Relation of child, caregiver, and environmental characteristics to childhood injury in an urban Aboriginal cohort in New South Wales, Australia

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Abstract

Objective: Despite being disproportionately affected by injury, little is known about factors associated with injury in Aboriginal children. We investigated factors associated with injury among urban Aboriginal children attending four Aboriginal Community Controlled Health Services in New South Wales, Australia.

Methods: We examined characteristics of caregiver-reported child injury, and calculated prevalence ratios of 'ever-injury' by child, family, and environmental factors.

Results: Among children in the cohort, 29% (n=373/1,303) had ever broken a bone, been knocked out, required stitches or been hospitalised for a burn or poisoning; 40–78% of first injuries occurred at home and 60–91% were treated in hospital. Reported ever-injury was significantly lower (prevalence ratio ≤0.80) among children who were female, younger, whose caregiver had low psychological distress and had not been imprisoned, whose family experienced few major life events, and who hadn't experienced alcohol misuse in the household or theft in the community, compared to other cohort members.

Conclusions: In this urban Aboriginal child cohort, injury was common and associated with measures of family and community vulnerability.

Implications for public health: Prevention efforts targeting upstream injury determinants and Aboriginal children living in vulnerable families may reduce child injury. Existing broad-based intervention programs for vulnerable families may present opportunities to deliver targeted injury prevention.

Key words: Aboriginal child health, child injury, social determinants of health, injury prevention, Aboriginal Community Controlled Health Services

Injury is a major cause of child morbidity and mortality worldwide.[1] Every year in Australia, around 200 children aged 0–14 years die,[2] and around 80,000 children aged 0–17 are admitted to hospital,[3] because of an injury. Australian Indigenous (Aboriginal and Torres Strait Islander) children are disproportionately affected compared to non-Indigenous children, with up to five times higher mortality[4] and 10 times higher hospitalisation rates[5] for some injury types.

The burden and causes of injury vary by age, reflecting stages of development.[3] Internationally, studies have identified child, family and environmental factors associated with an increased risk of child injury.[6-14] Population-level studies have identified higher rates of injury in disadvantaged families and areas,[7,8,15] which may be a proxy for other unmeasured exposures, such as inadequate parental supervision, structurally unsafe homes or traffic volume, that may be causally associated with child injury.[16] Other key injury risk factors include male versus female gender,[6,7,14,17] and living in more rural/remote areas.[9,10,14] Previous studies have also identified an increased risk of injury among children exposed to adverse prenatal and early life exposures including maternal smoking and stress.[11-13] Because these early life exposures influence early childhood physical and cognitive development, it is hypothesised that they may, in turn, influence injury risk.[12]

To date, the majority of evidence about injury in Indigenous Australian children has been derived from national or state-wide hospital and mortality data.[14,15,18] At a population level, this has demonstrated a significantly higher burden of unintentional injury resulting in hospitalisation or death among Indigenous, versus non-Indigenous, children. It has also shown that area-level

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remoteness and disadvantage only partially explain the differences in unintentional injury hospitalisation rates between Indigenous and non-Indigenous children.[15] Population data only capture more severe child injuries and, as a result, little is known about the magnitude and aetiology of non-hospitalised injury. Further, population data lack detail on individual and family risk factors.[18-20]

Indigenous child injury is complex and may be associated with the child's physical health, life circumstances and environmental conditions, among other factors.[21] The identification of specific factors associated with Indigenous child injury is important for the design of injury prevention programs that are relevant to the population's sociocultural and environmental conditions.[6] Despite this, there is a paucity of evidence regarding the child, family, and environmental factors associated with injury in Indigenous Australian children.[18]

The Study of Environment on Aboriginal Resilience and Child Health (SEARCH) retrospectively collected data about non-fatal injury among urban Aboriginal children in New South Wales (NSW), Australia, as well as child, family, and environmental characteristics.[22] With respect to this cohort, we use the term Aboriginal, rather than Indigenous, because Aboriginal people are the original inhabitants of NSW,[23] and constitute the vast majority (95%) of the NSW Indigenous population.[24] We aim to describe caregiver-reported child injuries in this cohort of urban Aboriginal children, and to identify child, family, and environmental characteristics associated with injury.

Methods

Study population

We used baseline data from the SEARCH, a cohort study of 1,669 Aboriginal children in NSW. This analysis excludes children whose carers did not complete a child survey (n=193), children aged >18 years at survey (n=1), children asked an out-dated version of injury questions from the pilot questionnaire (n=36), and children with missing data on the outcome (n=up to 136, depending on the specific injury outcome).

Data collection

SEARCH is conducted in partnership with four Aboriginal Community Controlled Health Services (ACCHSs) at Mount Druitt, Campbelltown, Wagga Wagga and Newcastle. Urban-dwelling children (including those in inner regional areas) and their caregivers were invited to participate in SEARCH between 2008 and 2012, at the time of presentation to the participating ACCHSs.[22]

An Aboriginal Research Officer interviewed the child's caregiver to record demographic, social, lifestyle and health data on the caregiver and child. Participating families also provided consent for follow-up and data linkage, although the current analysis only uses questionnaire data. Details on the study design are provided elsewhere.[22]

Analysis variables

Outcomes

We examined five child injury outcomes, reported by caregivers at the time of the baseline survey, including if the child had ever: broken a bone; been knocked out because of an injury; had to stay in hospital because of a burn; had to stay in hospital because of an accidental poisoning; or had any stitches because of an accident or injury. This survey item (see Supplementary File 1) was adapted from injury questions used in the Western Australia Aboriginal Child Health Survey (WAACHS).[25]

Caregivers only reported on the first injury that occurred within each injury type; caregivers were not asked to report on more recent injuries if the child had experienced multiple injuries of the same type. Because there were too few injuries to model the associations of child, family and environmental characteristics with each injury outcome separately, we aggregated the five injury outcomes. Children were classified as 'ever injured' if they had ever experienced any of five the injury types, 'never injured' if they had never experienced any of the five injury types (with complete data across injury types), and 'missing' if injury status could not be ascertained because no injuries were reported but data were incomplete (missing data on at least one of the injury types).

Caregivers were also asked to report the child's age when the injury first occurred, the place where the injury occurred (at home – including the home of the child, a friend, or a relative; school, sports, or playground – including parks; on the road; or other), and whether and where the injury was treated (not treated; treated at home; treated at hospital – including both inpatient and emergency; treated at primary care – including treatment by an ACCHS or Doctor's surgery; or other).

Explanatory variables

Child characteristics included the child's sex; age at survey (0–2, 3–5, 6–9 or ≥10 years); exposure to breastfeeding (never versus ever breastfed), and smoke or alcohol and other drugs in utero.

Caregiver and family characteristics included the caregiver's age at the child's birth (≤20, 21–30, ≥31 years or not birthmother); Indigenous status; employment status (unemployed, home duties or employed/studying); highest educational qualification (<Year 12 versus Year 12 or further); and smoking status (current, past or never).

We measured caregivers' wellbeing according to: satisfaction with physical health (dissatisfied, 1–4/10; neutral, 5/10; or satisfied, 6–10/10), major health conditions (any versus no reported heart disease, kidney disease, diabetes, cancer or stroke), current chronic medical condition (any versus no reported condition lasting ≥6 months), any disability (on disability support benefit or reported limitation in normal activities due to health problem), psychological distress (low or high distress, according to K10), and service use related to social and emotional wellbeing (ever versus never received counselling/been hospitalised).

We analysed injury by the number (0–2, 3–5 or ≥6) of selected major life events experienced by the family in the past year, if the caregiver had ever felt mistreated or harassed by police due to being Aboriginal, whether the caregiver or their partner had ever served time in prison, and whether the caregiver or their relatives had been taken away from their natural family or traditional land.

Environmental characteristics included measures of children's home environment, including: the number of homes the child had lived in since birth (1, 2, 3 or ≥4); the number of people who normally sleep in the household (2–4, 5–6 or ≥7); if the caregiver considered their home was too small; housing tenure type (social housing, rental or owned/mortgaged by someone in the household); major electrical or structural problems in the home (including major electrical problems, sinking or moving foundations, major cracks in walls or floors, sagging floors, walls or windows not straight, and wood rot or termite damage); functioning smoke alarm in the home; any smoking in the household (anyone smokes inside versus smoke-free household); caregiver-reported problem with alcohol use or gambling in the household; and caregiver-reported neighbourhood

safety, problems with theft (no/small problem versus pretty bad to serious problem), and availability of safe parks or places to play.

Statistical analyses

We examined the prevalence of ever-injury for each of the five injury types, and the aggregate outcome (ever-injury), in the cohort.

We calculated the median and interquartile range for variables related to children's age at first injury and age at survey because the age data are highly skewed. Children who were older at survey had more opportunity to have ever experienced an injury than younger children, so we examined the number of children ever injured, and the age at first injury, stratified by the child's age at survey. Given expected differences and similarities in the age profile across injury types,[14] we grouped injuries into two broad categories: broken bones, stitches and knock outs; and burns and poisonings.

We fit log-binomial models to calculate the Prevalence Ratio (PR) of ever-injury with 95% Confidence Interval (CI) across categories of each child, family, and environment variable. These analyses were adjusted for age group, sex, and ACCHS only, and were conducted within the generalised estimating equations (GEE) framework to account for the correlations within a family (exchangeable correlation structure).

Because exposures measured at the baseline survey might not reflect the exposures at the time of injury, especially in cases where the injury occurred many years before the survey, we conducted a sensitivity analysis restricting the sample to children <6 years old at the time of survey. This analysis was also adjusted for age group at survey (0–2 years versus 3–5 years). Although some characteristics may have changed within the child's first six years of life, we anticipated that these measures would be highly correlated. If changes in exposures over time were diluting true associations, we expected to see stronger exposure-outcome associations in the age-restricted analysis. Given the expected variation in severity between reported injuries, we also conducted a sensitivity analysis restricted to severe injuries, defined as those treated in hospital (see Supplementary File 2).

To assess potential bias due to missing data, the analyses were repeated in a dataset with multiply imputed data on exposure variables (see Supplementary File 3). All analyses were conducted in Stata version 14.

Engagement strategy

The SEARCH study has strong Aboriginal governance, including Aboriginal leadership, formal partnership with the Aboriginal community-controlled health sector, and employment of Aboriginal research officers and data collectors; this partnership model is described elsewhere.

SEARCH partner representatives from Tharawal AMS (including author CW) provided input into the manuscript and interpretation of findings. Preliminary findings were discussed with ACCHS representatives and policymakers at the 2015 Annual SEARCH forum, and at a policy roundtable facilitated by the Australian Health Services Research Institute (University of Wollongong) and Office of Kids and Families (NSW Ministry of Health). Final results will be communicated to ACCHSs via an established knowledge exchange program.

Ethics

This study was conducted with approval from the ethics committees of the Aboriginal Health and Medical Research Council of New South Wales (reference 568/06) and of the University of Sydney (reference 12-2003/9429).

Results

Burden of injury

The majority (71%) of children participating in SEARCH had never experienced any of the five injury types, according to caregiver-report (Table 1); 29% of children (n=373/1,303) had ever experienced one of the five injury types, including 6% of children (n=83/1,303) who had experienced ≥2 of the injury types.

Of all first-time injuries reported, those requiring stitches were most common (17%; n=224/1,337 children), followed by those resulting in broken bones (10%, n=141/1,369),

Table 1: Characteristics of carer-reported child injuries in SEARCH baseline.

	Ever had injury type										Total ever injured[a]	
	Broken bone		Knocked out		Stitches		Burn		Poisoning			
% (n/N) children with injury	10%	(141/1,369)	4%	(58/1,341)	17%	(224/1,337)	3%	(34/1,337)	1%	(18/1,348)	29%	(373/1,303)
Median age (IQR) at first injury, in years	5	(3–8)	4	(2–9)	4	(2–7)	2	(1–4)	2	(1–3.5)	4[b]	(2–6)
Median age (IQR) at survey, in years	9.9	(7.0–12.9)	9.8	(5.0–12.9)	8.6	(5.8–11.6)	6.6	(4.9–10.5)	4.5	(3.1–7.3)	8.4	(5.4–11.7)
Median years (IQR) between first injury and survey	2.9	(1.4–5.6)	2.5	(1.2–5.4)	2.4	(1.2–5.7)	3.6	(1.4–5.6)	1.4	(0.8–3.1)	2.8[b]	(1.3–5.7)
	%	(n/N)	%	(n/N)	%	(n/N)	%	(n/N)	%	(n/N)		
Place of injury												
Home or house of friend/ relative	46	(65/141)	40	(23/58)	67	(150/224)	76	(26/34)	78	(14/18)		
Road	7	(10/141)	10	(6/58)	4	(9/224)	0	(0/34)	0	(0/18)		
School, sports, playground	33	(47/141)	34	(20/58)	13	(28/224)	9	(3/34)	0	(0/18)		
Other	9	(12/141)	3	(2/58)	7	(15/224)	3	(1/34)	0	(0/18)		
Missing	5	(7/141)	12	(7/58)	10	(22/224)	12	(4/34)	22	(4/18)		
Place of treatment of injury												
Not treated	1	(1/141)	2	(1/58)	0	(0/224)	0	(0/34)	0	(0/18)		
At home	1	(2/141)	16	(9/58)	0	(1/224)	0	(0/34)	0	(0/18)		
Primary care	13	(19/141)	7	(4/58)	25	(56/224)	0	(0/34)	0	(0/18)		
Hospital	79	(112/141)	60	(35/58)	65	(146/224)	91	(31/34)	83	(15/18)		
Other	0	(0/141)	5	(3/58)	0	(0/224)	0	(0/34)	0	(0/18)		
Missing	5	(7/141)	10	(6/58)	9	(21/224)	9	(3/34)	17	(3/18)		

Total N varies across injury types due to missing data on each injury outcome. Primary care includes treatment by an ACCHS or Doctor's surgery; hospital includes inpatient and emergency.

a: Restricted to children with data on the composite variable 'ever injured'.

b: Based on age at first ever injury across injury types.

or being knocked out (4%, n=58/1,341); 3% of children (n=34/1,337) had ever experienced a burn, and 1% (n=18/1,348) a poisoning, that resulted in hospitalisation.

Age at injury

The median age of children at survey was 5.8 years (IQR:3.2–9.8 years, n=1,303); 51.0% (n=665/1,303) of children in the sample were <6 years at the time of survey. We examined the median age at first injury separately by age group (<6, 6–9 or >10 years) given the variation in children's opportunity to have experienced an injury. Among children <6 years at survey, the median age at first injury of any type was 2 years (IQR:1–3); the median age was 4 (IQR:3–6) for children aged 6–9 years at survey, and 7 (IQR:4–10) for children aged >10 years at survey. Bearing in mind the differential opportunity to experience an injury by children's age at survey, the overall median age at first injury in the sample was 4 years (IQR:2–6), and the median length of time between the reported first injury and survey was 2.8 years (IQR:1.3–5.7).

We then examined the age at first injury by broad injury type: 1) broken bones, stitches and knock outs; and 2) burns and poisonings (Figure 1). The median age of first-time injury resulting in broken bones, knock outs or stitches was 2.0 years (IQR:1–3) for children aged <6 years at the time of survey; 4.5 years (IQR:3–9) for children aged 6–9 years; and 8.0 (IQR:4–10) for children aged >10 years. For burns and poisonings, the median age at first injury was 1.8 years (IQR:1–3); 3.5 years (IQR:1.5–5.5); and 3.0 years (IQR:2–7.5) for children aged 0–5, 6–9 and >10 years at survey, respectively.

Place of injury occurrence

Overall, the majority of reported injuries occurred at home (the child's own home or the home of a friend or relative), accounting for >75% of burns and poisonings (n=26/34 and n=14/18), 67% of injuries requiring stitches (n=150/224), and ≥40% of broken bones and knock outs (n=65/141 and n=23/58), see Table 1. Of the injuries occurring at home, the majority (71–96% across injury types) occurred at the child's own home, and the minority (4–29% across injury types) occurred at a friend or relative's home.

Injuries occurring at school, playground, or sports setting accounted for >30% of broken bones and knock outs (n=47/141 and n=20/58); 13% of injuries requiring stitches (n=28/224); and 9% of burns (n=3/34). An additional 10% of knock outs (n=6/58); 7% of broken bones (n=10/141); and 4% of injuries requiring stitches (n=9/224) occurred on the road. Across injury types, 0–9% of injuries occurred at a location that could not be categorised (e.g. tree, airport), and 5–22% were missing data on place of injury.

Place of injury treatment

Hospital was the most common place for treatment across all injury types (Table 1). All burns and poisonings were treated at hospital by nature of the question asked of caregivers, as well as: 79% of broken bones (n=112/141); 65% of injuries that required stitches (n=146/224); and 60% of knock outs (n=35/58). Injuries were also treated in primary care: 25% of injuries requiring stitches (n=56/224); 13% of broken bones (n=19/141); and 7% of knock outs (n=4/58). Few injuries were left untreated or treated at home. Five per cent of knock outs (n=3/58) were treated at a location not included in the pre-specified questionnaire categories (e.g. school). Data on place of injury treatment was missing for 5–17% of injuries across injury types.

Child, family, and environment characteristics associated with ever-injury

Several characteristics were associated with ever-injury in our sample, after adjustment for age group, sex and ACCHS (Table 2). Girls were 32% less likely to have ever experienced an injury than boys (PR=0.68,95%CI:0.57,0.0.81), and children were more likely to have ever experienced an injury with increasing age (up to PR=5.12,95%CI:3.41,7.67 for children aged ≥10 versus 0–2 years). Children were significantly less likely to have ever been injured if: their caregiver had better social and emotional wellbeing (K10<22 versus ≥22; PR=0.73,95%CI:0.61,0.86), their family experienced fewer major life events in

Figure 1. Percent of children injured and age at first injury in SEARCH baseline, by children's age at time of survey and broad injury type.

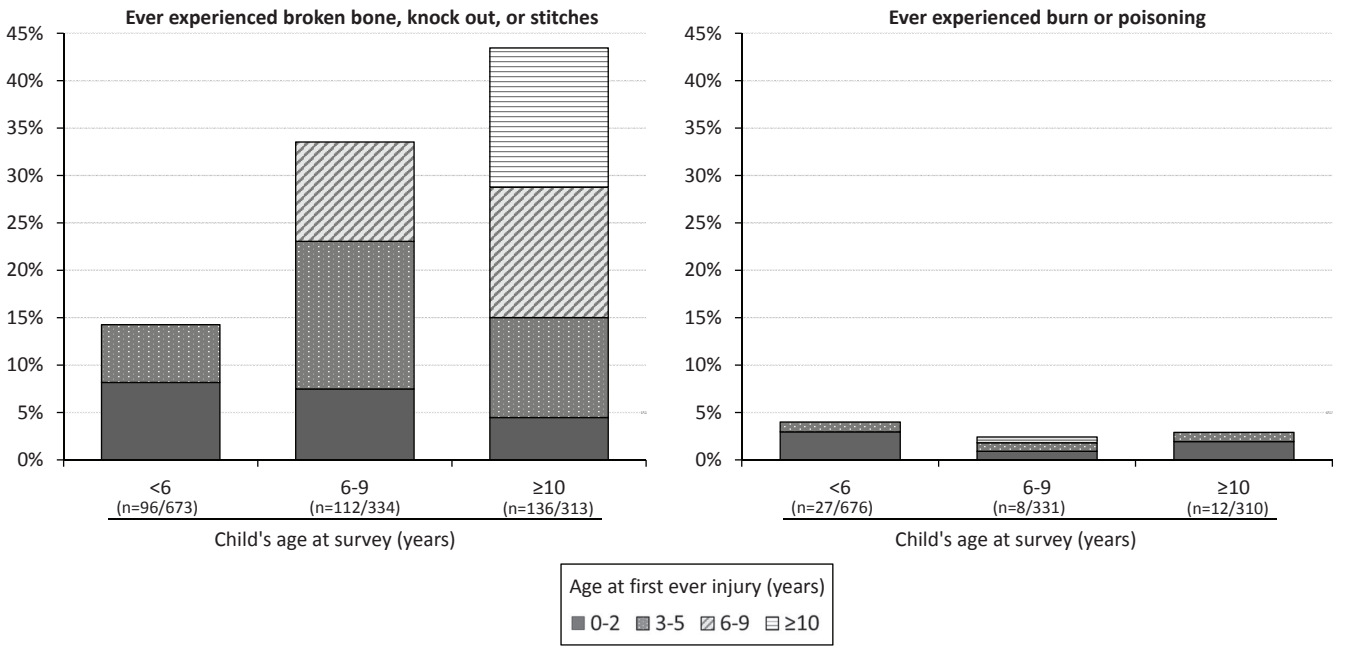

Table 2: Associations of child, caregiver, and environmental characteristics to ever-injury among all children participating in SEARCH baseline, and among children aged <6 years at baseline.

	Ever injured							
	Children aged <18 years at survey				Children aged <6 years at survey			
	%	(n/N)	PR	[95% CI]	%	(n/N)	PR	[95% CI]
Ever injured/total	29	(373/1,303)			17	(114/665)		
Child characteristics								
Sex[a]								
Male	34	(231/683)	1	[ref]	20	(70/347)	1	[ref]
Female	23	(142/620)	0.68	[0.57–0.81]	14	(44/318)	0.71	[0.51–1.00]
Age at survey (years)[a,b]								
0-2	9	(26/298)	1	[ref]	9	(26/298)	1	[ref]
3-5	24	(88/367)	2.69	[1.76–4.11]	24	(88/367)	2.75	[1.79–4.23]
6-9	36	(118/329)	4.02	[2.69–6.01]				
≥ 10	46	(141/309)	5.12	[3.41–7.67]				
Ever breastfed								
No	27	(146/549)	1	[ref]	16	(44/281)	1	[ref]
Yes	29	(206/704)	1.08	[0.91–1.28]	17	(61/358)	1.15	[0.82–1.60]
Exposed to smoke in utero								
Yes	29	(188/656)	1	[ref]	17	(55/326)	1	[ref]
No	28	(167/602)	0.97	[0.82–1.15]	17	(55/318)	0.99	[0.71–1.37]
Exposed to alcohol/drugs in utero								
Yes	28	(100/363)	1	[ref]	16	(30/189)	1	[ref]
No	29	(254/882)	1.01	[0.83–1.24]	18	(81/448)	1.13	[0.78–1.63]
Caregiver and family characteristics								
Caregiver's age at child's birth								
≤ 20 years	30	(78/262)	1	[ref]	17	(20/116)	1	[ref]
21-30 years	31	(188/615)	1.07	[0.87–1.32]	18	(56/309)	1.10	[0.70,1.71]
≥ 31 years	21	(39/185)	0.90	[0.66–1.23]	11	(13/120)	0.67	[0.35,1.26]
Caregiver completing survey not child's birth mother	28	(68/241)	0.96	[0.73–1.27]	21	(25/120)	1.13	[0.67,1.91]
Caregiver's Indigenous status								
Aboriginal and/or Torres Strait Islander	29	(289/1,011)	1	[ref]	17	(86/510)	1	[ref]
Non-Indigenous	29	(74/252)	1.06	[0.85–1.32]	19	(25/135)	1.05	[0.72–1.53]
Caregiver's employment status								
Unemployed– retired– unable to work	31	(47/152)	1	[ref]	22	(17/78)	1	[ref]
Employed or studying	34	(132/384)	1.03	[0.76–1.40]	22	(35/161)	1.07	[0.64–1.79]
Home duties	25	(181/714)	0.92	[0.68–1.23]	14	(58/401)	0.77	[0.48–1.25]
Caregiver's highest qualification								
Less than Year 12	27	(162/602)	1	[ref]	16	(51/322)	1	[ref]
Year 12 or further	30	(188/618)	1.06	[0.89–1.27]	18	(55/301)	1.06	[0.76–1.48]
Caregiver's smoking status								
Current smoker	29	(193/663)	1	[ref]	17	(57/337)	1	[ref]
Past smoker	31	(79/251)	1.07	[0.86–1.32]	20	(26/132)	1.13	[0.75–1.69]
Never smoker	25	(82/326)	0.87	[0.70–1.09]	16	(27/170)	0.92	[0.62–1.37]
Caregiver's satisfaction with health								
Dissatisfied	28	(44/160)	1	[ref]	17	(15/90)	1	[ref]
Neutral	32	(95/295)	1.04	[0.78–1.38]	18	(26/141)	1.11	[0.65–1.90]
Satisfied	27	(213/775)	0.94	[0.73–1.21]	17	(68/399)	1.03	[0.65–1.62]
Caregiver major health conditions								
Yes	27	(72/268)	1	[ref]	14	(18/127)	1	[ref]
No	28	(270/961)	1.06	[0.86–1.31]	17	(86/504)	1.25	[0.77–2.03]
Caregiver current chronic condition								
Yes	33	(133/404)	1	[ref]	20	(38/192)	1	[ref]
No	26	(212/818)	0.85	[0.71–1.01]	16	(70/441)	0.83	[0.59–1.17]
Caregiver has disability								
Yes	35	(80/231)	1	[ref]	21	(22/103)	1	[ref]
No	27	(251/930)	0.87	[0.71–1.06]	16	(78/491)	0.78	[0.51–1.19]
Caregiver's psychological distress[a]								
High (K10 score ≥ 22)	37	(87/236)	1	[ref]	19	(23/119)	1	[ref]
Low (K10 score < 22)	27	(256/938)	0.73	[0.61–0.86]	17	(85/487)	0.93	[0.64–1.36]
Caregiver previous mental health service use								
Ever	30	(143/478)	1	[ref]	18	(46/253)	1	[ref]
Never	27	(193/712)	0.92	[0.77–1.11]	16	(56/353)	0.90	[0.64–1.27]
Number of major life events in past year[a]								
≥ 6	39	(111/286)	1	[ref]	25	(31/125)	1	[ref]
3-5	26	(115/436)	0.77	[0.63–0.94]	14	(32/227)	0.62	[0.41–0.95]
0-2	25	(133/527)	0.74	[0.61–0.91]	16	(47/289)	0.73	[0.50–1.06]

Table 2 continued: Associations of child, caregiver, and environmental characteristics to ever-injury among all children participating in SEARCH baseline, and among children aged <6 years at baseline.

	Ever injured							
	Children aged <18 years at survey				Children aged <6 years at survey			
	%	(n/N)	PR	[95% CI]	%	(n/N)	PR	[95% CI]
Caregiver or caregiver's partner has served time in prison[a,b]								
Self and/or partner	32	(86/266)	1	[ref]	21	(33/158)	1	[ref]
Neither	26	(219/827)	0.75	[0.62–0.92]	15	(62/410)	0.67	[0.47–0.95]
Caregiver has been mistreated or harassed by police because Aboriginal								
Yes	32	(91/282)	1	[ref]	17	(23/133)	1	[ref]
No	28	(213/766)	0.92	[0.75–1.13]	18	(70/394)	1.02	[0.67–1.55]
Forced removal of caregiver or relative from family								
Yes	30	(107/359)	1	[ref]	19	(36/188)	1	[ref]
No	27	(184/676)	0.92	[0.75–1.13]	17	(59/346)	0.86	[0.60–1.22]
Forced removal of caregiver or relative from traditional land								
Yes	30	(49/165)	1	[ref]	17	(13/75)	1	[ref]
No	26	(199/759)	0.93	[0.73–1.18]	15	(61/398)	0.94	[0.55–1.61]
Environmental characteristics								
Number of houses child has lived in since birth								
≥ 4	38	(131/344)	1	[ref]	24	(23/95)	1	[ref]
3	29	(69/237)	0.85	[0.66–1.08]	18	(19/103)	0.79	[0.46–1.35]
2	24	(69/290)	0.88	[0.67–1.15]	15	(26/172)	0.78	[0.47–1.30]
1	21	(70/341)	0.95	[0.74–1.22]	14	(36/256)	0.78	[0.49–1.24]
Number of people who normally sleep in house								
2-4	27	(120/445)	1	[ref]	20	(51/261)	1	[ref]
5-6	30	(148/489)	1.04	[0.85–1.27]	16	(37/227)	0.84	[0.58–1.21]
≥ 7	29	(84/294)	0.97	[0.76–1.24]	15	(21/138)	0.88	[0.56–1.37]
Home too small								
Yes	29	(168/574)	1	[ref]	16	(45/284)	1	[ref]
No	28	(187/663)	0.94	[0.79–1.12]	19	(65/350)	1.11	[0.79–1.54]
Housing tenure type								
Social housing	30	(234/789)	1	[ref]	18	(71/396)	1	[ref]
Rental	25	(57/229)	0.92	[0.72–1.18]	17	(22/132)	1.02	[0.69–1.50]
Owned or mortgaged by someone in household	30	(61/206)	1.00	[0.79–1.26]	14	(14/99)	0.75	[0.44–1.27]
Major electrical or structural problems in home								
Major problems	30	(153/503)	1	[ref]	16	(39/239)	1	[ref]
No major problems	27	(183/686)	0.91	[0.76–1.08]	17	(65/373)	1.07	[0.76–1.51]
Functioning smoke alarm in home								
No	24	(22/91)	1	[ref]	19	(10/54)	1	[ref]
Yes	29	(330/1,133)	1.09	[0.76–1.58]	17	(100/573)	0.98	[0.60–1.59]
Smoke-free status of household								
≥ 1person smokes inside	27	(137/514)	1	[ref]	15	(41/273)	1	[ref]
Smoke-free household	30	(191/640)	1.04	[0.87–1.25]	18	(59/323)	1.21	[0.85–1.73]
Problem with alcohol use in household[a,b]								
Yes	39	(43/110)	1	[ref]	29	(16/56)	1	[ref]
No	27	(301/1,113)	0.75	[0.58–0.95]	16	(91/578)	0.51	[0.36–0.72]
Problem with gambling in household								
Yes	33	(22/66)	1	[ref]	23	(5/22)	1	[ref]
No	28	(323/1,143)	1.05	[0.68–1.62]	17	(101/598)	0.69	[0.37–1.29]
Feel safe in neighbourhood								
Disagree	36	(63/177)	1	[ref]	22	(17/76)	1	[ref]
Neutral	30	(50/167)	0.95	[0.72–1.26]	21	(18/86)	0.83	[0.47–1.44]
Agree	27	(235/871)	0.84	[0.67–1.06]	16	(72/461)	0.67	[0.44–1.02]
Problem with theft in community[a,b]								
Pretty bad to serious problem	35	(133/379)	1	[ref]	22	(39/177)	1	[ref]
No or small problem	26	(167/643)	0.80	[0.66–0.97]	15	(51/342)	0.68	[0.47–0.98]
Safe parks/places to play in the community								
No	33	(97/290)	1	[ref]	19	(24/124)	1	[ref]
Yes	25	(169/666)	0.85	[0.69–1.04]	16	(57/363)	0.79	[0.52–1.20]

The sample is restricted to children with data on the composite variable 'ever injured'. Total N varies across exposures due to missing data on the exposure of interest. All models are adjusted for the child's age group at survey– sex– and ACCHS– and account for clustering within families.

a: Variable is significantly associated with injury in the full sample (p-value for Wald test <0.05).

b: Variable is significantly associated with injury among children less than 5 years of age at the time of survey (p-value for Wald test <0.05).

the past year (PR=0.77,95%CI:0.63,0.94 and PR=0.74,95%CI:0.61,0.91 for 3–5 and 0–2 versus ≥6, respectively), their caregivers had not served time in prison (PR=0.75,95%CI:0.62,0.92), the child was not exposed to a problem with alcohol use in the household (PR=0.75,95%CI:0.58,0.97), and the child lived in a community where theft was not a problem (PR=0.80,95%CI:0.66,0.97).

Results of our sensitivity analyses were consistent with our primary analysis (Table 2; Supplementary File 2 and 3).

Discussion

Burden of injury

The majority of urban Aboriginal children in this sample had not experienced any of the five injury outcomes prior to their participation in the baseline survey. However, 29% of children had experienced at least one of the five injury types, and 6% of children had experienced more than one of the injury types, according to caregiver-report. Although we have limited information on the severity of the injuries reported in our study, the vast majority required treatment from a service provider – most commonly in hospital.

Caregivers most commonly reported that their child had ever had an injury that required stitches, followed by an injury that resulted in broken bones, and in knock out; caregivers were less likely to report that their child had ever had a burn or poisoning that resulted in hospitalisation. The proportions of children ever experiencing injuries resulting in broken bones, knock out, burns and poisoning are consistent with findings from 2000–2002 WAACHS, which used a similar injury survey question.[25] The types of injuries reported in this cohort are consistent with national patterns in the burden of hospitalised injuries among Indigenous children aged 0–17 years in 2011–2013, where the burden was substantially higher for injuries caused by falls, road crashes and other unintentional causes compared to burns or poisonings.[14] However, given that our paper has focused on the prevalence of 'ever-injury' in our sample, it is not possible to directly compare our findings to rates of hospitalisation and mortality in the broader Australian child population.

A strength of this analysis is that it was not restricted to injuries that resulted in hospitalisation, providing a more comprehensive picture of injury in urban Aboriginal children.[19] Our sensitivity analysis indicated that factors associated with hospitalised injuries were not materially different from factors associated with all (hospitalised and non-hospitalised) injuries. Up to 40% of broken bones, knock outs and stitches reported in this sample were not treated in hospital. Globally, it is estimated that for each fatal child injury there are 12 children admitted to hospital or permanently disabled, and 34 children who needed medical care or missed school or work because of an injury.[1] As such, analyses restricted to hospitalised injury miss a substantial burden of injury.[20] Although our study did capture injuries that were treated outside of hospital, it is important to note that our sample was limited to children who were in contact with an ACCHS; therefore, we have not captured the burden of injury among those who are not accessing ACCHSs.

The age profile of first injury varied across injury types, with children's first burns and poisonings most commonly reported around the age of two years, and the first occurrence of other injury types distributed more evenly across age groups. The pattern of age at first injury for broken bones, knock out, burns and poisonings is consistent with findings from 2000–2002 WAACHS,[25] and with whole-of-population data linkage studies on hospitalised injury – including studies of Aboriginal and non-Aboriginal children in NSW.[5,14,26] These studies have demonstrated that child injuries associated with burns and poisonings are more common in very young children, peaking at 1–4 years of age; injuries resulting from falls are common across developmental stages; and rates of injury relating to transport or other unintentional causes increase with age.

Place of injury occurrence

In this cohort, the first occurrence of injury – across injury types – most often occurred at home, consistent with other evidence from NSW.[26] The majority of these injuries occurred in the child's own home, with the minority of these injuries (>30%) occurring at a friend/relative's home. Injuries resulting in broken bones, knock outs and stitches commonly occurred at school, playground or sports settings, and on the road. Environmental modification, such as improving home and playground safety, could contribute to decreasing the burden of injury in this population.[5] Additional data would assist in the contextualisation of reported injuries. For example, there are several potential external causes for injuries that occur on the road; we do not know if children in this study were injured while riding a bike, walking, or while in a car. Each requires different prevention strategies, so the non-specific nature of the 'road' injury category limits our ability to interpret findings.

Place of injury treatment

Across injury types, most injuries were treated in hospital settings, with a smaller proportion treated in primary care. This might indicate that these injuries were on the more severe end of the spectrum and required hospital treatment, but could also reflect other factors, including access to, and availability of, services. For example, service opening hours and cost of treatment may affect where a child seeks and/or receives treatment. It is important to note that, by nature of the survey question, injuries from burns and poisoning had to have been treated in hospital in order to be recorded.

Child, family, and environmental factors related to injury

Consistent with Australian and international literature, girls were less likely (>30%) to have ever been injured than boys. Globally, boys are reported to have both more frequent and more severe injuries than girls,[1] with rates varying by injury mechanism and stage of child development. In Australia, rates of hospitalised injury are higher for Indigenous males versus females at each age group, with the greatest difference in injury rates observed in the 10–14-year-old age group.[14] Gender differences in childhood injury have been attributed to greater risk taking or higher activity levels in males,[1,26] or differences in socialisation between boys and girls.[1,6]

Older versus younger children in our study were significantly more likely to have ever been injured, which reflects the increasing opportunity to have accrued an injury over time. Children are exposed to different risk factors and settings at different ages; for example, older children attend school and play sport, and are therefore more likely to experience injuries in these settings;[3,14] this is reflected in the changing profile of injury type as children age.[5,14,26]

It is widely established that socioeconomic disadvantage is associated with child injury; however, research indicates that standard

sociodemographic characteristics (e.g. receipt of benefits, unemployment, overcrowding, maternal age at childbirth and area-level disadvantage) are not sensitive indicators of children's injury risk.[17] This study provides the first detailed evidence on other features of family and community vulnerability associated with injury in Aboriginal children, which can inform targeted prevention. Family and community wellbeing were protective against child injury in this sample; indicators of better life circumstances and safe neighbourhoods were associated with a 20–30% lower prevalence of ever-injury. Children were significantly less likely to have ever been injured if their caregiver had better social and emotional wellbeing and had not served time in prison, if their family experienced fewer major life events in the past year, and if they were not exposed to alcohol misuse in the household or theft in the community.

The relationship of caregivers' social and emotional wellbeing to child injury demonstrates the importance of parental wellbeing to child health outcomes, and lends support to the existing programs and services delivered by ACCHSs to support caregivers' wellbeing. Given the established relationship between the wellbeing of Aboriginal children and their caregivers,[27] the relationship between caregiver wellbeing and child injury could be partially mediated through the child's own social and emotional wellbeing. The relationship could also be partially mediated through other factors such as major life events or disadvantage.

Parental factors associated with injury in this sample (poor social and emotional wellbeing, major life events, contact with the justice system, alcohol misuse) are also associated with other negative child outcomes. As such, existing broad-based intervention programs that aim to support vulnerable and disadvantaged families and improve child outcomes may offer a vehicle for delivering injury prevention measures to at-risk families. Conversely, children may also benefit through the incorporation of family support within the context of existing ACCHS injury programs.[28]

Consistent with our findings, research conducted in the UK has identified an increased injury risk among children living in areas with high crime rates; this may be an indicator of area-level disadvantage, or of environmental quality (e.g. housing, roads).[16] The observed association between child injury and community-level factors suggests that community-level interventions to improve child and family safety may also have the potential to reduce the burden of Aboriginal child injury.

Although we did not observe a relationship between injury and family-level measures of socioeconomic disadvantage (e.g. parental education, employment, income) in this Aboriginal cohort, other large-scale studies have demonstrated an association between these social determinants and child injury.[7,18] Our study may have been underpowered to detect these associations given the relatively small numbers, particularly the small numbers in the more advantaged strata of socioeconomic measures. As such, measures of family-level disadvantage should be considered alongside other risk factors identified here.

Limitations

Our ability to quantify the burden of injury in this cohort was limited by the injury questions asked. Because caregivers were only asked to report the age that the child first experienced each injury type, we were limited to examining the prevalence of first-time injuries, rather than all injuries, that occurred prior to survey. Although we could determine if a child had experienced more than one of the five injury types prior to recruitment, we could not ascertain whether the child had experienced multiple injuries of the same type. We were also limited to ascertaining hospitalised injuries, rather than all injuries, from burns and poisoning.

Further, exposures were measured at the time of survey, not necessarily before, or close to, the time of injury. For caregivers reporting a child injury that occurred many years before the survey, exposures measured at the time of survey might not reflect the actual exposures at the time of injury. To reduce the impact of these issues on the study findings, we focused our analysis on exposures that we assumed were relatively stable, or highly correlated, over time (e.g. caregivers' education). Adding strength to our findings, results of the analysis restricted to children aged <6 years at survey were consistent with the results of the primary analyses. The effect of exposures on ever-injury was diluted for some variables in the restricted sample, which may be attributable to the reduced sample size.

This paper relies on data reported by children's caregivers. There is the potential for recall bias relating to measurement of injury outcomes; caregivers may be more likely to recall more recent injuries (versus the first injury occurrence) for children who have experienced multiple injuries. There may be differential recall biases for injuries depending on their severity, or on the length of time between the first injury occurrence and the survey. Examination of the age distribution of first injury, by injury type, indicates that caregivers may have been more likely to forget to report children's burn or poisonings, given that these injuries tend to first occur at younger ages. Relying on caregiver-report may be particularly problematic for children who have had multiple caregivers, or who live in unstable home environments. Further, there is the potential that caregivers under-reported injury occurrence if they were concerned about accusations of child maltreatment.

These findings are based on nearly one-quarter of all children attending four ACCHSs in NSW, constituting the largest cohort of urban Aboriginal Australian children. As is the case with many cohort studies, the sample is not intended to be representative of all urban Aboriginal children; however, the data remain valuable for examining exposure–outcome relationships within the sample.

Where possible, the SEARCH questionnaire uses measures validated for use with Aboriginal peoples (such as the K10[29]), however many measures have not been validated for this population. Around 10% of children were missing data on injury, and 3-30% of children were missing data on exposures. However, results of the multiple imputation analyses were consistent with the primary analysis, indicating that the impact of biases due to missing data are likely to be minimal.

This study is cross-sectional, and presents associations between exposures and injury, but cannot provide evidence on causality. These relationships can be explored in more depth using longitudinal data and detailed child health data from SEARCH, when available.

Conclusion

This study, conducted in partnership with ACCHSs in NSW, contributes contemporary information on child injury in urban Aboriginal community settings, including both hospitalised and non-hospitalised injuries. These findings provide the first in-depth understanding of family and environmental characteristics associated

with injury across the childhood years in this population. They provide evidence to assist in the development of strategies to prevent Aboriginal child injury, through identifying specific features of families and communities that are protective of child injury and can be promoted through injury prevention efforts, and through identifying high-risk groups.[8,18]

In addition to efforts targeting the proximal causes of child injury, reducing the burden of injury among Aboriginal children may require broader injury prevention approaches, targeting factors underlying child injury, such as family functioning and community safety, and other upstream social determinants of health. The international evidence demonstrates that multi-faceted, and culturally appropriate, interventions targeted at disadvantaged families have the potential to reduce child injury, including through increased uptake of home safety measures.[30]

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Supporting Information

Additional supporting information may be found in the online version of this article:

Supplementary File 1: Injury questions used in the SEARCH baseline survey.

Supplementary File 2: Results of the severity sensitivity analysis.

Supplementary File 3: Results of the multiple imputation analysis.