Original Article

Childhood unintentional injury: The impact of family income, education level, occupation status, and other measures of socioeconomic status. A systematic review

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Abstract

Introduction: Unintentional injuries represent a substantial public health burden among children and adolescents, and previous evidence suggests that there are disparities in injury by socioeconomic status (SES). This paper reports on a systematic review of literature on injury rates among children and adolescents by measures of SES.

Methods: A systematic literature search was conducted using six electronic databases: MEDLINE, PsycINFO, CINAHL, HealthSTAR, EMBASE, and SportsDiscus. This review considered children ages 19 years and under and publications between 1997 and 2017—representing an update since the last systematic review examined this specific question. Fifty-four articles were summarized based on study and participant descriptions, outcome and exposure, statistical tests used, effect estimates, and overall significance.

Results: Most articles addressed risk factors across all injury mechanisms; however, some focused particularly on burns/scalds, road traffic injuries, falls/drowning cases, and playground/sports injuries. Other studies reported on specific injury types including traumatic dental injuries, traumatic brain injuries, and fractures. The studies were of moderate quality, with a median of 15.5 (95% confidence interval [CI]: 15.34 to 15.66) out of 19. Thirty-two studies found an inverse association between SES and childhood unintentional injury, three found a positive association while twenty were not significant or failed to report effect measures.

Conclusion: Given the variability in definition of the exposure (SES) and outcome (injury), the results of this review were mixed; however, the majority of studies supported a relationship between low SES and increased injury risk. Public health practice must consider SES, and other measures of health equity, in childhood injury prevention programming, and policy.

Keywords: *Childhood injury; Childhood unintentional injury; Education level; Family income; Socioeconomic status*

In 2013, the Global Burden of Diseases (GBD), Injuries, and Risk Factors study reported that approximately 4.8 million people around the world died from injuries (1). According to the Public Health Agency of Canada, in 2008, unintentional

injuries were the leading cause of death among males and females ages 1 to 34 years (2). In 2008, a report by the World Health Organization (WHO) and UNICEF stated that injuries are disproportionately higher in low-income countries

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(41.7 unintentional deaths per 100,000 children) compared with high-income countries (12.2 unintentional deaths per 100,000 children) (3). Even for those living in higher-income countries, such as Canada, injury rates are reportedly 40% higher for those living in areas associated with lower socioeconomic status (SES) (average family income below \$51,001/year) (4).

In 1999, Mackay et al. completed a systematic review on the relationship between SES and childhood unintentional injury, including studies from 1980 to 1996 (5). While this review found that many of the studies were of poor quality, the authors concluded that there was a significant relationship between SES and childhood unintentional injury (5).

The objective of this systematic review was to update the previous systematic review by including studies published in the last 20 years (1997 to 2017). The aim is to examine the association between SES and unintentional injuries among children and adolescents.

METHODS

Literature search

The literature search began with a selection of search terms using medical subject headings (MeSH) and key terms, indexed by database (Table 1). Six electronic databases were systematically searched (MEDLINE, PsycINFO, CINAHL, HealthSTAR, EMBASE, and SportsDiscus) using the search strategy outlined in Table 2.

Using the search terms from Table 1 and strategy outlined in Table 2, articles were first screened by title and then full abstract. Duplicates were removed and articles were included if they met the following criteria: (1) included a measure of SES as an exposure variable or a covariate, (2) defined a measure of unintentional injury as the outcome (including mortality, hospitalizations, injury reports, and Emergency Department visits), (3) included a study population inclusive of children, 19 years of age or younger (4) were published in English; and (5) published between 1997

and 2017. Articles were excluded if they (1) did not include a measure of SES as the exposure, (2) did not include unintentional injuries as an outcome, (3) had a target population greater than 19 years of age, (4) were considered case studies, cases series, or literature review study designs, and (5) were studies published before 1997. Articles using gross domestic product (GDP) as an SES indicator were also excluded since it is a broad measure.

Database extraction and quality assessment of articles

Data were extracted using a data extraction table (Supplementary Table 3). All articles were critically appraised using the Downs and Black Quality Assessment Tool (6). The tool consists of 27 items, with a total possible score of 32. Downs and Black is a validated tool for use with both intervention and observational studies that allows for both qualitative and quantitative description of overall study quality (6). Where dimensions of the tool were specific to intervention studies (e.g., randomized control trials), these questions were scored as 0, resulting in a total possible score of 19 for all observational designs included. Two independent reviewers critically appraised each article. Reviewers discussed individual ratings and discrepancies were consulted with a third party reviewer, when necessary. Studies were considered to have demonstrated a level of significance, defined as report of an increased injury rate with one or more measure(s) of SES (where the 95% confidence intervals are not inclusive of the null). The SES measure could be the primary or secondary research question.

RESULTS

The search identified 2,311 documents, of which 239 were duplicates. The remaining 2,072 articles were screened by title, resulting in 589 potentially relevant articles. From the 589 articles, 481 were removed after being screened by abstract, resulting in 108 articles to screen in full text. Among these, 23 articles were excluded due to SES not being defined as the exposure variable, 18 from lack of unintentional injury as an outcome, 11

Table 1. Search terms used to find relevant papers discussing SES risk factors for childhood unintentional injury (ages 0–19 years)

Concept A (outcome)	Concept B (risk factor)	Concept C (SES)	Concept D (child)
1. Injur* (keyword)	5. Risk factor	6. SES	15. Child
2. Wounds and injuries		7. Socioeconomic status	16. Pediatric
3. Falls		8. Social class	17. Pediatrics
4. Athletic injur* (MesH)		9. Socioeconomic factors (Mesh)	
		10. Educational status (Mesh)	
		11. Income	
		12. Occupation	
		13. Employment	
		14. Deprivation	

Table 2. Search strategy (filtered by age group 0–17, and years: 1997–2017)

	Medline	PsycINFO	CINAHL	HealthSTAR	EMBASE	Sports Discus
A. 1 OR 2 OR 3 OR 4	989492	16668	258219	72048	68153	164348
B. 5	706690	34551	325063	15077	64911	24841
C. 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14	291488	40001	192086	147733	37405	39763
D. 15 OR 16 OR 17	1595596			37134		104706
A AND B AND C AND D	455	302	600	616	273	51
POTENTIAL DUPLICATES	256 15	85 17	198 60	128 42	145 84	19 9
RELEVANT (title screened)	241	68	138	87	61	10
RELEVANT (After Abstract screening)	25	3	10	10	3	2
TOTAL:	53					

for containing a study population aged 19+, and 2 because the SES indicator was too broad (e.g., they included GDP as an indicator)—resulting in 54 final articles (Figure 1). Agreement in individual critical appraisal rating was reached between the two reviewers; therefore, no third-party reviewer was necessary for rating discrepancies.

Study characteristics

Among the 54 studies included in this review, 19 were cohort studies (5 prospective, 14 retrospective) 20 cross-sectional, 9 case-control, and 6 ecological studies. All included studies were published between 1997 and 2017. There were 16 articles from North America, 16 from Europe, 4 from Australia and New Zealand, 9 from Asia and the Middle East, 7 from South America, and 2 from Africa.

Exposure measures for SES included average parental income, parental education, household size, neighbourhood income quintiles, and geographic mapping (collecting and analyzing data with the use of spatial locations and digital maps). For outcome measures, studies reported on various injury types and mechanisms, including burns, traumatic dental injuries (TDI), traumatic brain injuries (TBI), fractures, road traffic injuries (RTI), playground or sports injuries, drowning, falls, and a categorization of all injuries.

Outcome measures were reported as unintentional injury mortality or incidence rates (e.g., hospitalizations and emergency room visits due to injuries).

Injury type

All injuries

Most of the articles addressed SES as a risk factor for all injury mechanisms—this included 7 of 19 cohort studies (7–13), 2 of 9 case-control studies (14,15), 3 of 6 ecological studies (16–18), and 11 of 20 cross-sectional studies (19–29).

The association reported between SES and injury varied across studies. From the seven cohort studies, three studies examined SES at an aggregate level—of these, two found that childhood injury rates were higher in the most deprived areas compared to more affluent ones (odds ratio [OR] = 1.68, 95% confidence interval [CI]: 1.07 to 2.62 and OR=1.04, 95% CI: 1.01 to 1.08) (9,10) while the other study found that SES played a significant role in home, recreational, and fall injuries (Supplementary Table 3) (8). Another study found that parental education (12 years of education or less) and household size (single mother household) were associated with increased childhood unintentional injury mortality among families in the USA (RR=1.65, 95% CI: 1.07 to 2.52 and RR=1.08, 95% CI: 1.01 to 1.15) (11). Another study conducted in China found that high family income, classified as families earning greater than 4,000 Yuan per year, was a risk factor for increased childhood unintentional injuries (OR=1.42, 95% CI: 1.11 to 1.81), suggesting a positive association (13). One cohort study found that having a teenage mother who has a low average income was significantly associated with childhood unintentional injury (Supplementary Table 3) (12).

Among the 11 cross-sectional studies, 7 found that low SES was a risk factor for unintentional childhood injury (Supplementary Table 3) (19–21,24,27–29). One of these studies reported that children classified under the most deprived SES quintile were at greater risk for specific injuries such as: road traffic injuries, burns, and poisoning (Supplementary Table 3) (19). Another study specifically reported that low family income was highly associated with falls among children ages 13 to 20 years (OR=1.26, 95% CI: 1.51 to 3.11) (27). Three studies found no significant association between SES and injury (22,25,26). Finally, one study reported no effect measures to test significance (23).

Figure 1. Flow chart on process for extracting relevant papers for systematic review (n=54).

From the two case-control studies reporting all injuries, one found that a father's occupation level was associated with increased childhood injury (OR=5.70, 95% CI: 1.80 to 18.50) (14). The other study found that low maternal education was a risk factor for unintentional childhood injury in young girls (OR=1.20, 95% CI: 1.10 to 1.40) while household income was a significant SES indicator for both boys and girls (Supplementary Table 3) (15). Of the three ecological studies, two found that children from low-income neighbourhoods had an increased risk for unintentional injury (16,17), while the last ecological study reported no significant association (18).

TDI

TDI was the main outcome for 6 of 20 of the cross-sectional studies (30–35), 2 of 19 cohort studies (1 retrospective and 1 prospective) (35,36), and 1 of 9 case-control studies (37). Of the six cross-sectional studies, four studies found that SES was not significantly associated with TDI (29,31,33,34) and one study found that low SES was a risk factor for TDI among

children (OR=2.33, 95% CI: 1.05 to 3.97) (30). Another study found that SES was significantly associated with mild dental injuries (RR=1.78, 95% CI: 1.11 to 2.85) but not severe dental injuries (32). The prospective cohort study found that children ages 0 to 4 years from higher-income families—those who made more than the minimum wage in Brazil—showed an increased risk for childhood injury compared to families who made less than the minimum wage (RR=1.66, 95% CI: 1.08 to 2.56), suggesting a positive association between high SES and the risk for TDI (36). The retrospective cohort study did not report any effect measures to determine significance (37). The sole case-control study addressing TDI did not find SES to be a significant risk factor for injury (38).

Burns/scalds

Burn and scald injuries were the main outcomes for 3 of 19 cohort studies (39–41), 2 of 9 case-control studies (42,43), and 2 of 6 ecological studies (44,45). Five studies reported a significant association between SES and childhood unintentional

burn injuries (39,40,42,43,45) while two studies failed to report effect measures to test significance (41,44). One study concluded that living in households with single adults or high maternal deprivation were both significant risk factors for unintentional scald injuries in children (OR=1.26, 95% CI: 1.08 to 1.46 and OR=1.82, 95% CI: 1.40 to 2.37, respectively) (43). One ecological study found that low parental education was significantly associated with unintentional burns in children 12 and under (OR=3.61, 95% CI: 3.01 to 4.33) (45), while the other ecological study did not report any effect measures to determine significance (44).

TBI

Two studies measured TBI as an outcome—one cross-sectional study (46) and one case-control study (47). While the case-control study found that SES was a risk factor for unintentional TBI among children (OR=1.71, 95% CI: 1.52 to 1.92) (47), the cross-sectional study reported no significant association (46).

Fractures

Among two cohort studies addressing fracture injuries, one study found that children in the most deprived SES quintile had a higher incidence of fractures; however, the results were higher for boys (OR=1.41, 95% CI: 1.34 to 1.50) compared to girls (OR=1.29, 95% CI: 1.20 to 1.36) (48). The other cohort study failed to report any effect measures to test significance (49). One case-control study found that living in low-income households increased the risk of fractures by 50% for girls ages 7 to 14 years in comparison to girls ages 0 to 6 years of age (OR=1.50, 95% CI: 1.01 to 2.22) (50).

Injury mechanism

Road traffic injuries

Road traffic injuries (RTI) were the primary injury outcome for 2 of 19 cohort studies (51,52) and 1 of 6 ecological studies (53). All three studies found a significant association between SES and RTI.

Playground/sports injuries

Playground or sports injuries were the main outcome for 3 of 19 cohort studies (54–56), 1 of 9 case-control studies (57), and 1 of 20 cross-sectional studies (58). Of the three cohort studies, one found that SES was significantly associated with childhood playground injuries (RR=1.52, 95% CI: 1.24 to 1.86); however, after controlling for adherence to the Canadian Standards Association (CSA) guidelines for equipment-based playground design, this association was no longer significant (RR=1.13, 95% CI: 0.95 to 1.32) (55). One retrospective study reported a positive association between high family income and recreational injuries among children (OR=2.10, 95% CI: 1.50 to 3.10) (54). The final retrospective cohort study reported no

significant association between SES and sports injuries (56). The case-control study also found no significant association between SES and playground injuries (57), and the cross-sectional study failed to provide effect measures to test significance (58).

Falls and drowning injuries

Among the articles in this review, one cross-sectional study and one case-control study reported on unintentional childhood falls and drowning injuries. Low neighbourhood income was associated with an increased incidence of falls with results varying between people of different ethnicities—a greater proportion of black children from low-income neighbourhoods were injured from falls compared to Hispanics; however, the study failed to report any effect measures to test significance (59). The case-control study concluded that low maternal education was a risk factor for increased childhood mortality from drowning (OR=1.69, 95% CI: 1.01 to 3.81) (60).

Methodological quality

The median score for studies included in this review was 15.5 (95% CI: 15.34 to 15.66). Approximately six studies presented some biases or systematic errors as they failed to report effect estimates, such as odds ratios or rate ratios, resulting in the inability to quantify the reported results.

Studies included in this review that used self-reporting methods to collect data, such as questionnaires and interviews, may result in an increased risk of recall bias. Recall bias can introduce bias in either positive or negative directions because people may over or under estimate both the outcome and the exposure. For example, one study suggests that among parents or children with less education, there are fewer injury reports filed for unintentional injuries in comparison to families with parents who have a higher education (26). This may be a result of underreporting or recall bias. Such potential biases must be considered for future injury research among lower SES groups.

DISCUSSION

This systematic review examined the association between SES and unintentional injury in children and adolescents. While most studies report higher injury rates among lower-income populations, the results vary based on injury type and mechanism and the specific SES exposure. Further research is essential to better understand how SES risk factors result in unintentional childhood injuries. Among studies examining SES with all injury as the primary outcome, 18 found a significant relationship, of which 1 reported a positive association. This study suggests that children of higher SES had an increased risk for unintentional injuries (13). The studies looking at TDI among children had mixed results—six studies did not find

any significant association while three studies did, depending on the severity of the dental injury or the type of SES measure. One of these studies reports that high family income is associated with an increased risk for TDI among children (36).

Previously published literature demonstrates that family income and deprivation level are potential risk factors for childhood unintentional injuries (5). This was supported by this review since many studies demonstrated a significant association for both family income and deprivation indices as risk factors for child injury outcomes (8–10,16,17,19,20,24,27,28,39,40,43,47,48,51,59). This may suggest that parents with lower income have challenges in uptake and integration of known injury prevention strategies. Parents of low-income households are often required to work long and odd work hours, resulting in decreased time spent and opportunity for injury prevention education. Similarly, evidence suggests that parents with less education may lack specific injury prevention skills to transfer to their children (7,11,15,16,45,51,60). In addition, two studies found that living in single-parent households was a risk factor for childhood unintentional injuries, which presents the likelihood that the lack of another supervising parent may impact the child's safety or knowledge of safety regulation (12,41). The child's age is also important to consider; one study suggests that children who are younger often require more attention and monitoring from their parent(s) to ensure appropriate development and to avoid these injuries (45). Additional research is necessary to further understand how parental supervision may be a mediating factor in the relation between SES and childhood unintentional injury.

Future directions

The results from this systematic review stress that program planners and policy makers must take preventative measures to reduce childhood unintentional injury rates with consideration of the differences in SES gradients and injury types. For instance, some research suggests that high SES is a risk factor for sports injuries while low SES is a risk factor for burns. Further research and evaluation is essential before implementing any new policies and programs.

Strengths and limitations

This study does come with a few limitations that must be considered. First, the studies included varying methods of data collection and outcome measures, in addition, to varying contexts in which the studies were evaluated. In addition, all studies included were of observational designs and may be prone to presenting biases. This review was also limited to include articles from 1997 to 2017, excluding potentially relevant studies prior to 1997. However, this project was situated within the context of the review by MacKay et al., capturing studies on SES and injury in childhood post 1999. Another limitation of this review is that for specific injury types, such as TBI, only two studies were found which presents the need for further research on such

injuries in relation to SES. Finally, some articles were excluded as they were not available in English.

CONCLUSION

The majority of the studies included in this review report an association between low SES and unintentional injuries in children and adolescents. However, there is some variability in the results, particularly related to recreation injuries and TDI where some studies report higher income children and adolescents appear to be at an increased risk. These results suggest that there remains room for improvement in working towards equity in child health across populations and that additional research is warranted specific to various unintentional injury types to further understand how SES associates with childhood unintentional injury and to make suggestions for future policy and program planning.

SUPPLEMENTARY DATA

Supplementary data are available at *Paediatrics & Child Health Online*

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