

Low Income/Socio-Economic Status in Early Childhood and Physical Health in Later Childhood/Adolescence: A Systematic Review

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Abstract To systematically review the literature on the relationship between early childhood low income/socio-economic status (SES) and physical health in later childhood/adolescence, to identify gaps in the literature and to suggest new avenues for research. A systematic search of electronic databases from their start date to November 2011 was conducted to identify prospective longitudinal studies in industrialized countries with a measure of low income/SES in the first 5 years of life and physical health outcomes in later childhood or adolescence. STROBE criteria were used to assess study quality. Risk estimates were expressed as odds ratios with 95 % confidence intervals where possible. Heterogeneity of studies precluded meta-analysis. Nine studies fulfilled the inclusion criteria. Significant associations of early childhood low income/SES with activity-limiting illness, parent-reported poor health status, acute and recurrent infections,

increasing BMI percentile and hospitalization were reported. Results for parent-reported asthma were less consistent: there was a significant association with low income/SES in early childhood in 2 studies but null findings in 3 others. This systematic review of the association of early childhood low income/SES with physical health status in later childhood and adolescence shows that, in contrast to the extensive literature on the impact of poor childhood social circumstances on adult health, the evidence base is limited. The literature points to some associations of early low income/SES with later poor health status, but many key research questions remain unanswered. Implications for further research are considered.

Keywords Child poverty · Child health · Adolescent health · Low income · Low SES · Social class · Longitudinal studies · Life course analysis

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Introduction

Increasing interest in life course epidemiology [1] has generated an extensive literature on the association of low income/SES in early childhood with a range of adverse chronic health outcomes in adulthood [2–6]. These studies have postulated pathways through which early childhood social disadvantage exerts its long term effect on adult health [7], explored potential mediators and moderators over the life course [8–10] and examined sensitive/critical periods when exposure to early childhood disadvantage is most likely to be detrimental to adult health [3, 4]. Yet it is not known when these processes with such a long term impact of early exposure to poverty take place and if they are already present during childhood and adolescence.

The association of childhood low income/SES with poor child health and wellbeing is well-established [8, 11–19]. However, with the exception of studies linking birthweight and gestational age of low SES newborns with health in later childhood and adolescence [20–22], little research attention has been paid to the association of early childhood exposure to low income/SES with physical health in later childhood and adolescence. Mental health in later childhood and adolescence has been more extensively researched [23–26] than physical health. As a result, the mechanisms and pathways by which early childhood low income/SES impact on physical health in later childhood and adolescence, and in later adulthood remain elusive [8].

In presenting a life course perspective on health disparities originating in childhood, Braveman [2] argues that effective policy interventions to address health disparities in adulthood must be directed at improving the living conditions of children. Consistent with Braveman's argument, we postulate that health inequalities in later childhood and adolescence need to be understood in the context of early life course exposures and interventions aimed at reducing these inequalities must be informed by robust evidence of mechanisms and pathways from early childhood to later childhood and adolescence.

We undertook a systematic review of the literature on the association of early childhood low income/SES and physical health in later childhood/adolescence. We included only prospective studies which measured poverty in the first 5 years of life and physical health outcomes between 6 and 18 years of age. We assessed the quality of included studies against the STROBE criteria [27], an internationally recognised approach to the assessment of the likelihood of bias in cohort studies. The review seeks to identify the extent to which current literature addresses the following research questions and inform a future research agenda aimed at providing evidence for effective policy and practice interventions to reduce child health inequalities in industrialised countries:

1. Does early life exposure to low income/SES have an adverse effect on physical health in later childhood/adolescence and if so, what is the magnitude of the effect?
2. If an adverse effect is shown, is there evidence of a relationship between duration of early childhood low income/SES (transient v. chronic) and risk of adverse effects on physical health in later childhood/adolescence?
3. If an adverse effect is shown, how does low income/SES interact with other factors, such as parenting and family functioning, in influencing later childhood/adolescent physical health? Have mediators and/or moderators of the relationship been identified?

Methods

Definitions

Low Income/SES in Early Childhood

Low income 0–5 years was defined as living in a household with an income below the national poverty level or with incomes in the lowest quintile at least once in the first 5 years of life. Low SES was defined as living in a household headed by adults with low occupational or educational status at least once in the first 5 years of life.

Duration of Low Income/SES in Early Childhood

Living in low income/SES on one out of at least two measured occasions in the first 5 years of age was defined as *transitory low income/SES*; living in low income/SES on at least 2 occasions or more in the first 5 years of age was defined as *chronic low income/SES*.

Physical Health Outcomes from 6 to 18 Years

Physical health included acute illness, chronic conditions or long standing illnesses such as asthma, cerebral palsy and other disabling conditions. Physical growth, stunting or growth retardation and overweight and obesity were included in the definition of physical health.

Inclusion Criteria

Longitudinal prospective studies conducted in industrialized countries were included if low income/SES was measured at least once in the first 5 years of life and physical health outcomes measured later in childhood/adolescence. Only English and French language studies were included.

Exclusion Criteria

Studies were excluded if outcomes were measured only after 18 years of life or outcomes were mental rather than physical health. Studies in which exposure to low income/SES was measured only in pregnancy or later than 5 years of age were excluded as were studies in which the age range of children at the time of exposure was greater than 0–5 years and those aged 0–5 years were not separately identified in the analysis. Cross-sectional studies and retrospective studies were excluded to avoid the problem of recall bias. Reviews, and studies conducted in non-industrialized countries were excluded.

Search Strategy

The following electronic data bases were searched from their start dates to November 2011—Medline, Embase, and Psych-Info using the following key words:

Exposure: early childhood; 0–5 years; infancy; poverty; chronic poverty; persistent poverty; low income; social deprivation; low socioeconomic status; social disadvantage.

Outcome: children 6–18 years; adolescence; physical health; illness; disease; asthma; anaemia; disability; long-standing illness; chronic illness; growth; obesity.

Study type: longitudinal prospective studies; cohort studies.

Secondary search of publications cited in the papers identified in the primary search was undertaken.

Data Extraction/Appraisal

Abstracts obtained by the search strategy were assessed for possible inclusion by one researcher. Studies were eliminated if inclusion criteria were not satisfied from the abstract. Full text papers of the remaining studies were obtained and assessed by the three authors independently. Differences of opinion on inclusion were settled by discussion and consensus. An Excel spreadsheet was used for data extraction from included papers. Reasons for exclusion of papers were recorded.

Quality Assessment

Quality of studies was assessed by all three researchers independently using the STROBE criteria [27] to judge the likelihood of bias. Differences of opinion were settled by discussion and consensus. Specific quality criteria were as follows: (1) population fully described, (2) sample representative of population, (3) sample size sufficient to minimize type II error, (4) sample characteristics clearly presented, (5) participation rate reported, (6) characteristics of non-participants reported, (7) attrition rate reported, (8) characteristics of those lost to follow up reported, (9) appropriate and clearly stated statistical methods used, (10) potential confounding variables adequately accounted for, and (11) role of potential mediators recognised and accounted for in the analysis. Each criterion was awarded one point if adjudged to be present; studies scoring 8 and over were adjudged to have a low likelihood of bias, those scoring 6–7 to have a moderate likelihood of bias and those scoring <6 a high likelihood of bias.

Analysis

Odds ratios with 95 % confidence intervals were extracted from papers where available. Where odds ratios were not reported, estimates were computed from data presented in papers if available. Heterogeneity of studies precluded meta-analysis for all outcomes.

Results

There were 1,378 abstracts that were identified from which 68 full text papers were obtained. Nine studies fulfilled the study criteria. Fifty-nine studies were excluded for the following reasons: outcomes measured later than 18 years of life (8 studies); outcomes measured earlier than the fifth year (7 studies); outcomes were mental or behavioral rather than physical health (6 studies); exposure to poverty/low income was measured in pregnancy (2 studies) or later than 5 years of age (15 studies); age range of children at the time of exposure was greater than 0–5 years and those aged 0–5 years were not separately identified in the analysis (11 studies); cross-sectional (6 studies); studies conducted in non-industrialized countries (2 studies). Two studies were retrospective.

Table 1 presents the characteristics of included studies. All studies had a prospective longitudinal design: two were based on Canadian data [28, 29]; three on US data [30–32]; two on Australian data [33, 34]; two on UK data [35, 36]. One study used a country-specific measure of poverty as exposure variable [28], four studies used low household income measures [30–32, 34], one study used low neighborhood income [29], one used a measure of cumulative disadvantage [33] and, two low social class [35, 36]. Three studies reported measures of low income/SES on only one occasion in early childhood [29, 35, 36]. The remaining studies reported measures of low income/SES consistent with the definition of chronic low income/SES. One study reported multiple measures before 5 years old that enabled comparison of the impact of transitory and chronic early low income/SES on physical health [28].

The range of physical health outcomes reported is shown in Table 1. Four studies reported outcomes in 5–9 year old children [28, 32–34] and five studies in older children and adolescents 10–14 years of age [29–31, 35, 36]. Case et al. [31] reported outcomes at both 4–8 years and 9–12 years; however, as this review focuses on outcome after 5 years of age we report only the outcome at 9–12 years. In addition to reporting outcomes at 6 years, Kozyskyj et al. [34] report outcomes at 14 years; however, the measure of chronic low income used as a predictor in their analysis of asthma at 14 years included family income levels beyond 5 years so are not included in the review.

Table 1 Description of the included studies

Study	Design	Country	Sample size	Data source/study title	Age at exposure	Measure/s of exposure	Age at outcome	Health outcomes measured
Bor et al. [33]	Longitudinal prospective birth cohort	Australia	5,057	MUSP	0–5 years	Cumulative disadvantage	5 years	Health status (maternal report); activity limiting illness; hospitalizations since birth; sick in previous 6 months; treated by doctor previous 6 months; asthma; persistent head cold; persistent vomiting/diarrhoea; persistent bronchitis; dental caries
Case et al. [31]	Longitudinal prospective cohort	USA	2,950	PSID'97 with income data from earlier years	0–3 years	Mean family income ages 0–3 years	4–8 years and 9–12 years	Health status (maternal report)
Petrou and Kupek [35]	Linked birth registration and hospital records	UK	117,212 births with linkage from birth to age 10 years	Oxford Record Linkage Study—all births from 1.1.79 to 31.12.88	Birth	Low social class	10 years	Hospital inpatient admission
Lethbridge and Phipps [28]	Longitudinal prospective cohort	Canada	11,077	NLSYC Canada 2000 (4th cycle)	0–5 years	Poverty—transient and chronic	5–7 years	Asthma
Belsky et al. [32]	Longitudinal prospective birth cohort	USA	1,041	10 US sites	0–4.5 years	Income to needs aggregated over first 5 years of life	6 years	Health status (maternal report)
Chen et al. [30]	Longitudinal prospective cohort	USA	Not clear—see note ^a	NLSYC USA—study start date—'86	0–5 years	Education	10–11 years	Asthma: activity limiting illness; school limiting illness; physician treated illness
Oliver and Hayes [29]	Longitudinal prospective cohort	Canada	2,152	NLSYC Canada 2002 (5th cycle)	2–3 years	Low neighborhood income	10–11 years	BMI
Tennant et al. [36]	Longitudinal prospective birth cohort	UK	252	1000 Families Study, Newcastle—born '47	Birth	Low social class at infant's birth	14 years	Forced expiratory volume (FEV1)
Kozyrskyj et al. [34]	Longitudinal prospective birth cohort	Australia	2,151	West Australian Pregnancy Cohort (Raine) Study	0–5 years	Low family income—chronic over first 5 years of life	6 years	Asthma

^a Chen et al.: exact numbers included in the analysis not stated—5,874 had data on income at least once; 6,306 had data on asthma; 5,362 about activity limitation; 5,321 about school limitations; 5,360 had data on physician treatment

MUSP Mater-University of Queensland Study of Pregnancy, NMHS US National Maternal and Infant Health Survey, NLSYC-USA US National Longitudinal Study of Children & Youth, NLSYC-Canada Canadian National Longitudinal Study of Children & Youth, QLSCD Quebec Longitudinal Study of Child Development, UKMCS UK Millennium Cohort Study, PSID Panel Study of Income Dynamics (with its associated Child Development Supplement)

Table 2 Quality scores of included studies

Author	Population (4 points) Well described Sample size Representative sample Characteristics well presented	Rate participation & attrition (4 points) Participation rate Characteristics non-participants Attrition rate Characteristics attrition	Analysis (3 pts) Methods Confounding variables Mediators/moderators	Total quality score
Bor et al. [33]	2	3	2	7
Case et al. [31]	3	0	3	6
Petrou and Kupek [35]	3	3	3	9
Lethbridge and Phipps [28]	4	0	3	7
Belsky et al. [32]	2	1	3	6
Chen et al. [30]	4	1	3	8
Oliver and Hayes [29]	4	1	3	8
Tennant et al. [36]	2	2	2	6
Kozyrskyj et al. [34]	3	3	2	8

The quality scores of the included studies are summarized in Table 2. Five studies score between 6 to 7 indicating a moderate likelihood of bias [28, 31–33, 36]. The remaining four studies have a low likelihood of bias. Five studies scored 0 or 1 on participation and attrition as rates of participation and attrition and characteristics of non-participants and those lost to follow up were inadequately described. All except the study by Tennant et al. [36] had adequate sample sizes and representative samples. The quality of the methodologies used was high—no study scored <2 on these criteria.

The extent to which the included papers address each of the research questions posed above is considered below:

Does early life exposure to low income/SES have an adverse effect on physical health in later childhood/adolescence and if so, what is the magnitude of the effect?

Early life exposure to low income/SES is associated with a range of adverse physical health outcomes in later childhood/adolescence (Table 3). Of the studies reporting asthma as the outcome, two [28, 36] reported statistically significant associations of early low income/SES with later asthma. Bor et al. [33], Chen et al. [30] and Kozyrskyj et al. [34] also reported odds ratios greater than one for exposure to early low income/SES but the 95 % confidence intervals crossed unity and so their results were not statistically significant. Statistically significant associations with early low income/SES were reported in the two studies including activity limiting conditions as an outcome [30, 33], in the three studies including maternal reported health status [31–33], and the two studies including hospitalization [33, 35]. Bor et al. [33] found a statistically significant association of

early low income/SES with ear and upper respiratory infections (URTI), accidents and dental caries. Oliver and Hayes [29] reported increased ORs for BMI percentile in poor neighbourhoods adjusted for individual family factors but the 95 % CI crossed unity.

The heterogeneity of the studies precluded meta-analysis so an estimate of the magnitude of the impact of early poverty/low income on physical health in later childhood/adolescence is difficult from these studies. However, the odds ratios for asthma by early low income/SES mainly lie between 1.17 and 1.56. For activity limiting illness, the odds ratios lie between 1.63 and 1.82. The odds ratios for hospitalizations vary between 1.27 and 1.58.

Is there evidence of a relationship between duration of early childhood low income/SES and risk of adverse effects on physical health in later childhood/adolescence?

Six of the included studies [28, 30–34] had measures of chronic low income/SES (see Table 1). Five studies examined the effects of chronic low income/SES on physical health [30–34] and only one study [28] allowed comparison of the effects of transitory and chronic low income/SES on physical health (see Table 3). In this study, the odds ratios for chronic low income/SES were higher than for transitory low income/SES suggesting longer duration of early childhood low income/SES is associated with higher odds of asthma diagnosed by a health professional and asthma attack in the past 12 months [28]. Caution should be exercised in interpreting these findings as the 95 % confidence intervals around the odds ratios for chronic and transient low income/SES overlap.

Table 3 Odds ratios/*p* values of early low income/SES on physical health outcomes

Physical health problems	Studies	Effect size by chronic low income/SES—OR (95 % CI)	Effect size by transient low income/SES—OR (95 % CI)
Asthma (including asthma attacks in past 12 months; asthma diagnosed by a health professional; ‘ever had asthma’)	Bor et al. [33]	1.40(0.84, 2.32)	N/A
	Lethbridge and Phipps [28]	1.52(1.02, 2.29)	1.15(0.78, 1.68)
	Chen et al. [30]	1.33(0.96, 1.84)	N/A
	Tennant et al. [36] (reduced FEV1)	N/A	<i>p</i> = 0.049
	Kozyrskyj et al. [34]	1.17(0.82, 1.65)	N/A
Activity limiting illness	Bor et al. [33]	1.63(1.16, 2.30)	N/A
	Chen et al. [30]	1.82(1.28, 2.58)	N/A
Maternal reported health status	Bor et al. [33]	3.12(1.88, 5.17)	N/A
	Case et al. [31]	<i>p</i> < 0.005	N/A
	Belsky et al. [32]	<i>p</i> < 0.05	N/A
Hospitalization	Bor et al. [33]	1.58(1.13, 2.21)	N/A
	Petrou and Kupek [35]	N/A	1.27(1.26, 1.28)
	Bor et al. [33]	Ear 1.8(1.1, 2.9) URTI 1.5(1.1, 2.0)	N/A
Infections	Bor et al. [33]		
BMI (percentile change)	Oliver and Hayes [29]	N/A	Increase of 1.46(0.16, 2.75)
Accidents	Bor et al. [33]	2.31(1.14, 4.68)	N/A
Dental caries	Bor et al. [33]	1.30(1.13, 1.69)	N/A

Bor et al.: Adjusted for: maternal education; maternal age; child’s age

Lethbridge and Phipps: Adjusted for: Maritimes versus Rest of Canada; age and sex of child; maternal age; marital status; child’s birth order; maternal education; number of children in household; rural versus Urban; birth weight; maternal smoking in pregnancy; breast fed

Chen et al.: Adjusted for: race; gender

Tennant et al.: Adjusted for: gender; duration of breast feeding; TB aged 0–5 years; BMI at 14 years; height at 14 years; history of asthma <14 years

Belsky et al.: Adjusted for: parenting; maternal age; maternal education; partner presence; race

Case et al.: Adjusted for: sex; race; presence of mother; maternal age; maternal age/presence interaction; father’s presence; father’s presence/age interaction; father’s education/presence interaction; family size

Petrou and Kupek: Adjusted for: *Individual level variables*—parity; maternal weight at first antenatal visit; maternal smoking in pregnancy; obstetric problems in pregnancy; mode of delivery; multiple birth; gestational age; birth weight; maternal age at birth; child adopted or fostered; *other level variables*—birth cohort period; child’s survival period; child’s survival/social class interaction

Kozyrskyj et al.: Adjusted for gender, preterm birth, maternal asthma, dog ownership in first year, pregnancy stress and chronic family stress

How does low income/SES interact with other factors such as marital status, parenting, living arrangements, ethnicity, and neighbourhood characteristics in influencing later childhood/adolescent physical health? Have mediators and/or moderators of the relationship been identified?

All the included studies control for a range of confounding variables (see Table 2); however, only one paper [32] addressed mediation of the relationship of early childhood low income/SES with physical health in later childhood/adolescence. Belsky et al. [32] reported that parenting mediates some but not all of the impact of socioeconomic status measured as low income to needs aggregated over the first 5 years of life and maternal education on maternal reported general health status when the child was 6 years old (standardized β for maternal

education fell from 0.17 to 0.14 when parenting variables entered in the regression model). No studies undertook analysis of effect modifiers or interactions.

Discussion

We set out to review available literature from industrialized countries on the association of low income/SES and its duration in early childhood with physical health outcomes in later childhood/adolescence. We limited our inclusion criteria to longitudinal prospective studies from industrialized countries that included at least one measure of low income/SES exposure within the first 5 years of the child’s life and subsequent physical health outcomes before 18 years of age. We identified nine studies that met the inclusion criteria. All nine studies were of reasonable

quality with none having a high likelihood of bias. The association with childhood low income/SES during the first 5 years of life varied by outcome studied. The 2 studies [30, 33] including activity limiting conditions as an outcome reported significant associations with early childhood low income/SES as did the 3 studies [30–32] including maternal report of less than optimal health status and the 2 studies [33, 35] with hospitalization as an outcome. Two [28, 36] of the 5 studies including asthma (including asthma attacks in past 12 months; asthma diagnosed by a health professional; ‘ever had asthma’ or reduced FEV1) as an outcome reported significant associations with low income/SES in the early years. The remaining 3 studies [30, 33, 34] reported ORs above unity for early childhood low income/SES but were not significant at the 5 % level.

Discussion of Findings in Relation to the Research Questions

There is consistent evidence from the review that early life exposure to low income/SES has an adverse effect on physical health in later childhood/adolescence although odds ratios vary by outcome studied and timing and duration of poverty exposure, and not all studies report statistically significant odds ratios at the 5 % level. The evidence supports an association but is not proof of causality.

Based on the papers identified by our review, the research questions addressing a relationship with duration of poverty in early childhood, and mediation/moderation of the relationship under study, remain unanswered. We found only one study [28] comparing the impact of transitory and chronic low income/SES before the age of 5 years on asthma aged 5–7 years. Although the findings of this study suggest that early childhood exposure to chronic low income/SES carries a higher risk of subsequent asthma, this constitutes only limited evidence of a relationship between duration of early life exposure and later physical health.

Belsky et al. [32] reported that parenting mediated some but not all of the effect of low income/SES on parent reported child health status at 6 years of age. No other included study reported on mediation/moderation of the low income/SES and later physical health relationship.

Strengths and Limitations of the Review

The main strength of this review is the focus on longitudinal prospective studies which eliminate recall bias when the impact of early childhood exposure to low income/SES on later physical health is studied. The role of early exposure to low income/SES in later mental health has received considerable research attention [23–26]. The impact of early low income/SES on physical health,

however, has received much less attention both in research and practice, despite the importance of conditions such as asthma and activity limiting chronic illness to child health and wellbeing [37–39].

We have searched a limited number of databases and have not searched the grey literature. These limitations increase the likelihood that studies meeting the inclusion criteria have been missed; however, in order to minimise the risk of omitting key studies, we carried out a search of papers cited in the identified studies and sought the advice of international experts on studies we may have missed.

We decided to limit our review to low income/SES exposure in the first 5 years of life. We identified a small number of papers in which the exposure occurred only in pregnancy and these were excluded. We also excluded papers that reported on early exposure but reported outcomes before, rather than after, the age of 5 years. This decision may have limited the findings of the review; however, our decision is consistent with the evidence that the first 5 years of life might be critical to child development and future adult well-being [18].

Conclusions

This review demonstrates the limited extent of published literature on the impact of low income/SES in the first 5 years of life on physical health in later childhood and adolescence. The review confirms the association of early childhood low income/SES exposure with later adverse physical health outcomes but important questions related to the impact of different duration of low income/SES and mediators and moderators remain unanswered. Further research using longitudinal prospective datasets will be necessary to address these questions which are important in understanding the pathways and mechanisms by which low income/SES in early childhood exerts its long term effect and so to design relevant and efficient preventive interventions.

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