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Can social risks in early life predict children's health and academic outcomes? An analysis of the Longitudinal Study of Australian Children

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ABSTRACT

Exposure to social risk in early life negatively impacts the health and wellbeing of children. While screening for social determinants of health is recommended, there is little evidence that identifying social risk early in life predicts longer-term poorer outcomes. The purpose of this study is to examine the extent to which assessing social risk using a standardized tool in young children up to age 6 years might predict poor health and academic performance at 10–11 years old. The social risk domains studied were housing instability, food insecurity, financial strain, transport problems, safety, lack of support and unemployment. The predictive validity of these social risk domains measured at 0–5 years was examined using data from the Longitudinal Study of Australian Children. Outcomes at 10–11 years included ongoing diseases and mental health conditions, hospitalization, injury, dental problems, overweight or obesity and academic achievement. Financial strain and inability to access support were the most sensitive measures of poor outcomes. Across all social risks, the positive predictive value was highest for academic outcomes. Across all domains, there was higher sensitivity for children with 2 or more social risks. Items in the social risk screening tool were moderate predictors of academic outcomes, but weak predictors of health outcomes at 10–11 years. This data will be useful for informing screening for social determinants of health.

Introduction

The social determinants of health are defined as the 'conditions in which people are born, grow, live, work and age, and the political, social and economic systems in place which shape daily life.' (CSDH, 2008) Adverse social determinants of health include housing instability, food insecurity, unsafe neighborhood and domestic environments, unemployment and a lack of support. Individuals affected by these social risks have been documented to experience poorer health outcomes (Marmot, 2005; Stringhini et al., 2017) and there is increasing evidence that early exposure to social risk negatively impacts the health of children (Garg et al., 2012, 2015).

Numerous professional organisations, such as the American Academy of Pediatrics and the Royal Australian College of Physicians, acknowledge that children who experience social disadvantage are at greater risk of poor health in childhood and premature morbidity and mortality in adulthood (AAP, 2004; Goldfeld & Woolfenden, 2018). Children whose families experience unmet social needs are also more vulnerable to poor developmental outcomes (Moore, McDonald, Carlon, & O'Rourke, 2015; Maggi et al., 2010). The social determinants of health are multifaceted and can be understood as a complex relationship between the lenses of sociodemographic characteristics, geographical environments, risk factors and health conditions (Goldfeld et al., 2018; Koh et al., 2010). In paediatric populations, it is imperative to not only consider the individual child's exposure to social risk but also the social risk of the parent or caregiver and the wider community (Goldfeld et al., 2018).

The World Health Organization's Commission of Social Determinants of Health has requested global action to address the social determinants of health in order to achieve health equity (CSDH, 2008). Screening for adverse social determinants of health in early childhood may help to identify children most at risk and provide an opportunity for intervention. Adverse social determinants of health generally do not exist in isolation and families experiencing one social risk often have additional unmet social needs (Beck et al., 2012). The cumulative nature of adverse social determinants of health suggests a need for a broad

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spectrum screening tool that identifies multiple key social needs.

While there is no consensus on which screening tool is best suited to the pediatric population, screeners that are implemented in clinical settings consist of multiple social risk domains (Silverstein et al., 2008; Sokol et al., 2019). Information regarding the validity or reliability of social needs screening tools is limited (Henrikson et al., 2019). While it is well understood that disadvantaged populations experience poorer academic and health outcomes, there is little evidence to support whether these outcomes are predicted by social risk screening (Straatmann et al., 2018).

In this study we examine the extent to which social risks in the first 6 years of life (age ≤5 years) can predict health and academic problems at 10–11 years. We used items from a multi-domain social determinants of health (SDH) screening tool to represent social risk exposures. The tool was adapted from the Health Leads Screening Toolkit (Health Leads, 2016) for use in the pediatric ward of a major tertiary hospital. The social determinants of health included in the screening tool represent the most common social needs impacting the health of individuals and questions were adapted in collaboration with paediatric nursing staff for readability and relevance in an Australian inpatient context. The following social risk domains were included: housing instability, food insecurity, household bill unaffordability, transport difficulties, safety, lack of support and unemployment. To the best of our knowledge, no studies have used the screening tool to predict outcomes for children. Therefore, we applied the screening tool items to data collected as part of the Longitudinal Study of Australian Children, which contains information on a broad range of social variables between 0 and 5 years. Screening tool items could be closely mapped to questions in the LSAC survey. We examined whether social risk at a specific age or cumulative social risk throughout early childhood is associated with health and academic outcomes. The choice of academic outcomes was based on the Australian Institute of Health and Welfare's key indicators of childhood health and wellbeing (Children's Headline Indicators). The outcomes included in our study align closely with the following Children's Headline Indicators: Chronic disease and mental health, Injury and poisoning, Dental health, Overweight and obesity and Literacy and numeracy benchmarks (AIHW, 2018). To emulate how a screening tool might be used in clinical care, we also assessed whether setting a threshold for the number of social risks improved the prediction of outcomes.

Materials and methods

Sample

The Longitudinal Study of Australian Children (LSAC) is a prospective cohort study that began in 2003 with a representative sample of Australian children. The 'B' cohort consists of children who were enrolled in 2004 at 0–1 years and followed up every 2 years. LSAC has a two-stage clustered sampling design which first involved selecting postcodes from which the sample would be drawn, followed by children living in those postcodes who were included in Medicare Australia's enrolment database (Mohal et al., 2021). The sampling strategy ensured representativeness across Australian states and regional/city areas. Analyses in this study involved LSAC 'B' cohort children at 0–1 years (Wave 1, 2004, n = 5,107), 2–3 years (Wave 2, 2006, n = 4,606), 4–5 years (Wave 3, 2008, n = 4,386) and 10–11 years (Wave 6, 2014, n = 3,764).

Ethics

The research methodology and survey content of LSAC have been reviewed and approved by the Australian Institute of Family Studies Ethics Committee. Parental consent was obtained at each wave of data collection.

Data statement

Access to the LSAC data is provided to *bona fide* researchers by applying to the National Centre for Longitudinal Data (https://growingupinaustralia.gov.au/data-and-documentation/accessing-lsac-data).

Social risks measured in LSAC

The 9 items of the SDH screening tool domains were matched to questions in LSAC (Table 1). As the SDH screening tool was adapted for parents of children aged 0–5 years, the LSAC questions were matched in Wave 1, 2, and 3 when children were aged 0–1, 2–3, and 4–5 years, respectively. Data was obtained from the child's primary parent (defined as the parent who knows the most about the child) via structured interviews.

Housing instability was defined as an inability to pay mortgage or rent on time and/or currently paying rent for state/territory housing, which was considered an indicator of low income. The SDH screening tool also explicitly screens for homelessness however this information was not readily available in LSAC, thus was omitted. Families were considered at risk of food insecurity if the household had gone without food over the last 12 months due to a shortage of money. Financial strain was assessed by the inability to pay household bills (electricity, gas, or telephone) on time due to a shortage of money. Transportation issues were characterized by the inability to access service(s) needed by the family due to 'transport problems'. Questions on transport problems were only available in LSAC Wave 1 so this domain was excluded from subsequent analyses. In the SDH screening tool, both household and neighborhood safety were assessed as part of the 'Safety' domain. In LSAC, household safety was matched to intimate partner violence. Families were considered at risk of an unsafe home environment if arguments between the primary parent and their partner ever resulted in physical violence. In LSAC, parents defined whether they agreed with the statement 'This is a safe neighborhood' and those that disagreed or strongly disagreed were considered to live in an unsafe neighborhood. Lack of support was defined as parents often feeling that they needed support but could not access it. Support could include emotional support, practical help or financial assistance from any source. While the SDH screening tool assessed whether anyone in the household had undertaken paid work in the last six months, families were considered unemployed in this study if the parent(s) (either single parent or both parents) living in the household with the child were unemployed. Except for Transport, all social determinants of health domains were measured with the same questions across the three waves of data collection in LSAC.

Outcomes

Outcomes included health and academic ability at 10–11 years (Wave 6, 2014) to capture a broad understanding of the children's development and wellbeing. Ongoing medical conditions were from parent/caregiver-report of the following: asthma, attention deficit hyperactivity disorder (ADHD), anxiety, depression, autism spectrum disorder (ASD) and diabetes. Diagnosis by a medical professional was not required. These conditions were chosen as they are leading causes of total burden of disease for children from 5 to 14 years (AIHW, 2018). Non-injury hospitalizations were defined as overnight hospital stays in the last 12 months that were not due to injury. We did not include hospital outpatient or emergency department stays to capture a higher severity of illness associated with hospitalization. Injury was defined as a child needing medical attention from a doctor or hospital because the child was hurt or injured. Medical attention because a child was unwell or had a fever was not included. Injury hospitalizations were defined as hospitalizations for at least one night because of injury, not including hospital outpatient or emergency department stays. Dental problems were from parent-report of whether their child had cavities or dental

Table 1
Social determinants of health screening tool mapped to LSAC social risk items.

Social Needs Domain	Social Risk	SDH Screening Question	LSAC Social Risk Question
Housing	Housing instability: unable to pay	"In the past 6 months, were you worried that you did not have enough money to pay your rent or mortgage?	"Over the last 12 months, due to shortage of money, have you not been able to pay the mortgage or rent on time?"
	Housing instability: state/territory housing		"Do you pay rent to the state/territory housing authority or government?"
	Housing instability: homelessness	"At any time in the last 6 months, were you and your family homeless or living in a shelter?"	
Food	Food insecurity	"In the past 6 months, were you worried that you did not have enough money for food for your family?"	"Over the last 12 months, due to shortage of money, have adults or children in your household gone without meals?"
Household bills	Financial insecurity: utilities	"In the past 6 months, were you unable to pay your electricity, gas or water bills?"	"Over the last 12 months, due to shortage of money, have you been unable to pay gas, electricity or telephone bills on time?"
Safety	Intimate partner violence	"In the past 6 months, did you feel that your or your family were not safe in your home environment?"	"Do you have arguments with your partner that end up with people pushing, hitting, kicking or shoving?"
	Neighborhood safety	"In the past 6 months, did you feel that you or your family were not safe in your neighborhood?"	"Do you live in an unsafe neighborhood?"
Transport		"In the past 6 months, have you been unable to do your day to day activities such as, shopping, going to appointments or work because you did not have transport?"	"Have you been unable to get the service(s) that you needed for this child due to transport problems?"
			"Have you been unable to get the service(s) that you needed for yourself or your family due to transport problems?"
Support	Social support issues	"In the past 6 months, did you feel that you had support from family, friends or community services?"	"How often do feel that you need support or help but can't get it from anyone?"
Employment	Unemployment	"Did you or anyone in your household undertake paid work in the last 6 months?"	'Unemployed' or 'Not in labour force'

decay and if the child had a tooth or teeth extracted as a result of the cavity or dental decay.

Weight and height measurements were collected by trained LSAC staff for the calculation of body mass index (BMI, weight/height^2). BMI was converted to age- and sex-specific z-scores according to the World Health Organization (World Health Organization, 2006). In this population, overweight is defined as weight greater than one standard deviation from the mean and obesity greater than two standard deviations from the mean.

Children's academic ability at age 10–11 years was obtained from a standardized national assessment called the National Assessment Plan – Literacy and Numeracy (NAPLAN). NAPLAN assesses children's abilities in reading, writing, language conventions (spelling, grammar and punctuation) and numeracy. NAPLAN is an annual assessment of all Australian children in Years 3, 5, 7 and 9 and is linked to LSAC data. Children in this study were assessed to have academic difficulties if their results in any of the literacy and numeracy domains were at or below the national minimum standard for Year 5 students (NAPLAN, 2016). While LSAC Wave 7 data had been released at the time of the study, NAPLAN data was not available for the entire cohort in later waves and thus Wave 6 was used for completeness.

Analysis

Analysis was conducted on children with complete data across exposures and outcomes. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of each social risk and outcome were calculated. Each exposure from Wave 1, 2 and 3 was analyzed separately, and then exposures were combined across all three waves and analyzed. We refer to social risk "at *any* wave" to indicate that a child was positive for social risk at either Wave 1 (0–1 years), Wave 2 (2–3 years) or Wave 3 (4–5 years); for example, food instability present at Wave 1 but not present at Wave 2 and 3. By looking across any of Wave 1, 2 or 3, we capture social risk occurring at any point in the first 6 years, akin to children being screened on presentation to hospital. We also analyzed social risks consistently present "at *every* wave" (Waves 1, 2 *and* 3) as this was expected to capture sustained disadvantage across the first 6 years of life. Social risk at every wave indicates that a child is positive for the same social risk at Waves 1 (0–1 years), 2 (2–3 years) and 3 (4–5 years).

Further analyses involved the sensitivity, specificity, PPV and NPV of families with one social risk at each wave and families with ≥2 social risks. Two or more social risks is defined as two or more *different* positive social risks in either Wave 1, 2 or 3. For example, food insecurity present at Wave 1 and housing instability present at Wave 2 was considered as the presence of 2 social risks. The cut-off point of two or more social risks was determined after plotting the distribution of exposures, as a reasonable balance of increased risk with sufficient numbers of children

Table 2
Characteristics of the study sample and prevalence of items representing social risks and health and academic outcomes.

	n (%), or mean ± SD
Sociodemographic characteristics, age 0–1, n = 3,578	
Male sex	1,835 (51.3)
Age at Wave 1 (months)	8.8 ± 2.5
Primary carer female	3,528 (98.6)
Primary carer biological parent	3,573 (99.9)
Primary carer age at Wave 1 (years)	31.7 ± 5.04
Primary carer born in Australia	2,871 (80.2)
Social risks, age 0–1, n = 3,578	
Housing instability: unable to pay	273 (7.6)
Housing instability: state/territory housing	46 (1.3)
Food insecurity	120 (1.8)
Financial strain: utilities	764 (21.4)
Intimate partner violence	188 (5.3)
Neighborhood safety	243 (6.8)
Transport issues	32 (0.9)
Support issues	246 (6.9)
Unemployment	233 (6.5)
Outcomes, age 10–11 years	
Ongoing diseases and mental health conditions[a], n = 3,522	753, (21.1)
Hospitalization not due to injury, n = 3,522	121 (3.4)
Injury, n = 3,522	789 (22.1)
Hospitalization due to injury, n = 3,522	37 (1.0)
Dental problems, n = 3,512	903 (25.2)
Overweight or obese, n = 3,404	817 (22.8)
NAPLAN at or below national minimum standard, n = 3,166	1,050 (29.4)

[a] Ongoing diseases and mental health conditions include: asthma, ADHD, anxiety, depression, ASD and diabetes.

Table 3
Population-weighted sensitivity (Se), specificity (Sp), positive predictive value (PPV) and negative predictive value (NPV) between social risk items at any wave between ages 0–5 years, and health and academic outcomes at age 10–11 years.

Social risks, in any of Wave 1, 2 or 3	n	S_e (95% CI)	S_p (95% CI)	PPV (95% CI)	NPV (95% CI)
Ongoing diseases and mental health conditions, age 10–11 (n = 798)					
Housing instability: unable to pay	498	20.7 (20.6, 20.9)	83.0 (82., 83.2)	26.2 (26.0, 26.3)	78.3 (78.1, 78.5)
Housing instability: state/territory housing	84	4.5 (4.4, 4.6)	96.2 (96.1, 96.3)	25.5 (25.4, 25.7)	77.7 (77.5, 77.8)
Food insecurity	114	5.4 (5.3, 5.5)	95.5 (95.4, 95.6)	25.8 (25.6, 26.0)	77.7 (77.5, 77.8)
Financial strain: utilities	1,055	39.9 (39.7, 40.1)	66.3 (66.1, 66.5)	25.6 (25.4, 25.8)	79.2 (79.0, 79.3)
Intimate partner violence	328	8.7 (8.6, 8.8)	88.9 (88.7, 89.0)	18.4 (18.3, 18.6)	77.0 (76.8, 77.2)
Neighborhood safety	403	17.6 (17.4, 17.7)	88.0 (87.8, 88.1)	29.7 (29.6, 29.9)	78.7 (78.5, 78.8)
Social support issues	713	31.1 (30.9, 31.3)	75.1 (74.9, 75.3)	26.4 (26.2, 26.6)	79.2 (79.0, 79.3)
Unemployment	372	19.2 (19.0, 19.3)	85.8 (85.6, 85.9)	28.1 (27.9, 28.3)	78.6 (78.4, 78.7)
Hospitalization not due to injury, age 10–11 (n = 121)					
Housing instability: unable to pay	498	23.5 (23.3, 23.7)	82.4 (82.2, 82.5)	5.0 (4.9, 5.0)	96.5 (96.4, 96.6)
Housing instability: state/territory housing	84	10.6 (10.5, 10.7)	96.3 (96.2, 96.4)	10.0 (9.9, 10.1)	96.5 (96.4, 96.6)
Food insecurity	114	3.1 (3.0, 3.1)	8401 (95.1, 95.3)	2.4 (2.4, 2.5)	96.2 (96.1, 96.3)
Financial strain: utilities	1,055	47.1 (46.9, 47.3)	65.4 (65.2, 65.6)	5.1 (4.9, 5.1)	96.9 (96.9, 97.0)
Intimate partner violence	328	16.6 (16.5, 16.8)	89.6 (89.5, 89.8)	5.8 (5.7, 5.9)	96.6 (96.5, 96.7)
Neighborhood safety	403	11.3 (11.21, 11.5)	86.6 (86.5, 86.8)	3.2 (3.1, 3.3)	96.2 (96.1, 96.2)
Social support issues	713	20.2 (20.0, 20.4)	73.5 (73.3, 73.7)	2.6 (2.5, 2.6)	96.4 (96.3, 96.5)
Unemployment	372	25.2 (25.0, 25.4)	85.0 (84.9, 85.2)	6.1 (6.0, 6.2)	96.7 (96.6, 96.8)
Injury, age 10–11 (n = 789)					
Housing instability: unable to pay	498	18.8 (18.7, 19.0)	82.5 (82.3, 82.6)	23.4 (23.3, 23.6)	78.1 (77.9, 78.2)
Housing instability: state/territory housing	84	4.8 (4.7, 4.9)	96.3 (96.2, 96.3)	26.7 (26.5, 26.8)	78.0 (77.8, 78.1)
Food insecurity	114	6.4 (6.3, 6.5)	95.7 (95.7, 95.8)	30.0 (29.8, 30.1)	78.2 (78.0, 78.4)
Financial strain: utilities	1,055	39.6 (39.4 39.7)	66.1 (66.0, 66.4)	25.0 (24.9, 25.2)	79.3 (79.2, 79.5)
Intimate partner violence	328	10.6 (10.5, 10.7)	89.4 (89.3, 89.6)	22.3 (22.1, 22.5)	77.8 (77.6, 77.9)
Neighborhood safety	403	11.9 (11.7, 12.0)	86.3 (86.2, 86.5)	19.9 (19.7, 20.0)	77.4 (77.2, 77.6)
Social support issues	713	28.9 (28.7, 29.1)	74.5 (74.3, 74.7)	25.1 (24.9, 25.3)	78.0 (77.8, 78.2)
Unemployment	372	15.4 (15.3, 15.6)	84.7 (84.5, 84.8)	22.4 (22.2, 22.5)	77.8 (77.6, 78.0)
Hospitalization due to injury, age 10–11 (n = 37)					
Housing instability: unable to pay	498	14.0 (13.8, 14.1)	82.1 (82.0, 82.3)	1.0 (0.9, 1.0)	98.7 (98.6, 98.7)
Housing instability: state/territory housing	84	5.9 (5.8, 6.0)	96.0 (96.0, 96.1)	1.9 (1.8, 1.9)	98.8 (98.7, 98.8)
Food insecurity	114	11.5 (11.3, 11.6)	95.4 (95.3, 95.4)	3.0 (3.0, 3.1)	98.8 (98.8, 98.9)
Financial strain: utilities	1,055	59.9 (59.7, 60.1)	65.3 (65.1, 65.4)	2.1 (2.1, 2.2)	99.2 (99.2, 99.3)
Intimate partner violence	328	6.2 (6.1, 6.3)	89.4 (89.2, 89.5)	0.7 (0.7, 0.8)	98.7 (98.7, 98.8)
Neighborhood safety	403	7.5 (7.4, 7.6)	86.6 (86.5, 86.8)	0.7 (0.7, 0.7)	98.7 (98.6, 98.7)
Social support issues	713	29.1 (28.9, 29.4)	73.8 (73.6, 73.9)	1.3 (1.2, 1.3)	98.9 (98.9, 99.0)
Unemployment	372	26.3 (26.1, 26.5)	87.8 (84.7, 84.9)	2.1 (2.1, 2.2)	98.9 (98.9, 99.0)
Dental problems, age 10–11 (n = 957)					
Housing instability: unable to pay	498	20.8 (20.7, 21.0)	83.2 (83.0, 83.3)	30.9 (30.7, 31.1)	74.4 (74.3, 74.6)
Housing instability: state/territory housing	84	6.7 (6.6, 6.8)	97.0 (96.9, 97.1)	44.8 (44.6, 45.0)	74.2 (74.1, 74.4)
Food insecurity	114	6.1 (6.0, 6.2)	95.7 (95.7, 95.8)	34.0 (33.9, 34.2)	73.9 (73.7, 74.0)
Financial strain: utilities	1,055	42.4 (42.2, 42.6)	67.5 (67.3, 67.7)	32.0 (31.8, 32.2)	76.4 (76.3, 76.6)
Intimate partner violence	328	9.7 (9.6, 9.8)	89.1 (89.0, 89.2)	24.4 (24.2, 24.6)	76.1 (73.0, 73.3)
Neighborhood safety	403	15.7 (15.5, 15.8)	87.6 (87.5, 87.7)	31.3 (31.1, 31.5)	74.3 (74.1, 74.5)
Social support issues	713	26.5 (26.3, 26.7)	73.8 (73.6, 74.0)	27.0 (26.8, 27.2)	73.2 (73.0, 73.4)
Unemployment	372	19.1 (18.9, 19.2)	86.0 (85.9, 86.1)	32.9 (32.7, 33.1)	74.6 (74.5, 74.8)
Overweight or obese, age 10–11 (n = 817)					
Housing instability: unable to pay	489	22.9 (22.7, 23.0)	84.1 (83.9, 84.2)	33.9 (33.7, 34.1)	75.3 (75.2, 75.5)
Housing instability: state/territory housing	84	4.9 (4.8, 5.0)	96.4 (96.4, 96.5)	32.9 (32.7, 33.1)	74.0 (73.8, 74.2)
Food insecurity	114	5.9 (5.8, 6.0)	95.5 (95.4, 95.6)	31.5 (31.3, 31.7)	74.0 (73.8, 74.2)
Financial strain: utilities	1,055	45.8 (45.6, 46.0)	68.8 (68.6, 68.9)	34.4 (34.2, 34.5)	78.1 (77.9, 78.2)
Intimate partner violence	328	13.7 (13.5, 13.8)	90.4 (90.3, 90.5)	33.7 (33.6, 33.9)	74.5 (74.4, 74.7)
Neighborhood safety	403	13.0 (12.9, 13.1)	86.6 (86.5, 86.8)	25.7 (25.5, 25.9)	73.7 (73.5, 73.9)
Social support issues	713	29.0 (28.8, 29.2)	74.2 (74.0, 74.4)	28.0 (27.8, 28.2)	75.2 (75.0, 75.4)
Unemployment	372	19.2 (19.1, 19.4)	85.9 (85.8, 86.1)	32.8 (32.6, 33.0)	74.9 (74.7, 75.1)
NAPLAN at or below national minimum standard, age 10–11 (n = 1,116)					
Housing instability: unable to pay	489	23.1 (22.9, 23.3)	86.0 (85.9, 86.2)	49.6 (49.3, 49.8)	65.3 (65.1, 65.5)
Housing instability: state/territory housing	84	7.1 (7.0, 7.2)	98.3 (98.3, 98.4)	71.5 (71.3, 71.7)	64.0 (63.8, 64.2)
Food insecurity	114	7.1 (7.0, 7.3)	97.2 (97.1, 97.2)	60.0 (59.8, 61.2)	63.8 (63.6, 64.0)
Financial strain: utilities	1,055	46.3 (46.0, 46.5)	72.7 (72.5, 72.9)	50.1 (49.9, 50.3)	69.5 (69.3, 69.7)
Intimate partner violence	328	11.7 (11.5, 11.8)	90.3 (90.1, 90.4)	41.5 (41.3, 41.7)	63.3 (63.1, 63.5)
Neighborhood safety	403	15.3 (15.1, 15.4)	88.8 (88.7, 89.0)	44.7 (44.5, 44.9)	63.9 (63.6, 64.1)
Social support issues	713	26.8 (26.6, 27.0)	75.1 (74.9, 75.3)	38.6 (38.4, 38.8)	63.8 (63.6, 64.0)
Unemployment	372	23.7 (23.5, 23.8)	90.6 (90.5, 90.8)	60.0 (59.8, 60.2)	66.6 (66.4, 66.8)

Abbreviations: NAPLAN, National Assessment Program in Literacy and Numeracy.

Table 4
Sensitivity (Se), specificity (Sp), positive predictive value (PPV) and negative predictive value (NPV) of applying social risk thresholds (0 versus 1 or ≥2) at any wave between 0 and 5 years, and health and academic outcomes at age 10–11 years.

Social risks at any wave between 0 and 5 years		S_e (95% CI)	S_p (95% CI)	PPV (95% CI)	NPV (95% CI)
Ongoing diseases and mental health conditions, age 10–11 (n = 798)					
Social risks (1)	767	24.4 (24.2, 24.6)	73.2 (73.0, 73.4)	20.8 (20.7, 21.0)	77.0 (76.8, 77.2)
Social risks (2 or more)	793	39.7 (39.5.39.9)	67.6 (67.4, 67.8)	26.2 (26.0, 26.4)	79.5 (79.3, 79.7)
Hospitalization not due to injury, age 10–11 (n = 121)					
Social risks (1)	767	17.3 (17.1, 17.4)	73.5 (73.3, 73.7)	2.2 (2.1, 2.2)	96.3 (96.3, 96.4)
Social risks (2 or more)	793	48.2 (48.0, 48.4)	66.4 (66.2, 66.7)	4.6 (4.5, 4.7)	97.4 (97.4, 97.5)
Injury, age 10–11 (n = 789)					
Social risks (1)	767	28.2 (28.0, 28.4)	74.4 (74.2, 74.6)	24.5 (24.3, 24.7)	77.9 (77.7, 78.0)
Social risks (2 or more)	793	37.9 (37.6, 38.1)	67.1 (66.9, 67.3)	25.3 (25.1, 25.5)	78.6 (78.4, 78.7)
Hospitalization due to injury, age 10–11 (n = 37)					
Social risks (1)	767	16.5 (16.3, 16.6)	73.7 (73.5, 73.9)	0.7 (0.7, 0.7)	98.8 (98.7, 98.8)
Social risks (2 or more)	793	53.9 (53.6, 54.1)	66.2 (66.0, 66.4)	1.8 (1.7, 1.8)	99.2 (99.2, 99.3)
Dental problems, age 10–11 (n = 957)					
Social risks (1)	767	24.1 (23.9, 24.3)	72.9 (72.7, 73.1)	24.5 (24.3, 24.7)	72.4 (72.2, 72.6)
Social risks (2 or more)	793	41.3 (41.0, 41.5)	68.6 (68.3, 68.8)	32.4 (32.2, 32.6)	76.2 (76.0, 76.4)
Overweight or obese, age 10–11 (n = 817)					
Social risks (1)	767	22.8 (22.6, 23.0)	72.7 (72.5, 72.9)	22.3 (22.1, 22.5)	73.3 (73.1, 73.5)
Social risks (2 or more)	793	44.2 (43.9, 44.4)	69.3 (69.1, 69.6)	33.1 (32.9, 33.3)	78.3 (78.2, 78.5)
NAPLAN at or below national minimum standard, age 10–11 (n = 1,116)					
Social risks (1)	767	23.9 (23.7, 24.1)	2.6 (72.4, 72.8)	33.5 (33.2, 33.7)	62.3 (6.1, 62.6)
Social risks (2 or more)	793	45.4 (45.2, 45.7)	73.3 (73.1, 73.5)	49.6 (49.3, 49.8)	70.0 (69.8, 70.2)

Abbreviations: NAPLAN, National Assessment Program in Literacy and Numeracy; NPV, negative predictive value; PPV, positive predictive value; S_e, sensitivity; S_p, specificity.

affected (see Supplementary Appendix C).

For the main analyses, we used the diagtest package (Newton et al., 2000) in Stata SE (versions 15 and 17), which allowed for population weighting. Longitudinal population weights were applied in order to re-weight the results of respondents across all waves of LSAC to be representative of the population at the time of selection into the study (Mohal et al., 2021). All other analyses were conducted using unweighted analysis and are collated in the Appendices.

Results

Table 1 maps LSAC questions against the SDH screening items.

Table 2 shows the characteristics of the study sample, prevalence of social risks at Wave 1 (aged 0–1 years) and the prevalence of health and academic outcomes at Wave 6 (aged 10–11 years). For brevity, we show the social risk data at Wave 1 only, as subsequent waves of data are very similar. Data on all social risk items at 0–1 years were available from 3,578 (70%) of the cohort (n = 5,107). The proportion of children with data for outcomes at age 10–11 years ranged between 3,522 (98%) for ongoing diseases and 3,166 (88%) for NAPLAN.

Social risks occurring at any wave

In the population-weighted analyses shown in Table 3, the sensitivity of individual social risk items across any waves were consistently higher for financial strain and support issues (unweighted analyses are provided in Appendix E). The sensitivity of financial strain ranged from 39.6% (95%CI 39.4, 39.7) for injury to 59.9% (95% CI 59.7, 60.1) for hospitalization due to injury. Similarly, sensitivity of social support issues ranged from 20.2% (95% CI 20.0, 20.4) for non-injury hospitalizations to 31.1% (95% CI 30.9, 31.3) for ongoing diseases. Specificity for financial strain and social support issues was <80% across all health and academic domains. PPV was 10% or lower for hospitalizations, ranged between 18.4% (95% CI 18.3, 18.6) and 44.8% (95% CI 44.6, 45.0) for all other health outcomes. NAPLAN outcomes had the greatest PPV and was >35% for all social risk items. For example, the highest PPV indicated that 71.5% (95% CI 71.3, 71.7) of children living in social housing at any point between 0 and 5 years performed at or below the national minimum standard in NAPLAN at 10–11 years.

Social risk at separate waves

When social risks at individual waves (Wave 1, 2 and 3) were analyzed separately, the pattern was similar for sensitivity and PPV across all waves (Supplementary Appendix C). Analyses of the three separate waves had similar predictive value and did not show a consistent pattern of increasing or decreasing sensitivity or PPV.

Social risk at every wave

Having social risks at all three waves showed low sensitivity (<10%) and PPV ranged widely from 0% to 100% (Supplementary Appendix D).

Comparison of none with 1 or ≥2 social risks at any wave

Table 4 shows population-weighted analyses for children with 1 social risk and with 2 or more social risks from 0 to 5 years compared with no social risks. Across all domains, there is higher sensitivity for children with 2 or more social risks. PPV are higher for those with 2 or more risks. Unweighted population analyses are shown in Appendix E.

Discussion

The current study shows that social risks screened at age 0–5 years are moderate predictors of poor NAPLAN performance at 10–11 years but poor predictors of health outcomes. Although sensitivity was weak, social housing, parental unemployment and food insecurity were the strongest predictors of poor NAPLAN results. Poor NAPLAN performance in Year 9 can be considered a predictor of access to higher education (Justman & Houng, 2014). Although no specific link has been made using Year 5 results, NAPLAN results at different ages are correlated. To confirm that social risk is a reasonable predictor of poor academic achievement, a more definitive measure of academic performance could be used, such as highest level of academic attainment, although such data was not available in the LSAC study. While social risks showed promising predictive ability for academic outcomes, it was surprising that risks were not as predictive for health outcomes given the known links between social disadvantage and poor health (Colvin et al., 2013; Procter et al., 2020; Russell et al., 2014).

With respect to the social domains examined, both financial strain

and lack of support had reasonable sensitivity when compared to other social risks. We expected that more sensitive or stigmatized issues (food insecurity and intimate partner violence) would be stronger predictors of poor outcomes, however the poor sensitivity of these exposures may be influenced by limited disclosure and low levels of need. Studies have shown that sensitive issues are disclosed at lower rates when questioned face to face (Gottlieb et al., 2014). Through attrition, LSAC has become a more advantaged cohort over time, although we attempted to address this via population weighting.

Setting a threshold for the number of social risks did not substantially improve the prediction of health and academic outcomes. While experiencing $\geq$2 social risks was a more sensitive marker for poor outcomes than experiencing one social risk, the predictive value of this measure was limited. In practice, setting a threshold for increased risk might be a way for screening tool administrators to identify the families most in need of social support. While our results suggest that setting a threshold for referral to further support is unlikely to improve health and academic outcomes of children, results may differ in a more disadvantaged sample. Furthermore, the full extent of social risks may not manifest themselves until older ages.

There was no consistent change in the predictive ability of social risk across the first three waves of data collection (age 0–5 years; Appendices C). The similarity of results across separate waves as well as comparing to the results in any wave indicates that SDH screening at any point between 0 and 5 years will similarly predict poor outcomes. While it was hypothesized that cumulative social risk would strongly predict poor outcomes, there were too few families who reported sustained disadvantage across the first three waves, and this analysis lacked power. To better analyze the predictive ability of cumulative disadvantage, an appropriately powered sample in a cohort with a higher prevalence of social risks and outcomes is required.

Social risk domains poorly predicted health outcomes in the LSAC cohort and these associations may be better detected in regions of greater social disadvantage. It is likely that including additional patient-level information, but not community-level information could improve the extent to which social risks are linked to health and development outcomes. Community-level data has not improved prediction models and may not identify all individuals who could benefit from social support (Cottrell et al., 2020). Instead, routine screening and social risk data collection at the patient-level are potentially more useful in the health care setting. Currently it is uncommon for social risk data to be collected routinely in Australian healthcare settings.

Strengths and limitations

The breadth of data available in LSAC allowed us to explore a wide range of social risk exposures. These risks represent some of the most common social needs that impact the health of individuals and it is recommended that these domains are included in social risk screening tools (Health Leads, 2016). Nevertheless, some aspects (e.g. unmet transport need) were not available in the LSAC dataset. Other social needs such as childcare availability and parental education could be assessed in future studies.

While closer proximity in time between exposures and outcomes may improve the power of this study, it remains that the majority of 10–11-year-olds do not have any chronic health problems. Year 5 NAPLAN results are not a final measure of academic success and further information about the cohort's educational attainment and academic achievement is required. Within LSAC, there will be opportunities to capture further health and academic outcomes as waves of data are released and further information is linked to the LSAC (i.e. NAPLAN results from subsequent year levels).

All social risks and most of the health outcomes were reported by caregivers. Primary caregivers are generally well informed of their family's situation and are best suited to report on both the presence of social risks and the health of their children. Recall bias is likely to be minimized due to the regular and prospective collection of data every 2 years. By Wave 6, attrition from LSAC was 30% (Fig. 1). For some outcomes, there were small proportions of children with the outcome which limited the power of the analyses. Additionally, some finer-grained information about health conditions such as the severity or whether they were diagnosed by a health professional, would have been desirable but was not available. Participants who dropped out of the study are more likely to be disadvantaged and it is possible that those with the most social risks were missing from the final analysis; however we speculate that the data are Not Missing at Random and in the absence of information on the missing mechanism/s it is difficult to know how to address missingness information. The use of longitudinal population weights may, in part, counteract any problems due to nonresponse. A further limitation of the study design is that we have retrofit the LSAC cohort responses to investigate our question. We have utilized existing data from a large, national, prospective cohort to overcome the expense and time delays with conducting a bespoke study of social needs and waiting for children to reach middle school age.

Implications for services

We were unable to find strong associations between the presence of specific social disadvantage by survey and subsequent poor health outcomes in the LSAC cohort. A likely explanation lies in the known greater attrition of more disadvantaged participants over time in the cohort, as well as the fact that rates of chronic childhood disease in Australia are low. These results do not therefore make the case for general screening of young children $\leq$5 years old as an effective strategy for identifying future health problems at age 10–11 years.

Implications for research

In order to improve the predictive qualities of screening for health-related social needs one obvious strategy is to focus on more circumscribed communities in which disadvantage is more prevalent. Health disparity is unequally distributed across communities, and research suggests that social inequity has been increasing in Australia since the 1970s (Davidson et al., 2020; Douglas et al., 2014). Future research should focus on families living in identified disadvantaged areas where the prevalence of social risks is higher. Targeting in this way may improve the predictive capability of these screening questions.

Conclusion

While screening for the social risks may be important for identifying and supporting families at risk, screening tools require satisfactory levels of sensitivity and specificity. Our data suggest that the tool we applied to assess social risks has reasonable predictive validity academic outcomes at 10–11 years but is poorer at predicting health outcomes, possibly due to a low prevalence of health problems at age 10–11 years as well as an advantaged sample. These data are informative for any future implementation of social risk screening in Australia.

Ethical statement

The research methodology and survey content of LSAC have been reviewed and approved by the Australian Institute of Family Studies Ethics Committee. Parental consent was obtained at each wave of data collection.

Data statement

Access to the LSAC data is provided to *bona fide* researchers by applying to the National Centre for Longitudinal Data (https://growingupinaustralia.gov.au/data-and-documentation/accessing-lsac-data).

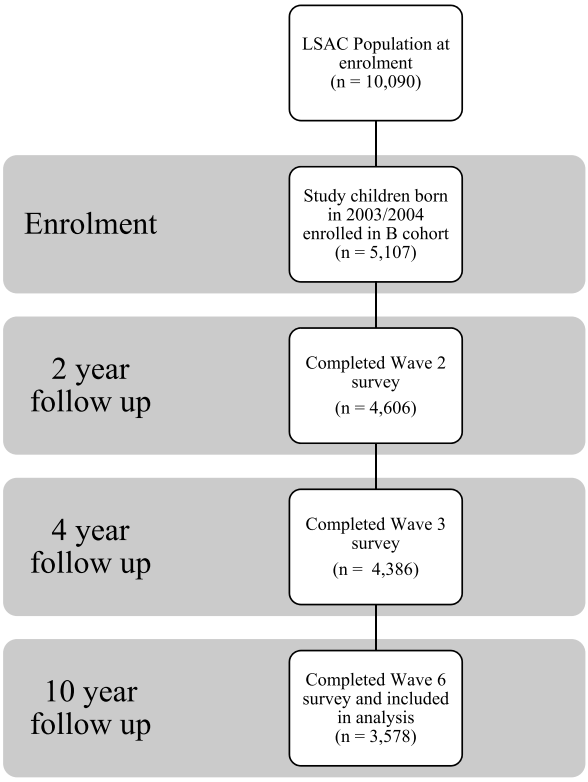

Fig. 1. STROBE flow diagram.

Originality

The manuscript is entirely original work of the authors. The work and words of others have been cited accordingly.

Publication

This manuscript is submitted to SSM: Population Health exclusively and is not under consideration at any other journal. However, part of the work described in this manuscript was in the form of a thesis by AW, who was supervised by LGS, MB and GM [redacted for peer review].

Authorship

All persons who made a significant contribution to the conception, design, execution and interpretation of the study are included as authors. All authors have seen and approved the final version of the paper and agree to its submission for publication.

Conceptualization, Formal analysis, Methodology, Project administration, Roles/Writing – original draft, **McMichael**: Conceptualization, Methodology, Supervision, Writing – reviewing and editing. Boyd: Conceptualization, Methodology, Supervision, Writing – reviewing and editing. **Smithers**: Conceptualization, Formal analysis; Methodology, Project administration, Supervision, Writing – Reviewing and Editing.

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Declaration of competing interest

LGS' institution is paid sitting fees for their scientific advisory role on the Consortium Advisory Committee, Longitudinal Study of Australian Children. MB has received honoraria for participation on advisory boards to VIIV Healthcare. AW and GM have no conflicts of interest to declare.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ssmph.2022.101070.

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