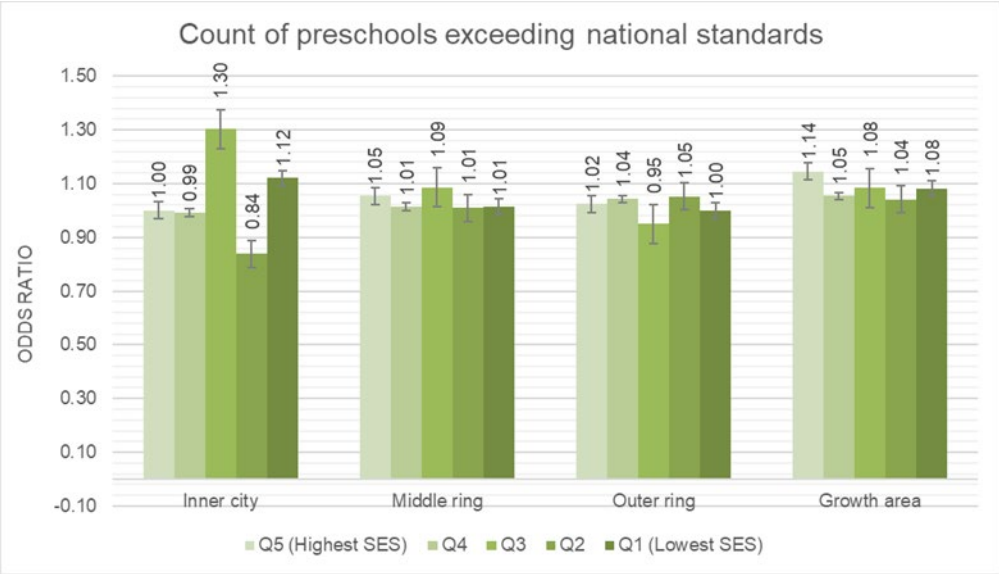


Figure 19. Count of quality preschools and developmental vulnerability by neighbourhood double disadvantage

Key: Q=Quintile. SES=Socio-economic status. Lowest SES=most disadvantaged. Highest SES=least disadvantaged.

Distance to the closest preschool with an exceeding national standard rating was not associated with DV1 (**Table 12**). The interaction results show marginal significant differences for children living in the most disadvantaged and middle disadvantaged (Q3) inner city; they were at 3-7% reduced odds of developmental vulnerability compared with children living in the least disadvantaged inner city areas (**Figure 20**).

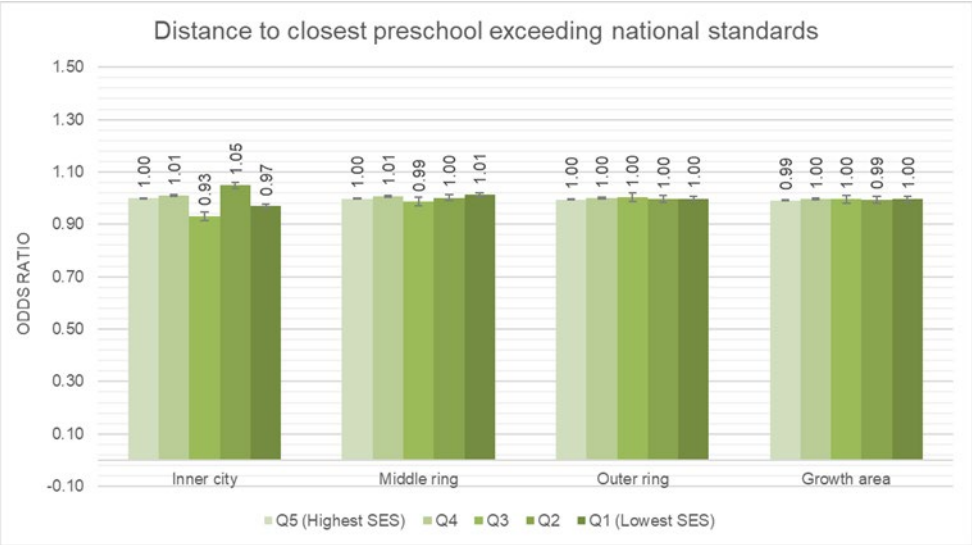
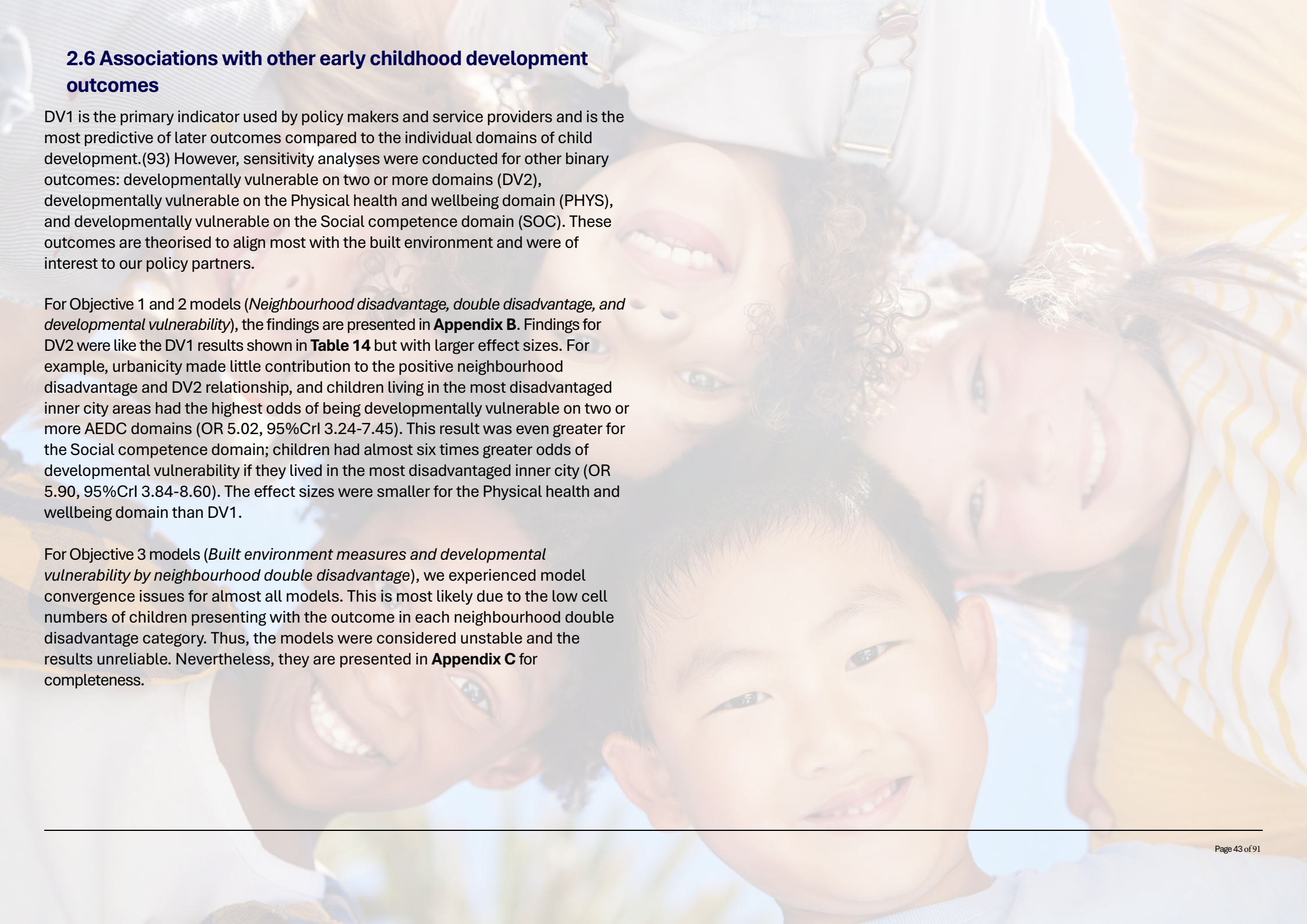


Figure 20. Distance to closest quality preschool and developmental vulnerability by neighbourhood double disadvantage

Key: Q=Quintile. Per 100m unit increase in distance to preschool exceeding national standards. SES=Socio-economic status. Lowest SES=most disadvantaged. Highest SES=least disadvantaged.

A group of diverse young children, including a girl with curly hair and a boy with short dark hair, are smiling and looking upwards. A hand is gently touching their heads. The background is a soft, out-of-focus blue and white.

2.6 Associations with other early childhood development outcomes

DV1 is the primary indicator used by policy makers and service providers and is the most predictive of later outcomes compared to the individual domains of child development.(93) However, sensitivity analyses were conducted for other binary outcomes: developmentally vulnerable on two or more domains (DV2), developmentally vulnerable on the Physical health and wellbeing domain (PHYS), and developmentally vulnerable on the Social competence domain (SOC). These outcomes are theorised to align most with the built environment and were of interest to our policy partners.

For Objective 1 and 2 models (*Neighbourhood disadvantage, double disadvantage, and developmental vulnerability*), the findings are presented in **Appendix B**. Findings for DV2 were like the DV1 results shown in **Table 14** but with larger effect sizes. For example, urbanicity made little contribution to the positive neighbourhood disadvantage and DV2 relationship, and children living in the most disadvantaged inner city areas had the highest odds of being developmentally vulnerable on two or more AEDC domains (OR 5.02, 95%CrI 3.24-7.45). This result was even greater for the Social competence domain; children had almost six times greater odds of developmental vulnerability if they lived in the most disadvantaged inner city (OR 5.90, 95%CrI 3.84-8.60). The effect sizes were smaller for the Physical health and wellbeing domain than DV1.

For Objective 3 models (*Built environment measures and developmental vulnerability by neighbourhood double disadvantage*), we experienced model convergence issues for almost all models. This is most likely due to the low cell numbers of children presenting with the outcome in each neighbourhood double disadvantage category. Thus, the models were considered unstable and the results unreliable. Nevertheless, they are presented in **Appendix C** for completeness.

Part 3 Lived experiences of families in growth areas

3.1 Overview

What did we do?

Between September 2023 and June 2024, we conducted one face-to-face focus group and two online interviews with primary caregivers/parents of children aged 0-8 years living in the growth area of Cardinia Shire, located on the urban fringe of Melbourne. Participants were asked about their experiences living in their local neighbourhoods and neighbourhood built environment features such as availability and access to services, crime and safety, and traffic exposure.

Consenting participants also completed a 10–20-minute online PPGIS (mapping) activity in their own time or at the beginning of the same focus group/interview session. The PPGIS activity asked about the important places for their child's development, perceptions about their local neighbourhoods' availability and access to local family-friendly places, safety and attractiveness, and household characteristics.

Analysis

We sought to identify important neighbourhood built environment factors for families with young children living in growth area suburbs. Themes were considered important if a participant mentioned its importance, it was discussed at length by participants, or several participants indicated it was important. The PPGIS activity was exported for descriptive statistics only. Seven participants completed an interview and/or participated in a focus group. Five participants had useable Maptionnaire data.

What did we find?

- Twelve main themes under five built environment domains were considered important for children's health, development, and wellbeing: Housing, public open space, family-friendly destinations and services, early childhood education and care services, and connectivity (**Table 15**).
- High-quality destinations and services were particularly important for families with young children.
- Walkability was not a major consideration in the decision to use destinations or services if they were accessible within 15-30 minutes by car.



Table 15. Perceived built environment themes important for young children’s development

Built environment domain	Theme	Description
1 Housing		
a	Lot size	Housing in new estates within growth areas is perceived to be on smaller lot sizes (200-350m ²), which limits back/front yard size and internal space for organising family life, e.g., room for play and toy storage. Participants reflected on the limited private space for children. However, there were mixed preferences on desires to upsize or downsize homes.
b	Housing affordability	The rising cost of living and housing prices influence families’ decisions, with respondents reflecting on how they can no longer afford to buy into certain areas or are locked into their current housing situation due to financial constraints.
2 Public open space		
a	Variety of accessible (walkable) high-quality public open space	Many high-quality public open spaces within walking distance.
b	Natural elements	Preference for spaces that encourage imaginative, nature-based play (e.g., rocks, sand, and gardens). Creeks and lakes support deeper connections to nature.
c	Improved quality in some park features	Playgrounds are generally well-equipped, but some lack adequate shade and toilets (issues noted with sun exposure and toilet training).
3 Family-friendly destinations and services		
a	Libraries	Libraries offer a range of activities for families with young children (e.g., Rhyme time), and there was a desire for more libraries in the area.
b	Parent groups	First-time parent groups, Mums-only groups, both parent groups, Dads groups and broader parenting groups open to parents with multiple children. There appear to be numerous parent groups that are regularly held (e.g., weekly) to support parenting topics and facilitate social connection.
b	Playgroups	Playgroups were important for supporting children’s play and development needs, and social interaction.
d	Community services supporting family wellbeing	Community and social work services support families facing disadvantage, including those affected by family violence, or other emergencies.
4 Early childhood education and care services		
a	Limited availability	There is a shortage of childcare centres in areas (e.g., in Officer), forcing parents to drive to Beaconsfield and Pakenham.
b	Service quality and accessibility	Financial barriers (expensive), Long waitlists, limited operating hours, inconsistent service quality, staffing issues, and delay in receiving Council information about kindergarten enrolments.
5 Connectivity		
a	Walkability vs. accessibility	‘Accessible’ places in terms of geographic connectivity were those perceived to be within a 30-minute drive. Walkable places were those up to 20 minutes away, but participants did not seem concerned about whether destinations were within walking distance.

3.2 Methods

Community of interest

We wanted to explore the lived experiences of families with young children living in Cardinia Shire, which is in a ‘growth’ area on the outskirts of Melbourne, Victoria (**Table 16**). Participants from this area were purposively invited to participate in the study based on project partnership and an established relationship in another project.

Table 16. Cardinia Shire population characteristics

Information about the LGA	Cardinia Shire	Victoria
State	Victoria	N/A
Geographical location	Metropolitan zone	N/A
Disadvantage indicator: SEIFA-IRSD decile for LGA (ranking within Australia) ²	8	N/A
Median age of residents (years) ²	34	38
Households where a non-English language is used (%) ²	19.8	30.2
Population	118,194	6,503,491
Average number of people per household	2.8	2.5
Average number of children per family (for families with children)	1.9	1.8
Families with children (%)	50.1	45.5
Children with median age 0-9 years (%) ²	0 - 4 = 7.7 5 - 9 = 7.9	0 - 4 = 5.8 5 - 9 = 6.2
Aboriginal and Torres Strait Islander status (%)	1.0	1.0
Average number of motor vehicles per dwelling	2.1	1.8

Key: LGA: Local Government Area. ¹Source: Rural, Remote, and Metropolitan Area (RRMA) classification (Australian Government, 2023). ²2021 Australian Bureau of Statistics Census data (Australian Bureau of Statistics, 2023). SEIFA-IRSD: Socio-Economic Indexes for Australia (SEIFA) Index of Relative Socio-Economic Disadvantage (IRSD). LGA (Local Government Area). SEIFA-IRSD deciles: 1-10, with 1 being the most disadvantaged LGA decile (54).

Participant recruitment

A one-page flyer promoting the project was developed and distributed to:

- Local spaces in the local government area: recreation centres, community centres, shopping centres, libraries, and early learning spaces.
- Online via social media (e.g., Facebook posts on local community groups and professional LinkedIn networks).
- E-mail to multicultural groups, Maternal Child Health Centres, and supported playgroups, with the assistance of local government professionals.
- Local ECEC services and primary schools distributed the flyer to families attending their services via Compass (school app) and other school communications (e.g., newsletters, bulletin board).
- A snowball sampling technique was also used to purposively recruit participants from Cardinia Shire. Participants were asked to recommend other potentially interested families.

Participant eligibility

Participants received a project information sheet (plain language statement) and consent form and were deemed eligible if they met three criteria: 1) were over 18 years of age; 2) a primary caregiver (parent) of at least one child aged 0-8 years of age; and: 3) lived in the suburb for at least six months.

Data collection

Between September 2023 and June 2024, we conducted one face-to-face focus group and two online semi-structured interviews (MS Teams) with primary caregivers of children aged 0-8. The focus group was conducted in a supported playgroup setting with five mothers. Interviews took place where a focus group could not be organised in time, or the parent preferred an interview setting.

Before data collection, participants were sent the focus group/interview guide. The focus group and interviews commenced with a brief statement about the project aims. The questions were open-ended, and the duration ranged from 40 minutes to 1.5 hours. Participants were asked about their experiences living in their local

neighbourhoods relevant to neighbourhood built environment domains e.g., availability and access, crime and safety, and traffic exposure.

If they consented, they also completed a 10–20-minute online mapping activity (Maptionnaire) in their own time or at the beginning of the same focus group/interview session. The activity asked about the important places for their child's development, perceptions about their local neighbourhoods' availability and access to local family-friendly places, safety and attractiveness, and household characteristics.

Focus groups and interviews were audio recorded, and participants provided informed written and verbal consent. For their time and input, participants were offered a supermarket gift card. They were also offered a further chance to win one of 10 supermarket gift cards for completing the online mapping activity.

Data preparation

The focus group and interviews were transcribed verbatim using an Australian transcription service (OutScribe transcription) and MS Teams, respectively. The researcher checked all transcripts for accuracy by listening to the audio and correcting transcript errors. Transcripts were imported into QSR International's NVivo for coding, a software designed to assist with organising and coding qualitative data. Maptionnaire data were imported from Excel format into Stata v18 for descriptive statistics analysis.

Data analysis

Interview and focus group data: Seven participants completed an interview and/or participated in a focus group. Coding and analysis were guided by an existing framework (16), including a recently published framework based on a review of the built environment on early childhood development through an equity lens. (26)

Data were analysed using a mixed deductive and inductive approach. The analysis sought to identify important neighbourhood built environment factors for families with young children living in growth area suburbs. Themes were considered important if a participant mentioned it was important, it was discussed at length by participants, or several participants indicated it was important.

PPGIS (Maptionnaire) data: Descriptive statistics of the Maptionnaire responses are presented in the next section to describe 1) participants' perceptions of their neighbourhood and 2) participants' views of important places for their child's development, health, and wellbeing. Five participants had useable Maptionnaire data.

Challenges and learnings

Challenges and learnings from the qualitative participatory component are presented in **Part 4**.



3.3 Sample characteristics

The findings are based on participants who completed the Maptionnaire activity and an interview or focus group. Eight participants completed the Maptionnaire activity (3 'online' and 5 face-to-face in a focus group setting). One participant was excluded from the analyses because they did not complete a focus group or interview. Two participants experienced technical difficulties with Maptionnaire and poor internet connections, and unfortunately, their data were not recorded in the system. However, their views could not be removed from the focus group due to a group setting discussion. Thus, five participants have both interview/focus group and Maptionnaire data. All participants were female, owned at least one car, and had a private garden (Table 17).

Table 17. Participant sample characteristics

Characteristic	(Participants)* n (%)
Gender	
Female	5 (83.3)
Age Group (years)	
25-34	3 (50.0)
35-44	2 (33.3)
No. Children 0-8 years in Household	
1	1 (16.7)
2	4 (66.7)
Missing	
No. Children 9-18 years in Household	
0	4 (66.7)
1	0 (0.0)
2	1 (16.7)
Gender of 0-8 year old child with most recent birthday	
Female	4 (66.7)
Male	1 (16.7)
Highest level of parent education	
Bachelor degree or higher	4 (66.7)
Year 12 or equivalent	1 (16.7)
Employment status	
Full-time	1 (16.7)
Part-time/Casual	1 (16.7)

Characteristic	(Participants)* n (%)
Other [#]	1 (16.7)
Unemployed and not seeking work	1 (16.7)
Unemployed and seeking work	1 (16.7)
Length of residence in suburb	
6 months – 1 year	1 (16.7)
1 - 5 years	3 (50.0)
6 – 10 years	1 (16.7)
Housing type	
Separate house	5 (83.3)
Household Structure	
Single parent/caregiver	1 (16.7)
Two or more parents/caregivers cohabit	4 (66.7)
Car ownership	
One car	2 (33.3)
>One car	3 (50.0)
Dog ownership	
Yes	2 (33.3)
Private garden	
Yes	5 (83.3)

Key and notes: *1 person did not provide demographic information. 2 people had technical difficulties, and their data were not saved in the system. [#]On full-time maternity leave.

3.4 PPGIS survey findings

3.4.1 General neighbourhood perceptions

When asked about the degree to which they agreed or disagreed with 35 statements about their neighbourhood (**Table 18**), all participants agreed that their neighbourhood was a good neighbourhood to bring up young children. This included agreeing to good quality parks and other play areas for children. Participants perceived that community, local government, and commercial organisations could be trusted. While all participants agreed that it was safe for their children to play outside during the day, most participants perceived high levels of petty and major crime and traffic in their neighbourhood. Responses to perceived affordable housing were mixed, with half in agreement and the rest in disagreement.

Table 18. Neighbourhood perceptions of growth area participants

	Statement	Strongly disagree n (%)	Disagree n (%)	Agree n (%)	Strongly agree n (%)	Unsure n (%)
Places and services						
1	There are places for children to play in this neighbourhood	0 (0.0)	0 (0.0)	2 (33.3)	3 (50.0)	0 (0.0)
2	There are good parks, playgrounds and play spaces in this neighbourhood	0 (0.0)	0 (0.0)	2 (33.3)	3 (50.0)	0 (0.0)
3	There is access to close, regular transport in this neighbourhood	1 (16.7)	0 (0.0)	1 (16.7)	2 (33.3)	1 (16.7)
4	There is access to basic shopping facilities in this neighbourhood	1 (16.7)	0 (0.0)	0 (0.0)	4 (66.7)	0 (0.0)
5	There is access to healthy food in this neighbourhood	0 (0.0)	1 (16.7)	2 (33.3)	2 (33.3)	0 (0.0)
6	Healthy food options are affordable in this neighbourhood	0 (0.0)	0 (0.0)	3 (50.0)	1 (16.7)	1 (16.7)
7	There is not a lot of unhealthy (e.g., fast food) in this neighbourhood	1 (16.7)	1 (16.7)	1 (16.7)	1 (16.7)	1 (16.7)
8	There is affordable housing in this neighbourhood	1 (16.7)	1 (16.7)	3 (50.0)	0 (0.0)	0 (0.0)
9	The houses in this neighbourhood are good for families with children	0 (0.0)	0 (0.0)	4 (66.7)	1 (16.7)	0 (0.0)
10	There is access to basic services such as childcare, banks, medical clinics, etc. in this neighbourhood	0 (0.0)	0 (0.0)	3 (50.0)	2 (33.3)	0 (0.0)
11	There are places to meet other families in this neighbourhood	0 (0.0)	0 (0.0)	3 (50.0)	2 (33.3)	0 (0.0)

	Statement	Strongly disagree n (%)	Disagree n (%)	Agree n (%)	Strongly agree n (%)	Unsure n (%)
Neighbourhood safety						
12	There is a lot of petty crime in my neighbourhood (such as vandalism, shoplifting)	0 (0.0)	1 (16.7)	1 (16.7)	1 (16.7)	2 (33.3)
13	There is a lot of major crime in my neighbourhood (such as armed robberies, break-ins, attacks)	0 (0.0)	1 (16.7)	1 (16.7)	1 (16.7)	2 (33.3)
14	Streets in my neighbourhood are well lit at night	0 (0.0)	1 (16.7)	2 (33.3)	2 (33.3)	0 (0.0)
15	There is heavy traffic on my street or road	1 (16.7)	1 (16.7)	1 (16.7)	2 (33.3)	0 (0.0)
16	It is safe for children to play outside during the day	0 (0.0)	0 (0.0)	3 (50.0)	2 (33.3)	0 (0.0)
Neighbourhood surroundings						
17	My neighbourhood is generally free from litter, rubbish, or graffiti	0 (0.0)	1 (16.7)	3 (50.0)	1 (16.7)	0 (0.0)
18	There is lots of greenery around my neighbourhood (trees, bushes, household gardens)	1 (16.7)	0 (0.0)	3 (50.0)	1 (16.7)	0 (0.0)
19	There are many interesting things to look at while walking in my neighbourhood	1 (16.7)	0 (0.0)	3 (50.0)	1 (16.7)	0 (0.0)
20	There are attractive buildings and homes in my neighbourhood	1 (16.7)	2 (33.3)	1 (16.7)	1 (16.7)	0 (0.0)
21	The state of footpaths is good in this neighbourhood	0 (0.0)	1 (16.7)	3 (50.0)	1 (16.7)	0 (0.0)
People in your neighbourhood						
22	I often see adults walking in my neighbourhood	0 (0.0)	0 (0.0)	1 (16.7)	3 (50.0)	1 (16.7)

	Statement	Strongly disagree n (%)	Disagree n (%)	Agree n (%)	Strongly agree n (%)	Unsure n (%)
23	I often see children walking in my neighbourhood	0 (0.0)	2 (33.3)	1 (16.7)	1 (16.7)	0 (0.0)
24	There are often children playing on the footpaths in this neighbourhood	0 (0.0)	3 (50.0)	1 (16.7)	0 (0.0)	1 (16.7)
25	People around here are willing to help their neighbours	0 (0.0)	1 (16.7)	2 (33.3)	0 (0.0)	2 (33.3)
26	People in this neighbourhood generally do not get along with each other	0 (0.0)	2 (33.3)	1 (16.7)	0 (0.0)	2 (33.3)
27	People in this neighbourhood do not share the same values	0 (0.0)	1 (16.7)	2 (33.3)	0 (0.0)	2 (33.3)
28	I feel a strong sense of identity with my neighbourhood	0 (0.0)	2 (33.3)	3 (50.0)	0 (0.0)	0 (0.0)
29	This is a close-knit neighbourhood	0 (0.0)	4 (66.7)	0 (0.0)	0 (0.0)	1 (16.7)
30	Most people in our neighbourhood can be trusted	0 (0.0)	2 (33.3)	0 (0.0)	0 (0.0)	3 (50.0)
31	Community organisations in my neighbourhood can be trusted	0 (0.0)	0 (0.0)	4 (66.7)	1 (16.7)	0 (0.0)
32	Local government organisations in my neighbourhood can be trusted	0 (0.0)	0 (0.0)	5 (83.3)	0 (0.0)	0 (0.0)
33	Commercial organisations in my neighbourhood can be trusted	0 (0.0)	0 (0.0)	4 (66.7)	0 (0.0)	1 (16.7)
34	I feel connected to my community	0 (0.0)	1 (16.7)	3 (50.0)	0 (0.0)	1 (16.7)

	Statement	Strongly disagree n (%)	Disagree n (%)	Agree n (%)	Strongly agree n (%)	Unsure n (%)
35	Generally, this is a good neighbourhood to bring up young children	0 (0.0)	0 (0.0)	4 (66.7)	1 (16.7)	0 (0.0)

Notes: Neutral was also a response option, but there were 0 responses. Responses for two participants were not recorded in the system due to technical difficulties during data collection.



3.4.2 Supportive destinations for young children's development

Participants identified 23 destinations they accessed in their neighbourhood and were asked to rate the supportiveness of these destinations for children's physical skills, social skills, emotional maturity, language and cognitive skills, and communication skills. Libraries and playgroups were the most popular destinations identified by participants (4 each), followed by sporting activities and friends' houses (3 each) (**Table 19**).

Table 19. Neighbourhood destination types mapped by participants

Destination type	n (%)
Church	1 (4.8)
Community centre	1 (4.8)
ECEC	2 (9.5)
Friend or relative's house	3 (14.3)
Health service	2 (9.5)
Library	4 (19.1)
Public open space	2 (9.5)
Playgroup	4 (19.1)
School	1 (4.8)
Shop	1 (4.8)
Sporting activity	3 (14.3)

Key: ECEC=Early childhood education and care. **Note:** *2 destinations could not be categorised.

Most participants identified the destinations to be 'very supportive' of their child's development (**Table 20**):

- Physical skills, e.g., playing, running, jumping, and getting exercise (65.2%)
- Social skills, e.g., playing, sharing, getting along with other children, negotiating personal needs, and trying new things (56.5%)
- Emotional maturity, e.g., helping others, being patient, and not being aggressive or angry (43.5%)
- Language and cognitive skills, e.g., pre-reading, reading, language, vocabulary, numeracy (26.1%); and:
- Communication skills, e.g., expressing their needs, seeking help from adults, listening, interacting with other children and adults (43.5%)

Table 20. Supportiveness of child development

Supportiveness	Physical skills	Social skills	Emotional maturity	Language and cognitive skills	Communication skills
	n (%)	n (%)	n (%)	n (%)	n (%)
Neutral	1 (4.3)	1 (4.3)	2 (8.7)	2 (8.7)	0 (0.0)
Somewhat supportive	1 (4.3)	4 (17.4)	1 (4.3)	2 (8.7)	0 (0.0)
Supportive	2 (8.7)	4 (17.4)	5 (21.7)	0 (0.0)	5 (21.7)
Very supportive	15 (65.2)	13 (56.5)	10 (43.5)	13 (56.5)	8 (34.8)
Missing	4 (17.4)	5 (21.7)	5 (21.7)	6 (26.1)	10 (43.5)
Total	23 (100.0)	23 (100.0)	23 (100.0)	23 (100.0)	23 (100.0)



Childcare centres were perceived to be very supportive of all five domains of children’s development (**Table 21**). All four libraries were identified by parents as very supportive of language and cognitive skills, and three were very supportive of the other domains (except for communication skills, which was missing).

Table 21. Destinations perceived as ‘very supportive’ of child development

Destination type	Very supportive				
	Physical skills	Social skills	Emotional maturity	Language and cognitive skills	Communication skills
	n (%)	n (%)	n (%)	n (%)	n (%)
Church	1 (6.7)	1 (7.7)	1 (7.7)	1 (7.7)	1 (12.5)
Community centre	1 (6.7)	1 (7.7)	0 (0.0)	1 (7.7)	Missing
ECEC	2 (13.3)	2 (15.4)	2 (20.0)	2 (15.4)	2 (25.0)
Friend or relative's house	Missing	Missing	Missing	Missing	Missing
Health service	2 (13.3)	1 (7.7)	1 (10.0)	1 (7.7)	1 (12.5)
Library	3 (20.0)	3 (23.1)	3 (30.0)	4 (30.8)	Missing
Public open space	1 (6.7)	1 (7.7)	1 (10.0)	1 (7.7)	1 (12.5)
Playgroup	1 (6.7)	1 (7.7)	0 (0.0)	1 (7.7)	0 (0.0)
School	1 (6.7)	1 (7.7)	0 (0.0)	1 (7.7)	1 (12.5)
Shop	0 (0.0)	0 (0.0)	0 (0.0)	Missing	0 (0.0)
Sporting activity	3 (20.0)	2 (15.4)	2 (20.0)	1 (7.7)	0 (0.0)
Total	15 (100.0)	13 (100.0)	10 (100.0)	13 (100.0)	8 (100.0)

Key: ECEC=Early childhood education and care.



When asked why the place was supportive of their child’s learning, development, and wellbeing, more parents selected safety, followed by social interaction (people), activities and programs offered, and lastly, the physical design of the place (**Table 22**). Other supportive reasons included an opportunity to interact with the environment and education (e.g., learning about and demonstrating water safety, exercise, movement, and body awareness).

Table 22. Reasons why destinations are supportive of child development

Destination type	Physical design ¹	People ²	Safety ³	Activities offered ⁴
	n (%)	n (%)	n (%)	n (%)
Church	1 (11.1)	1 (7.7)	1 (7.1)	1 (8.3)
Community centre	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
ECEC	2 (22.2)	2 (15.4)	2 (14.3)	2 (16.7)
Friend or relative’s house	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
Health service	0 (0.0)	2 (15.4)	2 (14.3)	0 (0.0)
Library	1 (11.1)	2 (15.4)	3 (21.4)	3 (25.0)
Public open space	1 (11.1)	1 (7.7)	1 (7.1)	1 (8.3)
Playgroup	1 (11.1)	1 (7.7)	1 (7.1)	1 (8.3)
School	1 (11.1)	1 (7.7)	1 (7.1)	1 (8.3)
Shop	1 (11.1)	1 (7.7)	1 (7.1)	1 (8.3)
Sporting activity	1 (11.1)	2 (15.4)	2 (14.3)	2 (16.7)
Total	9 (100.0)	13 (100.0)	14 (100.0)	12 (100.0)

Key: ECEC=Early childhood education and care. ¹The physical design (e.g., beautiful to look at, has lots of space); ²The people we spend time with here (e.g., friends, meeting new people); ³Feeling safe here; ⁴The activities offered here (e.g., programs for kids, places to play)

3.5 Interview and focus group findings

Twelve main themes from the interviews and focus groups that emerged under five built environment domains were summarised earlier in **Table 15**. Each theme is described below with supporting quotes.

3.5.1 Housing

Parents discussed two main housing themes. Families noticed the difference in **block size (lot size)** (*Theme 1a*) between older and newer estates, with older estates having large blocks (e.g., 1000 - 5000m²) and newer developments being on smaller blocks (e.g., 200-350 m²) within Cardinia Shire. There were perceived pros and cons to larger blocks. Some parents mentioned that smaller lot sizes meant less private space for children to play and smaller shared living spaces. Two parents felt their house was too large for their family's needs, leading to higher maintenance and more cleaning.

'My house is about 500 square [metres], and it's big. And only after, we realise that only after we moved in because it's too big... and all the maintenance things that you need to do, to clean, and just by yourself it's too much' (FG01)

Housing affordability (*Theme 2a*) was mentioned as a challenge, with the majority identifying the rising cost of housing in their area in the last few years. Some parents acknowledged they could not afford to move, either for larger homes with bigger backyards in their local government area or a more convenient location (e.g., closer to work). However, it appeared most parents were satisfied with their current housing situation.

'Like, I keep an eye out on what houses are going for, and yeah, it's insane. And like fat chance of it, we had the hope of potentially moving into somewhere closer to our work, you know, in the next year or so, but that's probably not going to happen because we just simply cannot afford closer to our jobs.' (FG01)

3.5.2 Public open space

Parents discussed three main public open space themes. They perceived parks as helping to compensate for smaller yard spaces, offering areas for outdoor play (e.g., swings, playgrounds, sand pits). All participants were very positive about public open spaces in their local area. They perceived **many high-quality** and **well-maintained parks** within **walking distance** (*Theme 2a*) that support multiple family activities. The **quality of parks** was perceived as important because of interesting play equipment for children (playgrounds, water play, sports facilities), a variety of family-friendly activities (e.g., BBQs), and well-maintained equipment by the local Council. For example, the Council was positively acknowledged for its quick response to park maintenance issues and helpful website resources on different parks available in the area.

'I've got several parks that are in walking distance but every single one of them offers something different...you go to a different one and you know it's got new things there again, so what I really like is the variety of play activities' (FG01)

'The parks are generally quite well maintained...They have high quality [play] equipment. I'm happy with the fact we've got good [parks] and I think they get because it's more new estates coming up and things like that.' (INT01)

'If there's ever any problems, you can report it and... And they [Council] constantly maintain it, maintenance is good' (FG01)

Natural elements (*Theme 3a*) were particularly valued because they encouraged creativity and connection with nature. Families wanted natural play environments (e.g., water features) and accessible nature spots closer to residential areas. Participants highlighted the presence of wildlife (e.g., birds), easy access to reserves, and walking trails.

'Deep Creek Reserve or Deep Creek play area has a really nice sort of open playground that encourages that imaginative play. They [children] can be in amongst the rocks, the sand, and the, you know, the garden. It's got a nice landscape, it kind of encourages that nature and safe risk taking play' (INT02)

Parents also suggested some improvements to public open spaces (*Theme 2c*). Concerns included the lack of essential amenities like toilets, water stations, and bins, limiting the time families spent at parks. Room for improvement also included requests for more shaded areas or better tree coverage in parks to support family outings. Some wanted more park features that catered for younger children.

'No place to fill up your water bottle, or a dog bowl, or any, like there's really limited amenities' (FG01)

'More that have toilets, it's probably the one because when kids are toilet training, they can't necessarily hold on' (INT02)



3.5.3 Family-friendly activities

Four themes were related to family-friendly activities and services. The presence of **libraries** (*Theme 3a*) and the programs offered were highlighted as important for young children. Parents positively reported that libraries offered a range of activities and programs for families with young children (e.g., baby and toddler rhyme time) and adults (e.g., skills classes). Library accessibility was mentioned as a concern. Libraries in the area are popular with families and other community members; thus, participants spoke about parking limitations. Building another library in the Officer area was desirable to improve accessibility for local families.

'I wish there was an Officer one. Because I'd be there more often, but the Pakenham one is just that, it's like 15 minutes away. So, when I've got to like haul children around it can be a bit [challenging]... and the parking there can be terrible. And so, we'd really like a library within more sort of the Officer area' [FG01].

A variety of **parent groups** (*Theme 3b*) were important for facilitating regular social interaction and building relationships with other local families. Parents spoke about diverse activities beyond the facilitated formal sessions, including meeting up for coffee, park walks, library visits, and botanical garden outings.

'So we regularly attend that. And we need like, like-minded people, same people, the same problems and we discuss things there... and we exchange ideas and, you know, support.' (FG01)

Playgroups (*Theme 3c*) were also important for providing opportunities for children's play and for young children to build social skills while parents met other parents to develop friendships.

Community and family support services (*Theme 3d*) were reported as supporting family wellbeing, particularly for families facing hardships, such as those affected by family violence. For example, one participant spoke positively about local services assisting with housing relocation, referrals, and assistance with essential needs such as purchasing food, financial counselling, and navigating government service systems. Another service collaborated closely with school wellbeing teams, providing specific support such as funded tutoring sessions and assistance with school-related needs.

There was perceived bias toward non-working parents for the times family-friendly activities and events were offered: activities were often scheduled during weekday business hours. The current schedule assumes a carer is available at these times, excluding full-time working parents. One participant advocated for the Council to hold weekend story time sessions to help incorporate diverse family schedules. While the Council was responsive, the timing (e.g., during toddler nap times) and infrequency (e.g., once a month) were limiting for the family.

'Because I am a full-time worker, and I do love the library, but unfortunately when things are on during office hours there's just no way that I can ever, ever take my children to those. It means that it's quite a privileged thing to be able to go to the events...if you can afford to only have one parent working, then you can go to those events. They're all during, for this age group at least; it's all during the day, Monday to Friday, which doesn't work if you're an office worker, I suppose.' (FG01)

3.5.4 Early childhood education and care services

Two themes emerged for early childhood education and care services. Childcare is viewed as essential for supporting children, family life, and working parents. Participants expressed that some areas had **fewer childcare centres** (Theme 4a) compared with more established suburbs in the local government area, meaning parents drive further for childcare. Limited operating hours was a barrier for working parents needing flexible care options. For example, childcare services often don't operate long enough to accommodate parents with long work commutes. This limited opportunities for dual-income families to access their preferred childcare. Further **service quality and inaccessibility** (Theme 4b) concerns for parents included long waitlists and cost (expensive).

'Childcare is quite competitive. I am on a waitlist forever. The childcare centres I went to tour all of them, I'm on waiting list, so like where are all these kids coming from? So they can't keep up with demand. Because so many families are moving out here' (FG01)

Inconsistent service quality was also reported, with experiences varying considerably between centres. Some centres were more friendly and welcoming, and others were described as elitist or dismissive. Others perceived that local

services were understaffed or not effectively advertised, making it difficult for families to find and navigate the support they need to apply for kindergarten placements. For example, there was a delay in receiving Council information about sessional kindergarten enrolments or uncertainty on where to find this information which meant the family 'missed out' on the enrolment process, thus paying more for childcare services (note: kindergarten hours administered in long daycare settings is subsidised, but the childcare component of the day still requires payment. Sessional kinder is subsidised by the Australian government (e.g., two days for four-year-olds).

'Financially, you know, being a pensioner card holder as well, it would have been more practical and affordable.... And then also she turned 4, so I didn't have any information.' (INT02)



3.5.5 Connectivity

Families were generally satisfied with the availability and variety of family-friendly destinations within their local government area. Families sometimes sought higher-quality amenities and diverse public open space experiences (e.g., Botanical Gardens) outside the LGA.

Daily activities such as having shops *within walking distance*, were not perceived as essential; family-friendly activities and services were convenient if they were within a 15-30-minute drive. The exception was that having a variety of parks within walking distance encouraged walking the dog, social connection, and children's play. Families reported a 20-minute radius from home was a manageable walkable distance with a 4–5-year-old child. Two parents mentioned that having more health care services and a hospital, or more health care services within a 15-minute drive, would be helpful for their families. Parents stated the need for external motivation to leave the house, with participants combining errands (e.g., grocery shopping with a library visit) to create purposeful outings. Without such motivations, some tend to stay at home.

'The recreation in the area are really good and the community services. Libraries and churches are helping people in need. There are a lot of activities for kids, such as playgroups and library events. There are lots of parks around very close to home, which means easy access. Have to travel a bit for GP access or big shopping. Happy about the area. (FG01, INT01)

3.5.6 Other built environment themes

When prompted by the researcher, public transport was discussed as infrastructure that existed but was not used by participants. However, it was identified as one person's top 3 features for supporting families with young children (**Table 24**).

Neighbourhood stressors such as perceived crime and traffic safety were mentioned but were not key concerns for participants because they generally felt their neighbourhood was safe. Certain destination locations, such as Pakenham train station, were noted as unsafe due to poor lighting and people hanging around.

Participants highlighted the importance of flat terrain, good traffic visibility, and bike paths as factors that enhance feelings of safety (e.g., riding bikes without the fear of steep hills causing accidents). Current roadwork upgrades contributed to extra time commuting but were not a considerable concern.

"The train station feels really unsafe, especially at night. There's poor lighting and people just hanging around" (INT02)



3.5.7 Social environment themes

Social interaction appeared to be very important for parents with young children. Some participants lived in newer neighbourhoods where they did not know many people. It was perceived that families with grandparents may be less likely to spontaneously socialise outside their home, making it harder for parents to connect. Some parents were willing to travel outside their immediate neighbourhoods to attend social groups or parks where they could more easily meet others. However, playgroups and organised activities such as sensory baby groups and parent groups were social spaces for families to connect with others in similar life stages. Another interviewee mentioned that community places such as community centres, parks, and recreational centres were opportunities to meet with friends. There was an overall perception that people in the community were friendly, that there was a sense of belonging, and that the community was safe.

‘But just affordable housing didn’t attract me to the area. I think it was the safety and also the sense of I felt I belonged to a community. When I came to this area, that’s what I felt I like.’ (INT01)

‘Our neighbourhood is quite new, so we are still getting to know our neighbours. But overall, I think it is a good place to bring [up] my baby’ (FG01)



3.5.8 Critical built environment themes perceived as supporting child development

When asked to name their top three most supportive neighbourhood built environment features for young children, the responses varied (**Table 24**). Access to a range of quality family-friendly activities, destinations, and services are important features for families with young children.

Table 23. Top built environment themes important for children’s health, development, and wellbeing

Top 3 Built environment features						
1	Good quality affordable food*	Accessible transport (bus, etc)	Outdoor play areas	Walking trails and footpaths	Good parks, outdoor activities, and good places to walk	Safe home: stable, violence-free home
2	Closer, more accessible health care	Close community and shopping centre hubs	Education and early development centres	Parks	Library and Council events	Quality ECEC
3	Better connected roads, shops, and services	Playground features catering to young children	Access to destinations and activities	Playgrounds	Religion support and easy access to family support services	Health care and community support services

Key and notes: *A variety of culturally diverse food was also raised as a positive. ECEC=early childhood education and care

Part 4 Learnings from lived experience field work

4.1 Intended approach

The qualitative participatory component of the project aimed to engage families with young children to understand their lived experiences of their neighbourhoods and the aspects of their neighbourhoods that they feel are important to their child's development, mental health, and wellbeing. We wanted to better understand:

1. What are young children's experiences of their neighbourhood built environments, and how do these environments relate to their development, mental health, and wellbeing?
2. What are primary caregivers' experiences of their neighbourhood built environments, and how do these environments relate to their young children's development, mental health, and wellbeing?

To do this, we intended to use qualitative focus groups and Public Participation (PPGIS) methods (specifically the Maptionnaire tool) to explore how young children and their primary caregivers in socioeconomically diverse Melbourne neighbourhoods experience their surroundings and how these relate to children's development, mental health, and wellbeing.

Specific to children, the original study design included the following components:

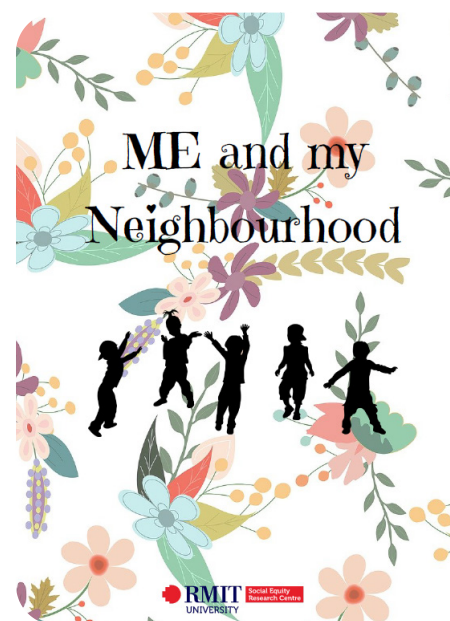
- Online PPGIS completed by primary caregivers of young children (8 years or younger);
- Face-to-face focus groups with primary caregivers of young children;
- Face-to-face activities with young children (4-8 years) consisting of:
 - Drawing activity (places children like/dislike in their neighbourhood);
 - Small group discussion about their drawings/places;
 - PPGIS, completed in-person using provided computers, with assistance from the primary caregiver/research team.

We aimed to recruit up to 32 families in a disadvantaged and advantaged suburb in one inner city (City of Port Phillip) and one urban growth (Cardinia Shire) local government area through early childhood services, community services, social

media, and local government advice. Separate focus groups and PPGIS sessions were intended for children aged 4-8 years old and their primary caregivers (parents).

- Focus groups aimed to capture multiple perspectives on neighbourhood history, social connectedness, local services, and destinations to understand how neighbourhood features impact early childhood outcomes.
- The PPGIS Maptionnaire tool aimed to collect demographic data, pinpoint locations, and gather open-ended comments tied to specific places important for families and children's development. PPGIS enables the visualisation of qualitative and quantitative data together, revealing patterns in neighbourhood experiences.

For child participants, the facilitator (researcher) used a 'story book' to explain the study aims, what was involved, and assent procedures. To build rapport and provide context to the neighbourhood concept, the children also completed a drawing activity before proceeding to discussing what they drew and completing the PPGIS activity (**Figure 21**).



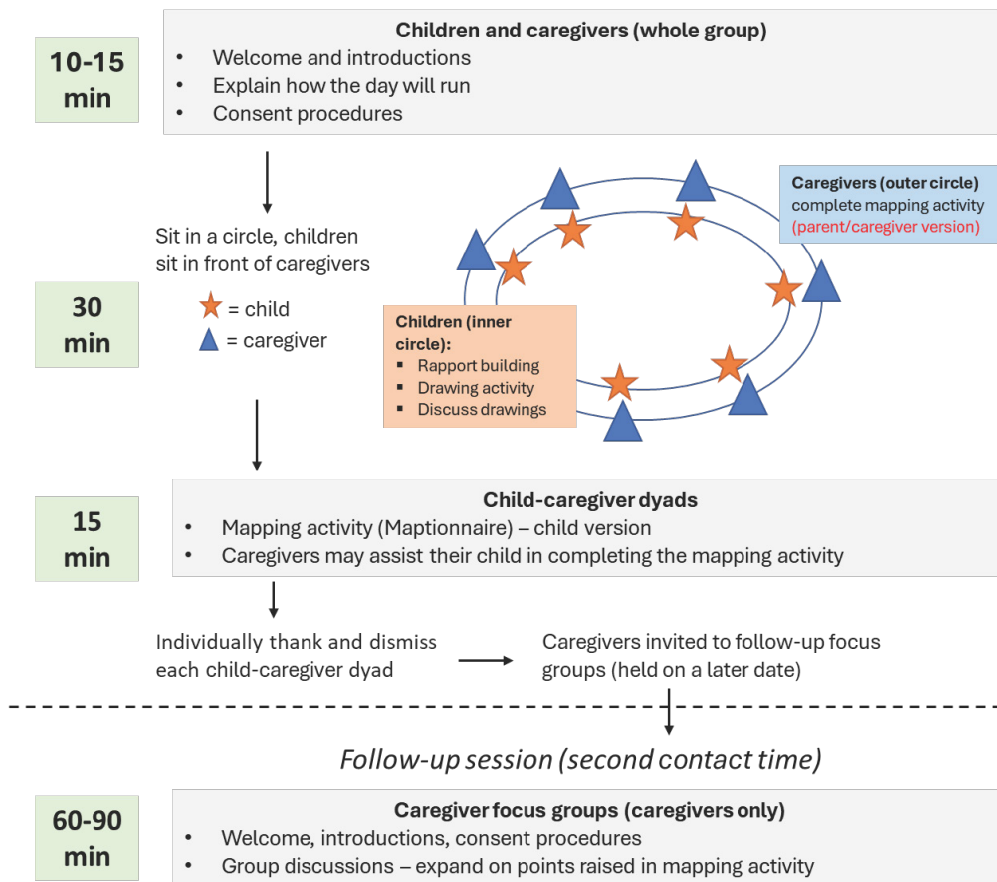


Figure 21. Intended data collection approach

4.2 Response rates

When using the PPGIS Maptionnaire approach, we had very low response rates for parents and children (**Table 24**). Ideally, we wanted to recruit up to 32 parent-child pairs involved (5-8 per LGA/SES combination). We had no expression of interests or participants from the *low SES, inner city* suburb. From the *high SES, inner city* suburb, we received 13 expressions of interest to participate in the study (not reported in table). One completed the PPGIS and interview. One completed a PPGIS

survey only. The remaining 11 participants were lost to follow-up. Of these 11 participants, two had signed the consent form but later withdrew due to other commitments, or it was too difficult to schedule a data collection time.

From the *high SES, growth area* suburb, two parents expressed their interest. Of these two, 1 parent participated in the PPGIS component only, and their child also participated in the study. From the *low SES, growth area* suburb, nine parents expressed their interest. Of these nine, seven parents (and two children) participated. Two could not attend the focus group due to unforeseen circumstances.

Some reasons for unsuccessful follow-up included participants not responding to follow-up, not completing the consent form, or choosing not to proceed due to non-compensation for time involved. This resulted in the final sample being recruited from a low SES suburb in Cardinia Shire (growth area).

Table 24. Response rates for the study

	Inner city	Growth area
Low SES	0 parent 0 children	7 parents 2 children
High SES	1 parent 0 children	1 parent (PPGIS only) 2 children

← **Key:** PPGIS: Public Participation Geographic Information System (PPGIS). SES: Socio-economic.



4.3 Challenges, reflections, and recommendations

Low response rates (**Table 24**) were a consequence of several structural and system, and situational challenges (**Table 25**). Taken together, these challenges contributed to delays and difficulties in recruitment.

At the beginning of the project, we faced a ban on recruiting through government schools and childcare centres (a policy legacy of the COVID pandemic). This was later lifted, but a policy banning incentives for families' participation in research remained.

Using PPGIS with young children (ages 4-8 years), supported by their primary caregivers, has not been done before. Previous studies have used other map-based platforms (e.g., Google Earth)(55) with preschool-aged children, but to our knowledge, this was the first study to try and use PPGIS with this age group. Children required considerable assistance with the PPGIS activity, especially those aged 4-5 years, and PPGIS with young children requires substantial investment in pilot testing. This was unsurprising given that most preschool-aged children are learning how to read. Investment in increasing its appeal (i.e., fun and engaging), user-friendliness (e.g., highly visual, icons), and simplifying the activity is needed.

Another challenge was families' preferences for online methods due to convenience. Our experience reinforced the importance of face-to-face (rather than online) data collection with children. PPGIS was difficult to conduct with young children online, resulting in parent-driven responses. However, one-on-one follow-up interviews with adults worked well for delivering the parent PPGIS activity and could be used in future studies.

The first important takeaway was that strong partnerships are critical to recruiting families with young children. We recommend 'going local' with partnerships - for example, engaging specific schools rather than larger districts/catchments. Strong, localised partnerships emerged as essential for effective recruitment. Additionally, young children needed significant support for PPGIS activities, making face-to-face methods more effective than online approaches. Finally, one-on-one parent followup interviews proved valuable for debriefing and could be useful for future research.

Table 25. Data collection challenges, reflections and recommendations

Challenge	Description/example	Reflections/Recommendation
Structural and system		
1 Ethics systems	Extra scrutiny because of high-risk population (i.e., young children), thus questions about whether it was appropriate to work with children directly in this way.	
2 Policy changes to recruitment	We could not conduct research in schools and ECEC settings post-COVID. Australian Government Department of Education rules and policy changed again, but by the time we were approved to recruit through schools and ECEC centres, it was November 2023 (e.g., end of year, busy time for parents and schools).	Apply for Australian Government Department of Education ethics approval <i>early</i> on the off chance that schools and ECEC may be used for recruitment. We received expressions of interest (EOIs) from parents whose children attended primary schools and ECEC.
3 Policy mismatch to incentives/reimbursements	The new government prevents families from receiving incentives or reimbursement for their research contributions. Instead, any incentives must go towards the school. However, RMIT University HREC has approved using \$50 Coles/Myer vouchers as reimbursement for parents' time to participate in the project.	This is government policy, but it may impact recruitment success. If schools and families were offered incentives, perhaps that would be a 'win-win' for everyone. Adequate reimbursement is needed for families.
4 Non-enterprise software procurement	Non-enterprise software: RMIT approvals for new software are onerous. <ul style="list-style-type: none"> Privacy Impact Assessment Security risk assessment ITS third-party risk assessment Legal team review Procurement supplier registration 	Many organisational approvals are required to get the software approved for purchase, which could take months.
Situational		
5 Partner organisation staff changes	Partners have assisted with participant recruitment through distributing flyers to their networks and community infrastructure services (e.g., Maternal and Child Health Centres, libraries, toy libraries, and recreation facilities) and connections with key stakeholders such as supported playgroups. High turnover in local government early years teams due to restructure, etc.	Strong partner relationships and engagement are needed upfront. Have a specific partner organisation that works on the ground with disadvantaged families.
6 Unable to 'boost' posts on social media local community groups	Attempted to recruit through community group Facebook pages for each local government area (e.g., general community groups and those targeted at families). Tried to 'boost' the posting, but this is not allowed on community group pages as they don't allow 'business advertising.' Some pages did not accept requests to post to the page, possibly because of university research.	Worth posting on social media if we've got the resources to boost the post/or monitor postings every day.
7 Playgroups most engaged	Playgroups have been a helpful platform for recruitment; however, although it captures parents, this largely misses the child age group we aimed to recruit (4-8 years).	
8 Length of data collection sessions	The activity may be too long for families with young children. We had asked for a 1–2-hour commitment from families.	Think carefully about the purpose of using PPGIS, e.g., for pilot testing, data collection to capture trends, data collection to translate people's lived

Challenge	Description/example	Reflections/Recommendation
9 Difficulty using PPGIS	<p>PPGIS mapping with young children proved challenging due to heavy parental involvement for children aged 4/5 years, limited researcher control during online sessions, and children's short attention spans. Children got 'bored' easily, particularly the younger children, so the tool needs to be highly engaging. The activity also required shorter, more tailored questions and extensive pilot testing to tailor the activity more appropriately for children.</p> <p>Question whether PPGIS offers significant advantages over traditional qualitative methods like drawing, photo-voice, or paper maps, suggesting these may be more effective with this age group.</p>	<p>experiences, or data collection to inform specific community planning. For research, this tool has been used effectively to capture large amounts of data from older children and adults, as well as for planning local areas. PPGIS could be useful as a 'mass data collection' exercise for parents. This could be the release of the survey (link/QR code) through social media, school and ECEC settings, local government, and local networks. However, a 'mass survey distribution' risks missing the most disadvantaged groups. For these groups, go-along interviews/interviews/focus groups/photo-voice would still provide rich data and what we need from participants.</p> <p>Extensive and tailored set-up and pilot testing are needed for younger children e.g., a map that has child-specific icons for destinations (e.g., a swing icon for playground) and simpler questions.</p> <p>Face-to-face interviews are preferable for young children, as facilitating the mapping exercise online was difficult.</p> <p>Drawing activity effective for prompting discussion about place.</p>



4.4 Adapted approach

To meet these challenges, the adapted approach to data collection differed substantially from the intended approach (**Figure 20**). We: 1) adapted data collection to online methods (individual interviews rather than focus groups); 2) pivoted to recruit through local government-run services, then through schools when the ban was lifted; and 3) provided incentives (donations) to schools rather than individual families. **Figure 22** illustrates an example of an ‘individualised’ online interview with a child and then parent.

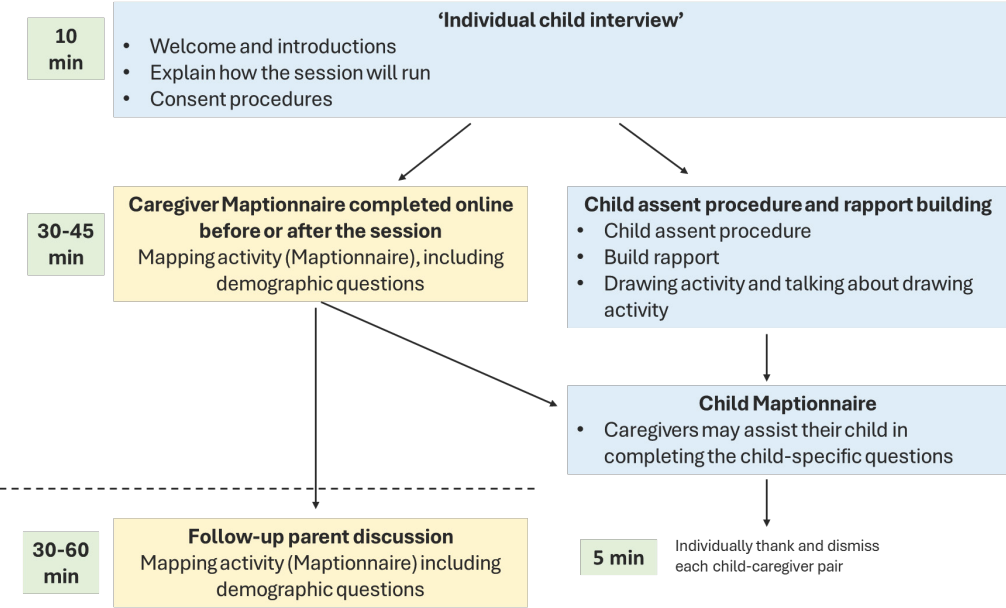


Figure 22. Adapted data collection approach



Part 5 Discussion and Conclusion

We aimed to identify the most critical child neighbourhood built environment indicators and understand the lived experiences of families with young children in different urban areas of Melbourne, Victoria. Using a large dataset of built environment indicators linked to early childhood development outcomes, we explored the effects of urbanicity and "double disadvantage"—living in outer growth areas and highly disadvantaged neighbourhoods—on children's developmental vulnerability. We also conducted research with parents of young children living in growth areas to better understand their lived experiences in their neighbourhoods and the built and social infrastructure that support their family.

5.1 Summary of key findings

Urbanicity

- Child development did not differ significantly on the basis of living in Melbourne's inner city compared with middle ring, outer ring, or growth area suburbs.

Neighbourhood double disadvantage

- Children living in the most disadvantaged areas had higher odds of developmental vulnerability regardless of urbanicity.
- The most concerning child development outcomes were associated with living in the most disadvantaged inner-city areas.

Objective built environment and early childhood development associations

- Outer ring and growth area suburbs have fewer amenities and infrastructure compared with inner city suburbs. However, children living in the most disadvantaged areas seem to have more amenities and infrastructure, on average, compared with children living in the least disadvantaged areas.

- Built environment domains of housing, walkability, public open space, and early childhood education and care were related to developmental vulnerability and should be priority areas of focus. Small effects were seen:
 - ✓ A one-unit increase in walkability was associated with a 2% increase in the odds of developmental vulnerability (OR 1.02, 95%CrI 1.01-1.04).
 - ✓ A 10% increase in the proportion of people in an SA1 under housing affordability stress was associated with a 5% increase in the odds of developmental vulnerability (OR 1.05, CrI 1.03-1.07).
 - ✓ One extra public open space within a child's 800m neighbourhood was associated with 1% reduced odds in developmental vulnerability (OR 0.99, 95%CrI 0.99-1.00).
 - ✓ A greater mix of public open space (i.e., different-sized public open spaces) within 800m of a child's home was associated with a 2% decrease in developmental vulnerability.
 - ✓ Children living further away from a child-friendly public open space were at slightly increased odds of developmental vulnerability, but the effect size was marginal (OR 1.00, 95%CrI 0.99-1.00).
 - ✓ An extra childcare centre with an exceeding national standard rating within 3km of a child's home was associated with 1% lower odds of developmental vulnerability.
 - ✓ An additional preschool with an exceeding national standard rating within 3km of a child's home was associated with 2% lower odds of developmental vulnerability.
- There was evidence of an interaction effect for housing, walkability, public open space, and early childhood education and care depending on where the child lived. This meant that the effect sizes or direction of association differed for some neighbourhood double disadvantage areas, compared to

children living in the least disadvantaged (highest SES) inner city area (high SES, high built environment amenity). Examples:

- The magnitude of association between housing affordability stress and developmental vulnerability was greater for children living in the most disadvantaged inner city and growth areas compared with children living in the least disadvantaged inner city.
- The interaction results were counterintuitive for the number of childcare and preschools. For example, for inner city residents, children living in the most disadvantaged inner city areas had 8% higher odds of developmental vulnerability for every additional high-quality childcare centre available locally.

Perceived built environment and early childhood development

- Important factors for child development and wellbeing included housing affordability, access to various high-quality and well-maintained parks within walking distance, family-friendly activities, and services such as libraries, parent groups, playgroups, community and family support services, and accessible early childhood education and care services (both available and easy to access).
- Except for parks, walkability was not a major consideration in caregivers' decisions to use destinations and services, as long as they were accessible within 15-30 minutes by car.
- Social interaction was a key theme in which the built environment could hinder or facilitate.

5.2 Contextualising the key findings

Outer and growth areas have fewer amenities, but the most disadvantaged areas may have more

Our descriptive built environment findings showed a spatial pattern; as distance from the CBD increased, children living in outer ring and growth areas, on average, had poorer access to local destinations and services (e.g., fewer destinations and shorter distances to the nearest one), poorer walkability characterised by less street connectivity, lower dwelling densities, and less of a mix of destinations. These findings closely align with others who have found that outer suburbs, compared with inner city suburbs, have fewer amenities and infrastructure, such as public transport and public open space (60, 61).

When we considered neighbourhood disadvantage, we often found a disproportionate distribution of infrastructure between the most and least disadvantaged areas in the *opposite* direction than expected. That is, children living in the least disadvantaged areas had poorer access (in terms of proximity) to destinations and services than those living in the most disadvantaged areas. While it is widely accepted that disadvantaged neighbourhoods have poorer access to resources, the evidence remains mixed, with others also finding that the opposite is true. (62-64) However, these findings also need to be contextualised with the fact that population densities are higher in the inner city, so there may be greater demand for these destinations and services in these areas. A limitation of our analysis is that we did not have information on service availability/demand, which is another important consideration when determining access to resources.

Place-based interventions should continue to focus efforts in the most disadvantaged areas

Children living in the most disadvantaged neighbourhoods had greater odds of developmental vulnerability than children living in less disadvantaged neighbourhoods. There was no clear association between urbanicity and children's developmental vulnerability. When neighbourhood disadvantage and urbanicity were considered together ('double disadvantage'), the compounding effect of neighbourhood double disadvantage on developmental vulnerability was unclear. We hypothesised that children living in the most disadvantaged growth areas would have poorer child development outcomes. But we found that children in the most disadvantaged inner-city areas had the highest odds of developmental vulnerability,

even higher than their disadvantaged counterparts in outer growth areas, despite growth areas having fewer neighbourhood resources.

Our findings emphasise that children living in the most disadvantaged areas are at greater risk of poorer child development, regardless of where they live (urbanicity). Our data further show that living in the least disadvantaged areas appears to be protective of child development, regardless of urbanicity. Experimental studies such as the Moving To Opportunity Study in the United States show that moving from high-poverty neighbourhoods to less disadvantaged neighbourhoods at a young age has positive effects on college attendance, salary earnings,(65) and adult subjective wellbeing.(66) Further, many neighbourhood effects and child development studies show that poorer child development outcomes are more likely in more disadvantaged neighbourhoods.(10, 11). Our findings indicate that neighbourhood disadvantage cannot be overlooked when examining the effects of urbanicity on child development.

Life in the inner city

Our neighbourhood double disadvantage findings align with the "deprivation amplification" hypothesis, suggesting disadvantaged neighbourhoods exacerbate existing social inequalities.(67) While socio-economically advantaged residents live in disadvantaged neighbourhoods and vice versa, it may be that the most disadvantaged families living in walkable, well-resourced inner city areas still have limited access to destinations and services. Furthermore, if these services incur costs, it could limit the availability of organised and non-organised activities and subsequently impact children's health and development. (63) While inner city areas offer more amenities and services, these may not be 'family-friendly'.(68, 69).

Our built environment findings also show some counterintuitive findings. For example, children living in the most disadvantaged inner city areas had 8% higher odds of developmental vulnerability for every additional high-quality childcare centre. A recent study using Western Australian AEDC data found that associations between built environment features and early childhood development (developmentally on track) were as expected for high socioeconomic neighbourhoods but mixed for more disadvantaged neighbourhoods. They similarly found that in more disadvantaged neighbourhoods, more education settings were associated with more children having poor physical and emotional development.(23) They concluded that the mixed findings for more disadvantaged neighbourhoods were likely due to a combination of

parental perceptions of the neighbourhood and quality and utilisation of built environment features (e.g., unaffordability of ECEC services located in the CBD). Access is also more complicated than we were able to address with this research. For example, living near a high-quality child care centre does not necessarily guarantee access in terms of service capacity, and where fees are higher, access to these child care centres may be limited for the most disadvantaged families. Also, inner city ECEC services may be attended by children whose caregivers work in the city, rather than children who reside in the city, but we are unable to determine this using our dataset.

Living in highly urbanised inner city areas may expose families to neighbourhood stressors like noise, crime, poor housing, and overcrowding, contributing to developmental vulnerabilities through the pathway of parent psychological distress (70-72). Being raised in a disadvantaged area further brings heightened exposure to risk from environmental hazards.(74) At the neighbourhood level, this includes concentrated poverty, high rates of crime and violence, and neighbourhood disorder and mistrust.(75) Others have found that both neighbourhood resources and stressors are higher in urbanised neighbourhoods, and this has been associated with poorer academic achievement.(76, 77) Neighbourhood stressors also align with key parental concerns about children's safety in the neighbourhood,(78-80) which can deter the use of neighbourhood resources.

Another plausible explanation for the higher likelihood of development vulnerability in disadvantaged inner city neighbourhoods relates to Melbourne's specific context. Many of the inner city's most disadvantaged neighbourhoods include public housing estates (including high-rise public housing towers). Melbourne is experiencing a shortfall in the public housing supply, and therefore, only families with the highest level of need are eligible for residence in public housing estates. The higher levels of developmental vulnerability observed in inner city, disadvantaged neighbourhoods in this study may reflect contextual influences relating to public housing estates specifically (e.g., maintenance and housing quality issues), demographic factors relating to the life circumstances of families living in public housing (e.g., families with complex needs), or a combination of both. For these families, the inner city neighbourhoods may be still more supportive than the alternative (e.g., living in growth areas with poor proximity to amenities and services), but the cross-sectional, observational nature of our study does not allow us to directly test this. Future research is needed to unpack these nuances to understand how inner-city

neighbourhoods can better support young families, especially those facing socioeconomic and other forms of disadvantage.

Built environment supports for early childhood development

Built environment domains of housing, walkability, public open space, and early childhood education and care were significantly related to developmental vulnerability. Recent reviews on the built environment and child development and mental health and wellbeing have found the most evidence supporting nature and public open space, local early childhood services, and housing related to children's mental health(81), and public open space with children's developmental outcomes.(26) These destination and service types may be more proximal and directly related to early childhood development outcomes than other built environment features such as traffic and public transport. Plausibly, these built environment features may have a greater influence on children's development as they acquire independent mobility. For example, although high traffic volumes impose constraints on young children's opportunities for play and social interaction (25), traffic may play a more influential role as children age and become more mobile in their local neighbourhood (e.g., walking to school and other destinations). It has been suggested that future research should consider a life-course approach to exploring built environment influences on early childhood, adolescence, and adult years (44).

Life in urban growth areas

Our findings show parents' perceptions of supportive built environments for families with young children align with our quantitative findings of housing, public open space, and early childhood education care services. Affordable housing, access to a mix of high-quality and well-maintained parks within walking distance, and available and accessible high-quality childcare were identified as important themes for supporting early development and wellbeing. Family-friendly activities and services such as libraries, parent groups, playgroups, and community and family support services were also important for families. While parents in growth areas wanted more libraries and improved quality (e.g., park features such as toilets), there generally wasn't a perceived 'lack of' locally available built environment infrastructure. Other research suggests that outer-suburban growth areas may offer benefits like better schools and less crime (82, 83), potentially providing a more balanced environment conducive to child development. Others have postulated that outer suburban areas and small towns may offer "the best of both worlds" for families.(76) That is, they may have

'enough' or 'moderate' availability or proximity to neighbourhood resources without being exposed to the 'chaos' of inner cities nor the geographic isolation of rural areas.(74).

Except for their expressed preference for walking to public open spaces (e.g., parks), walkability was not a main concern for parents living in outer urban areas as long as relevant destinations and services were accessible within a 15-30 minute drive. Our quantitative findings showed that more walkable environments were associated with greater developmental vulnerability overall, with greater effects for the most disadvantaged inner city areas only. Mixed findings may reflect our inability to account for family decision-making processes and neighbourhood self-selection (e.g., the reasons driving families' decisions to live in certain neighbourhoods, such as housing affordability or personal preferences). For example, families with young children are amongst the highest car ownership groups in Australia. In the latest 2021 Census, out of Australian households comprising two adults and one or more children, only 1%, or 6,414 families, did not own a motor vehicle. Other research has also shown that inner city mothers prioritised public transport access over the size of their homes. In contrast, outer suburban mothers preferred a larger home, and access to a car to travel to activities were highly valued.(84) Our findings show mixed preferences for larger versus smaller homes, but access to a car was considered a necessity.

For families without a private vehicle (or who do not have access to them during the day), the initial lag of infrastructure in outer and growth areas presents an equity problem. Those who can afford the cost of running a car can more easily drive to access essential services. While we found that most young children have neighbourhood access to basic local destinations and services, a higher proportion of families with no access to local public transport, early childhood education and care services, and family-friendly destinations live in outer suburbs and growth areas. This indicates that families may need to travel further (and potentially spend more on car running costs) to access some essential services for their needs. 'Transport disadvantage' has been explored using the proportion of income spent on daily travel, which includes private and public transport costs (e.g., fares) and parking.(87-89) Alongside the financial burdens of car ownership, families in outer and growth areas also report that long commute times negatively affect personal and family relationships by reducing the quality of time spent together.(90) Transport disadvantage, coupled with lower service accessibility and prevalent socio-

economic disadvantage in Melbourne's outer and growth areas, may compound to exacerbate disadvantage and widen inequities for many families with young children, particularly those most socio-economically disadvantaged. When families lack access to essential services like childcare locally, affordable and convenient public transport becomes vital, particularly if they don't have access to a car.(86)

5.3 Strengths, limitations and future directions

This study highlights several challenges and complexities of examining child development within different urban environments, particularly in the context of Melbourne.

Quantitative work

The strengths and limitations of the dataset have also been published in detail elsewhere.(29)

- The data are from observations (non-randomised) from a single point in time. This means some of the associations we see in the data could be influenced by the array of factors (e.g., housing affordability, preferences) driving families' decision-making about where to live. This may explain some of the counterintuitive findings and needs to be unpacked further. Future data linkage could leverage newly available population datasets (e.g., Child Wellbeing Data Asset) to explore these nuances in greater depth.
- Despite the data being outdated (from 2015-16), it remains relevant due to ongoing issues with delayed service and infrastructure provision in new developments.
- There is a time mismatch in variables, such as 2016 SEIFA-IRSD, 2016 urbanicity categories (based on 2003-2013 data), and 2015 AEDC data.
- Urbanicity is a proxy for built and social infrastructure present or absent in certain areas or distance from CBD. A nationally consistent measure of urbanicity could be developed to conduct national analyses in the future.

- We used individualised buffers as 'neighbourhood' units (i.e., spatial road network buffer around children's home addresses), meaning there is potential overlap between children's neighbourhoods. That is, if two children lived next to each other, the built environment within their 800m 'neighbourhood' would be similar. Results may be different if contiguous geographic areas such as an SA1 were used.
- We examined one developmental outcome because DV1 is the primary indicator used by policy makers and service providers and is the most predictive of later outcomes in comparison to the individual domains of child development.(93) We explored associations with other AEDC developmental domains e.g., AEDC developmental domain (e.g., Social competence, Physical health and wellbeing, developmentally vulnerable on two or more domains (DV2) but the results are unreliable due to model instability.
- A key limitation is that our measurement of service availability (such as ECEC) focuses solely on geographic availability and proximity rather than service capacity (e.g., number of open enrolments). While proximity measures indicate whether children can physically reach these services, they do not consider factors like enrolment capacity or waitlists, which considerably affect 'true accessibility'. This is especially relevant in high population density areas such as the inner city, where more families may compete for limited service availability. Although we considered urbanicity, we could not precisely adjust for differences in child population density across the city and the corresponding impact on open enrolments. Thus, some children may have been misclassified as having 'available' ECEC with no vacancies, potentially underestimating the true magnitude of association.(34)
- Future research should replicate this work with updated datasets (e.g., 2018 and 2021) and also explore other Australian cities and international contexts. For example, the analyses could also be applied internationally as the developmental vulnerability outcome measure is based on the Canadian Early Development Index (EDI). (91)

Qualitative work and mixed methods

Part 4 outlines our recruitment and data collection challenges, and the use of Maptionnaire as a method for understanding young children's lived experiences of their neighbourhoods.

Understanding neighbourhood self-selection is crucial for creating more relevant policies and strategies that are genuinely meaningful for families with young children.

- Future research needs to investigate the interplay between neighbourhood disadvantage, urbanicity, built environment, early childhood development, and other unmeasured social factors (e.g., parent perceptions of neighbourhood, community factors such as social capital) to understand and contextualise the associations.
- We could do this better by using mixed methods approaches to investigate family travel preferences, any trade-offs associated with travel, where families access destinations and services and why (i.e., their activity spaces and preferences), and how this interacts with other community factors such as safety and social connections.
- In particular, exploring the lived experiences of specific subgroups such as disadvantaged families with no car living in growth areas and disadvantaged families living in highly urbanised inner city areas is needed to best understand how to support families with young children who are potentially experiencing the greatest level of neighbourhood 'double disadvantage'.

5.4 Conclusion

In this project, we found that neighbourhood disadvantage was associated with developmental vulnerability even after adjustment for child and family factors, but urbanicity was not. Children living in the most disadvantaged inner-city areas were most at risk of developmental vulnerability, followed by the most disadvantaged areas in middle city, growth, and outer ring areas.

More consistent findings identified housing, walkability, public open space, and early childhood education and care as being associated with developmental vulnerability. Parents living in growth areas also perceived these built environment features as supportive of young children's development and wellbeing and also highlighted the importance of other family-friendly destinations and services such as libraries, parent groups, and playgroups for social interaction. Walkability to public open space was favoured by parents living in growth areas, but living within walking distance to other amenities and infrastructure was not a main concern. Our findings further support the need to focus policy interventions or place-based initiatives in the most disadvantaged areas and tailor interventions by urbanicity (e.g., inner city).



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Part 7 Appendices

Appendix A: Built Environment Data Sources

Appendix B: Neighbourhood double disadvantage and odds of developmental vulnerability (DV1, DV2, PHYS, SOC) across Melbourne

Appendix C: Built environment and odds of developmental vulnerability (DV1, DV2, PHYS, SOC)

Appendix D: Maptionnaire and focus group guide

Appendix E: Current outputs

1. APPENDIX A Built environment data sources

Table 26. Built environment data sources

Custodian	Year	Data source description	Purpose
Department of Education, Skills and Employment (now Australian Government Department of Education)	2015	Australian Early Development Census	Child development data, child demographics including data relating to geography derived using publicly available ABS sources (SEIFA-IRSD of child's SA1, ASGS remoteness category)
ABS	2016	Census of population and housing, customised data report	Housing affordability
	2016	ASGS Volume 1 geopackage	Mesh Block, SA1, SA2, SA3, SA4, GCCSA boundaries
	2016	Mesh Block dwelling and person counts	Dwellings
	2016	Mesh Block - Suburb linkage csv	Suburb
	2016	Mesh Block - LGA linkage csv	LGA
	2016	SA1 urban centres and localities linkage	Section of State
	2016	ASGS Volume 3 geopackage	Suburb and LGA geometries
	2016	ASGS Volume 4 geopackage	Significant Urban Area geometries
	2016	SEIFA IRSD 2011 (SA1)	IRSD related statistics
OpenStreetMap		Retrieved 1 October 2018	
	2018	Pedestrian network, generated using OSMnx, using Overpass API using hybrid walk-cycle network	Accessibility analysis
	2018	Intersections, generated using OSMnx with processed pedestrian network	Modelling street connectivity
	2018	Destinations (see definitions, elsewhere)	Accessibility analysis
	2018	Open Space (see definitions, elsewhere)	Accessibility analysis
ACECQA	2019	Australian Children's Education & Care Quality Authority child care centres (geocoded)	Accessibility analysis
ACARA	2019	Australian Curriculum, Assessment and Reporting Authority (ACARA), Primary and secondary schools, by sector (geocoded)	Accessibility analysis
NHSD	2017	National Health Services Directory (via AURIN Portal)	Accessibility analysis
Pitney Bowes	2014	Convenience stores	Accessibility analysis
Pitney Bowes	2014	Newsagencies	Accessibility analysis
Pitney Bowes	2014	Petrol stations	Accessibility analysis

Custodian	Year	Data source description	Purpose
HLC	2017	Additional geocoded datasets curated by Health Liveable Cities group from multiple sources (supermarket major chains, 2017; Australian Libraries, 2016-18)	Accessibility analysis
PSMA	2017	Transport and Topography	Traffic exposure
State Transport agencies	2018	GTFS feed data covering the period 8 October to 5 December for 2018	Accessibility and transport analysis

Key: Reproduced directly from Villanueva et al, 2020.(40)



2. APPENDIX B Neighbourhood double disadvantage and odds of developmental vulnerability (DV1, DV2, PHYS, SOC) across Melbourne

Table 27. Neighbourhood double disadvantage and odds of developmental vulnerability (DV1, DV2, PHYS, SOC) across Melbourne

Neighbourhood disadvantage quintile	DV1 ^a OR (95%CrI)	DV2 ^b OR (95%CrI)	PHYS ^c OR (95%CrI)	SOC ^d OR (95%CrI)
Q5 (Least disadvantaged)				
Inner city	1.0	1.0	1.0	
Middle ring	1.05 (0.84-1.28)	1.08 (0.75-1.55)	0.84 (0.62-1.11)	1.43 (1.00-1.93)*
Outer ring	1.06 (0.83-1.32)	1.09 (0.72-1.62)	0.75 (0.54-1.02)*	1.10 (0.74-1.55)
Growth area	1.16 (0.92-1.44)	1.35 (0.93-1.94)	1.03 (0.75-1.39)	1.57 (1.10-2.11)**
Q4				
Inner city	1.40 (1.03-1.85)*	1.62 (1.00-2.49)*	1.25 (0.79-1.85)	1.75 (1.11-2.61)**
Middle ring	1.05 (0.86-1.29)	1.25 (0.88-1.79)	0.87 (0.64-1.14)	1.47 (1.05-1.97)*
Outer ring	1.20 (0.94-1.49)	1.47 (0.99-2.18)*	0.90 (0.65-1.21)	1.59 (1.10-2.21)**
Growth area	1.41 (1.12-1.72)**	1.67 (1.18-2.37)	1.10 (0.82-1.46)	2.13 (1.52-2.81)***
Q3				
Inner city	2.00 (1.29-2.92)**	2.59 (1.44-4.31)***	1.28 (0.64-2.23)	2.72 (1.45-4.48)***
Middle ring	1.25 (1.00-1.52)*	1.48 (1.03-2.11)*	0.92 (0.67-1.22)	1.71 (1.21-2.31)***
Outer ring	1.48 (1.17-1.83)***	1.61 (1.09-2.36)**	1.18 (0.85-1.56)	1.81 (1.24-2.49)***
Growth area	1.58 (1.28-1.93)***	1.82 (1.28-2.57)***	1.16 (0.86-1.53)	2.15 (1.54-2.84)***
Q2				
Inner city	1.89 (0.98-3.26)*	1.50 (0.49-3.25)	1.15 (0.36-2.46)	0.60 (0.08-1.70)
Middle ring	1.54 (1.21-1.89)***	1.81 (1.24-2.58)***	1.11 (0.79-1.50)	1.85 (1.29-2.52)***
Outer ring	1.94 (1.54-2.40)***	2.44 (1.65-3.52)***	1.66 (1.21-2.19)**	2.32 (1.59-3.17)***
Growth area	1.82 (1.47-2.22)***	2.13 (1.49-3.02)***	1.35 (0.99-1.79)*	2.35 (1.67-3.11)***
Q1 (Most disadvantaged)				
Inner city	3.86 (2.73-5.29)***	5.02 (3.24-7.45)***	3.53 (2.29-5.14)***	5.90 (3.84-8.60)***
Middle ring	2.14 (1.65-2.67)***	2.72 (1.87-3.91)***	1.71 (1.21-2.30)**	2.44 (1.69-3.37)***
Outer ring	1.99 (1.58-2.46)***	2.33 (1.57-3.39)***	1.71 (1.27-2.26)***	2.51 (1.75-3.44)***
Growth area	2.06 (1.66-2.54)***	2.41 (1.69-3.43)***	1.54 (1.13-2.05)**	2.61 (1.84-3.46)***

Key: CrI: Credible Interval. OR: Odds ratio. Q: Quintile. ^aDV1: Developmentally vulnerable on one or more domains. ^bDV2: Developmentally vulnerable on two or more domains. ^cPHYS: Developmentally vulnerable on the physical health and wellbeing domain. ^dSOC: Developmentally vulnerable on the social competence domain. Model 1 (Neighbourhood area type and DV1) results are not presented. Model 2: Model 1 plus adjustment for child/family variables: child sex, child age group, child language background other than English, child Indigenous status, maternal education. See **Table 2** for variable descriptions. ***Statistically significant at p<0.001; **p<0.01; *p<0.05. **Notes:** Proportion of children DV1 (n=9,169, 19.2% of 47,743 children), Proportion of children DV2 (n=4,457, 9.31% of 47,857 children); Proportion of children PHYS (n=3,531, 7.37% of 47,901 children); Proportion of children SOC (n=4021, 8.40% of 47,893 children). The total sample sizes slightly differ for each outcome because separate datasets were derived based on removing children with missing data on key AEDC variables of interest (e.g., maternal education, neighbourhood disadvantage, outcome (i.e., DV1, DV2, PHYS, SOC). Urbanicity categories for DV1 sample: Inner city n=2,274. Middle ring n=17,523. Outer ring n=12,054. Growth area n=15,892. Neighbourhood area type combines neighbourhood disadvantage quintiles and urbanicity category for each Statistical area level 1, average of 400 persons.



3. APPENDIX C Built environment and odds of developmental vulnerability (DV1, DV2, PHYS, SOC)

Warning: The results for DV2, PHYS, and SOC are unreliable due to analysis problems (unstable models).

Table 28. Built environment and odds of developmental vulnerability (DV1, DV2, PHYS, SOC)

Built environment measure	Model 1 OR (95% CrI)				Model 2 OR (95% CrI)			
	DV1 ^a	DV2 ^b	PHYS ^c	SOC ^d	DV1 ^a	DV2 ^b	PHYS ^c	SOC ^d
Traffic								
Traffic exposure to busy roads ¹	1.11 (1.01-1.21)*	1.21 (1.07-1.36)**	1.04 (0.92-1.17)	1.13 (1.00-1.28)*	1.05 (0.96-1.15)	1.13 (1.00-1.28)*	0.95 (0.82-1.09)	1.10 (0.96-1.24)
Housing								
Housing affordability stress ¹ (per 10%)	1.08 (1.07-1.10)***	1.08 (1.06-1.10)***	1.07 (1.05-1.10)***	1.09 (1.07-1.12)***	1.05 (1.03-1.07)***	1.05 (1.03-1.07)***	1.05 (1.03-1.08)***	1.06 (1.04-1.08)***
Dwelling density ³ (per 10)	1.02 (0.98-1.06)	1.04 (0.99-1.09)	1.07 (1.02-1.13)**	1.04 (0.98-1.09)	1.04 (0.98-1.11)	1.07 (0.99-1.16)*	1.05 (0.97-1.15)	1.11 (1.03-1.21)**
Walkability								
Local living score ³	1.00 (0.99-1.01)	1.00 (0.99-1.01)	1.01 (0.99-1.02)	0.99 (0.98-1.00)	1.01 (0.99-1.02)	1.01 (0.99-1.03)	1.00 (0.99-1.02)	0.99 (0.97-1.01)
Walkability score ³	1.02 (1.01-1.03)**	1.03 (1.01-1.04)**	1.03 (1.02-1.05)**	1.02 (1.00-1.04)*	1.02 (1.01-1.04)**	1.03 (1.00-1.05)*	1.03 (1.01-1.06)**	1.02 (1.00-1.05)*
Public transport								
Number of public transport stops with frequent weekday service ³	1.00 (1.00-1.00)	1.00 (1.00-1.00)	1.00 (1.00-1.00)	1.00 (1.00-1.00)	1.00 (1.00-1.00)	1.00 (1.00-1.00)	1.00 (1.00-1.00)	1.00 (1.00-1.00)
Distance to closest public transport stop with frequent service (per 100m)	1.00 (1.00-1.00)	1.00 (1.00-1.00)*	1.00 (1.00-1.00)*	1.00 (1.00-1.00)**	1.00 (1.00-1.00)	1.00 (1.00-1.00)	1.00 (1.00-1.00)***	1.00 (1.00-1.00)
Family-friendly destinations								
Family-friendly destinations score ⁵	1.00 (0.98-1.03)	1.00 (0.97-1.03)	1.02 (0.99-1.05)	0.99 (0.97-1.02)	1.02 (0.99-1.05)	1.01 (0.98-1.04)	1.02 (0.98-1.06)	1.01 (0.98-1.05)
Public open space								
Number of public open space in 800m ²	1.00 (0.99-1.00)*	1.00 (0.99-1.00)	1.00 (0.99-1.01)	1.00 (0.99-1.00)*	0.99 (0.99-1.00)*	1.00 (0.99-1.00)	1.00 (0.99-1.00)	0.99 (0.98-1.00)*
Mix of public open space ²	0.98 (0.96-1.00)	0.97 (0.95-1.00)*	0.99 (0.96-1.01)	0.98 (0.95-1.01)	0.98 (0.96-1.00)*	0.97 (0.95-1.00)*	0.98 (0.95-1.01)	0.98 (0.95-1.01)
Distance to closest public open space (per 100m)	1.00 (0.99-1.01)	1.00 (0.99-1.02)	1.00 (0.00-1.01)	1.00 (0.99-1.01)	1.00 (0.99-1.01)	1.01 (0.99-1.02)	1.00 (0.00-1.01)	1.00 (0.99-1.02)
Distance to closest child-friendly POS (per 100m)	1.01 (1.00-1.01)***	1.01 (1.00-1.01)***	1.01 (1.00-1.01)**	1.01 (1.01-1.01)***	1.00 (0.99-1.00)*	1.01 (1.00-1.01)**	1.01 (1.00-1.01)*	1.01 (1.00-1.01)**

Built environment measure	Model 1 OR (95% CrI)				Model 2 OR (95% CrI)			
	DV1 _a	DV2 _b	PHYS _c	SOC _d	DV1 _a	DV2 _b	PHYS _c	SOC _d
Presence of child-friendly POS in 800m	0.92 (0.87-0.97)**	0.87 (0.81-0.93)***	0.94 (0.87-1.01)*	0.86 (0.80-0.92)***	0.96 (0.90-1.01)	0.89 (0.83-0.96)**	0.95 (0.88-1.03)	0.89 (0.83-0.96)**
Food outlets								
Percentage of healthier food outlets _s (per 10%)	1.00 (0.98-1.01)	1.00 (0.98-1.02)	0.98 (0.96-1.00)*	1.01 (1.00-1.03)	1.00 (0.98-1.01)	1.00 (0.98-1.02)	0.98 (0.96-1.00)*	1.01 (0.99-1.03)
Early childhood education and care								
Number of childcare centres exceeding national standards ₄	0.99 (0.98-0.99)***	0.98 (0.98-0.99)***	0.99 (0.98-1.00)*	0.98 (0.98-0.99)***	0.99 (0.99-1.00)*	0.99 (0.98-1.00)*	1.00 (0.99-1.00)	0.99 (0.98-1.00)**
Distance to closest childcare centre exceeding national standards (per 100m)	1.00 (1.00-1.00)	1.00 (1.00-1.00)	1.00 (1.00-1.00)	1.00 (1.00-1.00)	1.00 (1.00-1.00)	1.00 (1.00-1.00)	1.00 (1.00-1.00)	1.00 (1.00-1.00)
Number of preschools exceeding national standards ₄	0.96 (0.95-0.97)***	0.96 (0.94-0.97)***	0.97 (0.95-0.98)***	0.95 (0.94-0.97)***	0.98 (0.97-1.00)**	0.98 (0.97-1.00)*	0.98 (0.96-1.00)**	0.97 (0.96-0.99)***
Distance to closest preschool exceeding national standards (per 100m)	1.00 (1.00-1.00)*	1.00 (1.00-1.00)	1.00 (1.00-1.00)	1.00 (1.00-1.00)*	1.00 (1.00-1.00)	1.00 (1.00-1.00)	1.00 (1.00-1.00)	0.99 (0.97-1.00)

Key: CrI: Credible Interval. OR: Odds ratio. Q: Quintile. _aDV1: Developmentally vulnerable on one or more domains. _bDV2: Developmentally vulnerable on two or more domains. _cPHYS: Developmentally vulnerable on the physical health and wellbeing domain. _dSOC: Developmentally vulnerable on the social competence domain. ₁Spatial unit is Statistical Area Level 1 (SA1); ₂800m, ₃1,600m, ₄3,000m, or ₅3,200m street network distance around child's home. Count of child-friendly POS is not available in the dataset. Model 1: Built environment plus child/family variables: child sex, child age group, child language background other than English, child Indigenous status, maternal education. Model 2: Model 1 plus adjustment for neighbourhood double disadvantage. See **Table 2** for variable descriptions. ***Statistically significant at p<0.001; **p<0.01; *p<0.05.

Notes: Proportion of children DV1 (n=9,169, 19.2% of 47,743 children), Proportion of children DV2 (n=4,457, 9.31% of 47,857 children); Proportion of children PHYS (n=3,531, 7.37% of 47,901 children); Proportion of children SOC (n=4,021, 8.40% of 47,893 children). The total sample sizes slightly differ for each outcome because separate datasets were derived based on removing children with missing data on key AEDC variables of interest (e.g., maternal education, neighbourhood disadvantage, outcome (i.e., DV1, DV2, PHYS, SOC)).



4. APPENDIX D Maptionnaire and focus group guide

Parent (primary caregiver) Maptionnaire survey

Page 1

What is it about where you live that affects the health and wellbeing of families with young children?

About this survey

This survey is about life in your neighbourhood. The 'Data to Decisions' Study aims to understand parents' (and children's) views on how their cities and neighbourhoods play a role in young children's development and wellbeing.

Where do you go in your neighbourhood? What places do you think are important for your child's health, development and wellbeing and why? This survey will allow you to tell us using interactive maps!

Who is conducting this survey?

RMIT University.

Am I eligible to participate?

If you are a parent or primary care giver of a young child aged 4-8 years, have lived in your neighbourhood for at least 6 months, and are over 18 years of age, we would like to hear from you. You are receiving this because your local council are our project partners.

How long will this survey take?

The survey will take about [20-30] minutes to complete. Filling out this survey is voluntary.

How will your information be used?

The information we collect from you will be used in our research about what it is about neighbourhoods that supports young children's development.

Consent

If you don't want to complete the survey, you don't have to. If you do participate, there are no wrong answers. By completing the survey, you will be giving us consent to use the information you provide in this research project and related publications.

Confidentiality

Responses are anonymous, so we do not need your name. We just want your opinion, and all your answers are strictly confidential as required by our University's Human Research Ethics Committee. We will not report any information about individual families or children. Our

research will report what we learn about what makes neighbourhoods good for children and families in general.

Win ONE of 10x \$50 vouchers

To thank you for participating in this online survey, you can go in a prize draw to win one of 10 x \$50 Coles vouchers. For parents recruited through schools and childcare services, a book voucher of equal value will be made to your local school or childcare instead. We would appreciate it if you could complete the survey within the next two weeks [that is by [insert date two weeks away]]. If you wish, we can provide you with a summary of project findings at the end of the study.

Contact and further information

If you have any questions or need assistance completing the survey, please reach out to us.

Data to Decisions Project Coordinator: Dr Karen Villanueva: karen.villanueva@rmit.edu.au

If you would like more information on the project, please read through the Project Information and Consent Form found here [<https://cur.org.au/project/data-to-decisions/> or Attach here]

Thanks for taking time to consider this invitation!

Are you eligible to complete this survey? Please answer these three questions

[Mandatory question]:

- 1) Have you lived in your neighbourhood for at least 6 months?
 - Yes
 - No [unfortunately you are not eligible to complete this survey] [exit survey]
- 2) Are you a parent or primary caregiver of a child aged 0-8 years old?
 - Yes
 - No [unfortunately you are not eligible to complete this survey] [exit survey]
- 3) Are you over 18 years old?
 - Yes
 - No [unfortunately you are not eligible to complete this survey] [exit survey]

[proceed to survey]

Page 2

How are you completing this survey today?

Online - first page of survey

Face-to-face with support from a RMIT team member [skip to next question on page

3]

Page 3

Enter your unique code here: [mandatory question] [This is the code given to you by a RMIT team member (face-to-face participants only)]

Page 4 [text information/instructions only]

Let's improve neighbourhoods for families with young children! *We would like to learn more about your neighbourhood experiences with your child. What neighbourhood qualities help children be happy, healthy, and learn about the world? Which places and environments outside the home are used the *most* by young children and families?*

This section is a map-based questionnaire, which means you can place your answers directly on a map. We will ask you to mark 3 things:

1. Your home or nearest street intersection
2. Places you think are **important** for your child's health, development and wellbeing.
3. Other places you **usually** visit with your child on a daily or weekly basis, or on weekends. If you have already mapped this place as an *important* place, then you *do not* need to map this place again.

Do you have more than one child aged 0-8 years old?

Yes. Yes. If yes, please answer this survey with the following in mind.

Online participants

Please answer these questions thinking about your child who has had their *most recent birthday*.

Face-to-face participants

Please answer these questions thinking about your *child who is participating in this study*.

Page 5 [text information/instructions only]

Let's practice ! (if you need) *Navigating the map is similar to how you might use google maps, for example. You can navigate and move the map by clicking and dragging the map and zoom in and out with your mouse, trackpad or with your fingers on a phone or tablet.*

Feel free to skip this page and move to the mapping activity if you are confident using the map features

Symbols to help you map

You will see six symbols directly to the right of this box which help you navigate the map.

1. '+' lets you zoom in
2. '-' lets you zoom out
3. The third symbol down lets you search an address or place.
4. The fourth symbol down shows your current location.
5. The fifth symbol down brings you back to the original start point.
6. The last symbol hides this panel.

Switching map views

You will see a 'diamond-shaped' button in the *top right corner*. This lets you change the map, for example to a satellite or aerial image.

Marking a place on a map and answering questions about it

Use the button bar and click where you want to place it on the map. A pop-up box will appear with follow up questions. Click 'done' when you have finished.

Deleting a place

If you want to delete a place you have marked on the map, click on it and press delete.

Click the example blue bar below to try for yourself! [This button lets you place a point on the map]

Pop-up question when participant places a point on the map:

Do you feel comfortable marking a place on the map?

Yes (you're ready to map ! Select 'Done', and click on the right arrow to proceed)

I need more practice (Select 'Done', and click on the blue button bar to mark another place on the map)

Page 6

Map your every day experiences and important places

Which local government area do you live in?

City of Port Philip

Cardinia Shire

Other local government area

Which suburb do you live in ? [enter the suburb you live in]

Task 1. Mark your home or nearest street intersection [Home]

Task 2. Mark the places you think are IMPORTANT to your child's health, development and wellbeing and answer the questions in the pop-up window [Important place]

(For each place):

- 1) What is this place? [Write name or brief description (e.g., Ascot Park, child care centre)]
- 2) How would you rate this place's ability to support your child's learning, development, and wellbeing? *(Please select ONE response for each statement. By supportive we mean it is a 'good' place for encouraging your child's learning, development, and wellbeing)*

<i>This place encourages my child's...</i>	<i>Very supportive</i>	<i>Supportive</i>	<i>Not very supportive</i>	<i>Not supportive at all</i>	<i>Does not apply: this place is harmful ('bad') for my child</i>
--	------------------------	-------------------	----------------------------	------------------------------	---

Physical skills (e.g. playing, running, jumping, getting exercise)

Social skills (e.g. playing, sharing and getting along with other children, negotiating personal needs, trying new things)

Emotional maturity (e.g. helping others, patient and not aggressive or angry)

Language and cognitive skills (e.g. pre-reading, reading, language, vocabulary, numeracy)

Communication skills (e.g. expressing their needs, seeking help from adults, listening, interacting with other children and adults)

- 3) What is it about this place that is good for your child's learning, development and wellbeing? *(Select all that apply)*

The physical design (e.g., beautiful to look at, has lots of space)

The people we spend time with here (e.g., friends, meeting new people)

Feeling safe here

The activities offered here (e.g., programs for kids, places to play)

Other [skip to next question]

None of the above: This place is harmful ('bad') for my child's [skip to next question]

- 4) *[Open-ended question] Why is this place is supportive (or not supportive) for your child's learning, development and wellbeing? [It is okay if you want to write a few words]*
- 5) *[Open-ended question] Is there anything about this place that you think could be changed to better support young children's learning, development and wellbeing? [It is okay if you want to write a few words]*

Visiting this place

- 1) How often do you USUALLY go here with your child?

Every day

More than once per week

Once per week

Once per month

Less than once per month

2) Weekday visits (Monday-Friday)

2a) How much time does your child usually spend in this place on a WEEKDAY?

Multiple choice questions:

My child DOES NOT go here on weekdays

15 minutes or less

Between 16 and 30 minutes

Between 30 and 60 minutes

More than one hour

2b) How does your child USUALLY travel to this place during WEEKDAYS? (tick all that apply)

My child DOES NOT go here on weekdays

Walk (without a pram)

Walk (with a pram)

Bike/non-motorised scooter

Motorised scooter or motorbike

By public transport (bus, tram, train)

By private car
Rideshare (e.g., taxi, Uber, Lyft.)
With a dog
Other: (please list in next question)

[open-ended response] If you selected "Other", how does your child usually travel to this place during WEEKDAYS?

2c) [Open-ended question] What kinds of activities does your child/family usually do here during WEEKDAYS? (It is okay if you want to write a few words or list of activities)

3) Weekend visits (Saturday-Sunday)

[Repeat questions 2a-2c but for weekends]

Have you finished mapping your important places ? [information/instructions only]

No, I need to mark *another* place on the map

Click 'Done', then use the GREEN button bar to mark another *important* place

Yes, I have finished and would like to go to the next task

Click 'Done', then start mapping your USUAL places using the PINK button bar

Task 3. Mark other places you USUALLY visit with your child and answer the questions in the pop-up window [Usual place]

Map any *other* places you USUALLY visit. If you have already mapped this as an *Important* place (Task 2) then you DO NOT need to map it again here

(For each place):

Multiple choice questions:

a) How many days in a USUAL week do you visit this location with your child?

1-2 days per week

3-4 days per week

5-6 days per week

Every day

[Repeat the same 2a-2c questions here]

Page 7 [information/instructions only]

About your neighbourhood

What's in this section?

This section is about your neighbourhood. By neighbourhood, we mean the *local area around your home*.

Why are we asking for this information?

This section will help us to understand what qualities make these environments more family-friendly.

Page 8

How long have you lived in your neighbourhood/area?

6months to one year

1-5 years

6-10 years

11+ years

Don't know

Page 9

PLACES AND SERVICES

How strongly do you agree or disagree with the following statements about your neighbourhood? (Please select ONE response for each statement)

There are places for children to play in this neighbourhood

There are good parks, playgrounds and play spaces in this neighbourhood

There is access to close, regular transport in this neighbourhood

There is access to basic shopping facilities in this neighbourhood

There is access to healthy food in this neighbourhood

Healthy food options are affordable in this neighbourhood

There is not a lot of unhealthy (e.g., fast food) in this neighbourhood

There is affordable housing in this neighbourhood

The houses in this neighbourhood are good for families with children

There is access to basic services such as childcare, banks, medical clinics etc. in this neighbourhood

There are places to meet other families in this neighbourhood

Page 10

NEIGHBOURHOOD SAFETY

How strongly do you agree or disagree with the following statements about your neighbourhood? (Please select ONE response for each statement)

There is a lot of petty crime in my neighbourhood (such as vandalism, shoplifting)

There is a lot of major crime in my neighbourhood (such as armed robberies, break-ins, attacks)

Streets in my neighbourhood are well lit at night
There is heavy traffic on my street or road

It is safe for children to play outside during the day

Page 11

NEIGHBOURHOOD SURROUNDINGS

How strongly do you agree or disagree with the following statements about your neighbourhood? (Please select ONE response for each statement)

- My neighbourhood is generally free from litter, rubbish, or graffiti*
- There is lots of greenery around my neighbourhood (trees, bushes, household gardens)*
- There are many interesting things to look at while walking in my neighbourhood*
- There are attractive buildings and homes in my neighbourhood*
- The state of footpaths is good in this neighbourhood*

Page 12

PEOPLE IN YOUR NEIGHBOURHOOD

How strongly do you agree or disagree with the following statements about people in your neighbourhood? (Please select ONE response for each statement)

- I often see adults walking in my neighbourhood*
- I often see children walking in my neighbourhood*
- There are often children playing on the footpaths in this neighbourhood*
- People around here are willing to help their neighbours*
- People in this neighbourhood generally do not get along with each other*
- People in this neighbourhood do not share the same values*
- I feel a strong sense of identity with my neighbourhood*
- This is a close-knit neighbourhood*
- Most people in our neighbourhood can be trusted*
- Community organisations in my neighbourhood can be trusted*
- Local government organisations in my neighbourhood can be trusted*
- Commercial organisations in my neighbourhood can be trusted*
- I feel connected to my community*
- Generally, this is a good neighbourhood to bring up young children*

Page 13

About you and your family

What's in this section?

This section includes questions about your household. The purpose of this section is to have some background information on the families participating in this study.

Why are we asking for this information?

This will help us better understand how parents' experiences of their neighbourhoods might

vary from one family to another. It will also help us make sure that we hear from a range of families.

Page 14

What is your gender?

- Male*
- Female*
- Non-binary*
- Prefer not to say*

What is your age group? (years)

- 18-24*
- 25-34*
- 35-44*
- 45-54*
- 50-64*
- 65 or over*

Number of children normally living in your household

How many children (under 0-8 years old) normally live in your household?

- 1*
- 2*
- 3*
- 4 or more*

How many children (under 9-18 years old) normally live in your household?

- 1*
- 2*
- 3*
- 4 or more*

Page 15

What is the gender of your child who is between 0 and 8 years old?

What is the gender of your child who is between 0-8 years old and had their most recent birthday?

- Female*
- Male*
- Non-binary*
- Prefer not to say*

Please select the gender of your other children aged between 0-8 years old (select all that apply)

Female
Male
Non-binary
Prefer not to say

Face-to-face participants only

What is the gender of your child participating in this study?

Female
Male
Non-binary
Prefer not to say

Page 16

What is the highest level of education you have completed?

Less than Year 10 (or equivalent)
Year 10 or 11 (or equivalent)
Year 12 (or equivalent)
Trade/apprenticeship
Certificate/diploma
Bachelor Degree or higher

Page 17

How would you describe your current employment status?

In full-time work
In part-time or casual work
Unemployed and seeking work
Unemployed and not seeking work
Full-time student
In full-time home duties
Unable to work or retired
Other

Page 18

'Other' employment status, please specify:

Page 19

How would you describe the type of home that your family lives in?

Separate house
Semi-detached, row or terrace house, townhouse, villa (or similar) with one storey

Semi-detached, row or terrace house, townhouse, villa (or similar) with two or more storeys
Flat or apartment in a one or two storey block
Flat or apartment in a three storey block
Flat or apartment in a four or more storey block
Flat or apartment attached to a house
House or flat attached to a shop, office, etc.
Other

Page 20

'Other' type of home, please specify:

Page 21

Which of the following best describes your family/household structure?

Single parent/caregiver
Two or more parents/caregivers, cohabiting
Two or more parents/caregivers, not cohabiting
Multi-generational household
Other

Page 22

'Other' family/household structure, please specify:

Page 23

Does your family have access to a car?

Yes, just one car
Yes, more than one car
No car

Page 24

Does your family have access to a private garden (e.g. back or front yard)?

Yes
No

Page 25

Does your family have a dog?

Yes
No

Page 26

Satisfaction with Life as a Whole

The following question asks how satisfied you feel, on a scale from zero to 10. Zero means you feel no satisfaction at all and 10 means you feel completely satisfied.

Thinking about your own life and personal circumstances, how satisfied are you with your life as a whole? [0 (no satisfaction at all) – 10 (completely satisfied)]

Page 27

Would you like to add any other comments about raising children in your neighbourhood?

Yes (write your comments below)

No (skip the next question)

[Open-ended question] **Further comments about raising young children in your neighbourhood**

Page 28

Thank you for participating!

If you would like to:

- 1) Win one of ten \$50 Coles/Myer vouchers
- 2) Request a summary of the project findings
- 3) Register your interest in participating in a small focus group about raising young children in my neighbourhood.

Then click on this link to enter your contact details: [insert link directing participant to Qualtrics https://rmit.au1.qualtrics.com/jfe/form/SV_6FKpTAWGCztFmSQ]

Read more about the project and small focus group: <https://cur.org.au/project/data-to-decisions/> [or attach PLS/Consent form]

[In Qualtrics]

Thank you for participating in the 'Data to Decisions' project about creating family-friendly neighbourhoods

I would like to: (tick all that apply)

☐ Win one of ten \$50 Coles vouchers. For parents recruited through schools and childcare settings, a book voucher of equal value will be made to your local school or childcare instead of the Coles voucher.

☐ Request a summary of the project findings:

☐ Register my interest in participating in a small focus group about raising young children in my neighbourhood. Read more about what's involved here: [attach PLS/Consent form]

What is your preferred contact method? (tick all that apply)

Email

Phone

Enter your email address:

Enter your name and phone number: _____

Thank you for participating!

Section D: Children's meaningful places (children, either as a separate questionnaire, or as part of the same parent questionnaire to be completed with assistance from their parents) This is a separate link found here: <https://app.maptionnaire.com/q/3lj7348kas38>

Page 1

Kids Maptionnaire survey – let's begin!

Enter your unique code here (This is the code given to you by a RMIT team member)

Page 2

Map your important places!

We would like to learn more about your neighbourhood experiences. What neighbourhood qualities help you and other children be happy, healthy, and learn about the world?

This section is a map-based questionnaire, which means you can place your answers directly on a map. We will ask you to mark places that are important to you. Which local government area do you live in?

City of Port Philip

Cardinia Shire

Other local government area

- 1) Mark on the map the places that are important to you and answer the questions in the pop-up window

(For each place):

Multiple choice questions:

- a) How often do you go there?

Every day

More than once per week

Once per week

Once per month

Less than once per month

- b) How much time do you typically spend there?

Less than 15 minutes

15-60 minutes

More than an hour

- c) How do you typically travel there?

Walk (without a pram)

Walk (with a pram)

Bike/non-motorised scooter

Motorised scooter or motorbike
Bus, tram or train
Car
Rideshare (e.g., taxi, Uber, Lyft)
With a dog
Other (please list in next question): _____

If you selected "Other", how do you usually travel to this place?

- d) Some kids like this place and other kids don't like this place. Which one are you more like?

Like this place
Don't like this place

- e) And so, do you dis/like this place "a little" or "a lot" ?

A little
A lot

Open-ended questions:

- f) What sort of things do you do in this place?
g) What do you like about this place?
h) Is there anything you don't like about this place?

Page 3

You're finished!

Thank you for your time and participation in the project.

Read more about the project here: <https://cur.org.au/project/data-to-decisions>

Indicative Focus Group Questions (Child Focus Groups):

Section 0: Rapport-building and drawing activity:

Can you tell me your name? How old are you? What do you like to do when you're not at school/preschool/kindy?

Today, I want to learn more about what you think about where you live. I'm going to ask you some questions about your neighbourhood, the places you go, what you like and don't like. First, I was hoping you could draw me a picture of where you live and some of the places you think are important. Once you are ready to show me your picture, I will ask you to tell me about what you drew. Does that sound OK? Remember, there are no right or wrong answers.

To help everybody think about what to draw, can someone tell me what you think the word 'neighbourhood' means? What are the different types of places in your neighbourhood?

Can you tell me about the picture you drew?

Section 1: Meaningful places

What things do you like about your neighbourhood?

What places do you like to go to in your neighbourhood? Why do you like them?

Is there anything you don't like about your neighbourhood?

Section 2: Opportunities for activities with family and friends

What kinds of things do you like to do in your neighbourhood?

Who are some of the people you see in your neighbourhood? When do you see them, and do you play or do activities with any of them?

What things does your family do together in your neighbourhood?

Section 3: Specific aspects of the built environment

Where in your neighbourhood do you like to play? Do you play outside a lot?

Which places do you spend time with your friends? With your family?

What do you do in your neighbourhood that makes you feel good?

Where in your neighbourhood do you feel safe?

Where might you meet other kids in your neighbourhood?

What are the parks like in your neighbourhood?

How easy is it to walk or ride a bike in your neighbourhood?

Where are the places in your neighbourhood that you are allowed to walk to? Ride a bike to?

How does your family get around? Do you walk, ride a bike, drive, take the bus or the train?

Which of these do you like the best?

How do you get to (child care, play group, community centre where the focus group is taking place)? Does it take long to get here?

Is it fun to get here?

Section 4: softGIS (see indicative softGIS questions above – Section D for children).

Can you help me make a map of your neighbourhood? We are going to put some places on the map. I want to know which places you think are important. I also want to know what you like or don't like about those places.

Proposed Focus Group Questions (Parent Focus Groups):

Build rapport:

Hi everyone, thanks so much for joining this discussion today. My name is Amanda/Karen and I'm from RMIT. To start off, can each of you tell me a little bit about yourselves – how many children you have, their ages, how long you have lived in your neighbourhood?

Section 1: Meaningful places

What things do you like about where you live? Any aspects of your neighbourhood that you think are good for young children and families?

Are there specific places in your neighbourhood that you think support wellbeing for young children, for parents, or for young families?

[Possible prompt] Can you tell me more about <place>?

[Possible prompt] How easy or challenging is it to access <place>?

[Possible clarification] Is <place> located in your neighbourhood, or do you have to travel out of the neighbourhood to get there?

Section 2: Opportunities for activities with family and friends

What kinds of things do you do with your family or your young children in your neighbourhood?

[Possible prompt] Where might you go to do <activity>? Would this be in your neighbourhood or do you have to travel out of the neighbourhood to get there?

Who are some of the people you see or interact with in your neighbourhood? When do you see them, and do your children play or do activities with any of them?

[Possible prompt] How easy or challenging is it to get together with other families in your neighbourhood? Why?

Where would you take your child to play? Where would you take your child to meet other kids?

[Possible prompt] Where in your neighbourhood do you feel your child gets to explore, be creative, or use their imagination?

Are there any places in your neighbourhood that you feel are important from a social perspective?

[Possible prompt] Where in your neighbourhood does your child get to practice working together with other children, sharing, or getting along with others?

[Possible prompt] Are there any places that help you connect with other parents or caregivers of young children?

Section 3: Specific aspects of the built environment

Do you use the parks in your neighbourhood?

[Possible prompt] Why/why not? Where might you go instead?

What are the parks like in your neighbourhood?

[Possible prompt] How easy or challenging is it to get to those parks with your young children? How do you get there?

[Possible clarification] Is <park> in <suburb> or in a nearby area? Do you tend to use the local parks or travel out of the suburb to other parks?

[Possible prompt] What is it like to take your young children to the parks here?

[Possible prompt] Is there anything you would change about the parks here to cater more for young children and families?

Can you tell me a bit about the houses in your neighbourhood?

[Possible prompt] Does the housing here cater for families? Is it affordable?

[Possible prompt] What types of houses are here (apartments, townhomes, detached single family homes)?

[Possible prompt] What is the quality of the housing stock like – inside, outside, etc.?

Do you use local services in your neighbourhood – such as local childcares, kinder, health services?

[Possible prompt] Why/why not? Where might you go instead?

How are the services for young children, mums and young families in your area? What is the quality like? Do you feel like your families' needs are being met by these services?

[Possible prompt] How easy or challenging is it to access services (for example, health, child care, kinder, playgroups, etc.) here?

[Possible prompt] How do you and your children get to these services? Do you drive, walk, take public transport, other ways of getting around?

[Possible prompt] How do you get to <child care, play group, community centre where the focus group is taking place>? Is it easy to get here?

How does your family get around? Do you walk, ride a bike, drive, take the bus or the train?

[Possible prompt] Which of these are easiest / do you like the best?

[Possible prompt] How easy is it to walk or ride a bike in your neighbourhood?

[Possible prompt] About how far (e.g., a 15-minute walk one-way? A 20-minute walk one-way?) would you walk in your neighbourhood with your child?

Is there anything about your neighbourhood that makes life harder or more stressful?

[Possible prompt] What is traffic like in your neighbourhood/area?

[Possible prompt] Is it noisy in your neighbourhood?

[Possible prompt] What are some things you would like to do with your child but are unable to do in your neighbourhood? Where do you go instead?

[Possible prompt] Where would you not go in this neighbourhood with your child? Why/what makes it challenging?

Is there anything about your neighbourhood that you feel makes life easier or takes away some of the stress of being a parent?

[Possible prompt] Where do you/other parents and families go if they want to relax?

[Possible prompt] What is convenient about living in your neighbourhood?

Are there other aspects of the physical environment in your neighbourhood that you think are important for young children or families?

What do you think are the top three factors for your child's development, if you had to rank them?

Section 4: softGIS (see questions above).

The last part is creating a map of your neighbourhood with specific places that you think are important for young children and families – these could be places we've already talked about or ones we haven't mentioned that you think are important. If you could add as many places you feel are important with a brief comment about each, that would be super helpful. There is no minimum or maximum number of places, it's up to you and what you feel is important.

5. APPENDIX E Current outputs

Capacity building:

1. In progress: Weiner, R., (PhD Candidate, RMIT University). Working title: Housing, Transportation and Family Stress – Exploring associations between housing stress, transport stress and early childhood development: Passed first PhD milestone: Project proposal and seminar. RMIT University. Supervisors: Badland, H., Kroen, A., Villanueva, K.
2. Eddy, T., 2024. Bachelor of Urban Planning Honours. Dissertation title: Fields of Play: Governance Factors Influencing Playspace Design Quality in Melbourne's Greenfield Developments. Supervisors: Alderton, A. Villanueva, K.
3. Strah, J., 2023. Bachelor of Urban Planning Honours. Dissertation title: The relationship between quality open space and child development outcomes. RMIT University. Supervisors: Badland, H., Alderton, A.
4. Porter, S., 2023. Bachelor of Urban Planning Honours. Dissertation title: Housing insecurity in Melbourne. RMIT University. Supervisors: Badland, H., Alderton, A.

Peer-reviewed papers:

1. Villanueva, K., Turrell, G., Alderton, A., Davern, M., Brinkman, S., Gauvin, L., Goldfeld, S., Badland, H., (2024). Neighborhood 'double disadvantage' and child development in inner city and growth areas. Wellbeing, Space, and Society. DOI: 10.1016/j.wss.2024.100231
2. Badland H, Villanueva K, Alderton A, Davern M, Goldfeld S. (2023). A framework for realising progress towards the New Urban Agenda for equitable early childhood development. Children's Geographies. DOI: 10.1080/14733285.2023.2192339.
3. Villanueva, K., Badland, H., Alderton, A., Higgs, C., Turrell, G., Goldfeld, S (2023). Examining the contribution of the neighbourhood built environment to the relationship between neighbourhood disadvantage and early childhood development in 205,000 Australian children. Academic Pediatrics. Vol. 23, No. 3, 631-645. DOI: doi.org/10.1016/j.acap.2022.11.014

Presentations:

1. Villanueva, K. (presenter), Alderton, A., Badland, H., Lived experiences of families in Melbourne's growth areas: Data collection lessons from the field. Public Health Association of Australia, Perth, September 2024.
2. Badland, H. (presenter), Villanueva, K., Alderton, A., Davern, M., Higgs, C., Turrell, G., Goldfeld, S. Examining the Contribution of the Neighborhood Built Environment to the Relationship Between Neighborhood Disadvantage and Early Childhood Development in 205,000 Australian Children. International Medical Geography Symposium (IMGS), July 2024.
3. Badland, H (presenter). Plenary presentation about 'Hidden Voices': Challenges and learnings from participatory research with communities, International Medical Geography Symposium (IMGS), July 2024.
4. Villanueva, K., (presenter), Alderton, A. Public Participation GIS use case 3: Child friendly neighbourhoods. Public Participation GIS Workshop, RMIT University, 18th November 2024.
5. Villanueva, K. (presenter). Guest lecture for intensive RMIT course for Urban Planning students: 'Planning liveable cities for children and adolescents' (Please note, students attending this intensive are typically studying urban planning). July 2023.
6. Villanueva, K., Alderton, A. (presenters). Guest lecture for University of Melbourne Child Public Health intensive course: 'Built environment and children's health through a public health lens' (Please note, students attending this intensive are typically paediatricians, or studying to become paediatricians). July 2023.
7. Villanueva, K., Alderton, A. Public participation GIS in practice: Lessons from the Early Childhood Data to Decisions project. PPGIS Community of Practice meeting, 7th March 2023.

Media:

Badland, H., Alderton, A., Villanueva, K., Davern, M. (2023) Editor: Alison Barrett. Is Melbourne really living the liveability dream? Croakey Health Media.
<https://www.croakey.org/is-melbourne-really-living-the-liveability-dream/>