Childhood socioeconomic position and risk of cardiovascular disease in adulthood: Systematic review of evidence from low- and middle-income countries

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Abstract

Context: Socioeconomic disadvantage in childhood is strongly associated with a higher risk of cardiovascular disease in high-income countries. However, the association in low- and middle-income countries, where childhood poverty remains prevalent, has not been reviewed.

Evidence acquisition: The authors systematically searched Embase, MEDLINE and Global Health databases for articles on the association between childhood socioeconomic position and risk of cardiovascular disease in adulthood in low- and middle-income countries until September 2020. Outcomes included measures of cardiovascular disease, its sub-clinical markers (e.g. carotid intima-media thickness) and its major risk factors (e.g. hypertension, dyslipidaemia, diabetes). Where available, associations were extracted before and after adjustment for socioeconomic position in adulthood. Results were synthesised qualitatively by outcome. The study protocol is registered on PROSPERO (CRD42018086984).

Evidence synthesis: The search returned 3568 unique abstracts, from which 29 eligible articles from 14 middle-income countries were identified, representing over 150,000 participants. The most commonly reported outcomes were cardiovascular risk factors; very few studies reported prevalent measures of cardiovascular disease, and no studies reported cardiovascular disease incidence or mortality. Of the 46 reported associations between childhood socioeconomic position and risk of cardiovascular disease, 8 were inverse, 0 were positive, and 38 showed no clear evidence of association. All articles had high (16/29) or medium (13/29) risk of bias.

Conclusions: Current evidence from middle-income countries provides little support for an association between childhood socioeconomic position and risk of cardiovascular disease, whilst evidence from low-income countries is lacking. It would be premature to consider childhood poverty as a target for cardiovascular disease prevention in these settings.

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44 **Abstract word count:** 250

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46 **Key words:** Cardiovascular disease, cardiovascular risk factors, childhood socioeconomic
47 position, life course, low- and middle-income countries, systematic review

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Introduction

Cardiovascular disease (CVD) is the leading cause of premature death in most low- and middle-income countries.[1] The burden of CVD is rising as populations age, placing increasing pressure on healthcare systems and indicating an urgent need for preventive strategies.[2] Socioeconomic disadvantage in childhood is associated with a higher risk of CVD in high-income countries, independent of socioeconomic position in adulthood.[3–6] It follows that socioeconomic disadvantage in childhood could be a substantial contributor to CVD burden in low- and middle-income countries, where over 20% of children live in extreme poverty.[7,8] If true, strategies to tackle childhood poverty might play an important role in controlling the CVD epidemic in low- and middle-income countries.

Previous systematic reviews on the association between childhood socioeconomic position and CVD were conducted in 2003 and 2004, and identified studies from high-income countries only.[3,4] It is not clear whether findings from high-income countries can be generalised to low- and middle-income countries, given the distinct range of socioeconomic conditions experienced across these settings.[9] This article systematically reviews literature on the association between childhood socioeconomic position and risk of CVD in low- and middle-income countries. It was hypothesised that after adjustment for adult socioeconomic position, socioeconomic position in childhood would be inversely associated with risk of CVD in low- and middle-income countries.

Methods

This systematic review is reported according to the PRISMA checklist (see appendix). The protocol is registered on PROSPERO (CRD42018086984).

Exposure

The exposure of interest was socioeconomic position measured or reported in childhood (age <18 years). To operationalise childhood socioeconomic position, a range of commonly used indicators of relative social status and material conditions were considered, including parental education, parental occupation during childhood and household income or assets during childhood.[10] Individuals' own education was not considered as an indicator of their socioeconomic position in childhood as it is typically used as an indicator of adult socioeconomic position, and has been reviewed previously.[11,12] The main association of interest was the association of childhood socioeconomic position independent of adult socioeconomic position, as adult socioeconomic position is a known determinant of CVD risk and tracks strongly from early life. For this, associations either adjusted for adult socioeconomic position or stratified by adult socioeconomic position (sometimes presented as social trajectory or social mobility analyses) were considered.

Outcome

The primary outcomes of interest were incidence and mortality of CVD, coronary heart disease or stroke, subclinical measures of CVD (carotid intima-media thickness, carotid plaque, arterial stiffness), major CVD risk factors (blood pressure or hypertension, lipid profile or dyslipidaemia, fasting glucose, insulin or diabetes) and composite variables derived from these (CVD risk score or metabolic syndrome). To be eligible, studies had to report

outcomes measured in adulthood (age ≥18 years). Outcomes could be incident or prevalent. Self-reported disease and risk factors were included, but were considered to be secondary to objectively measured outcomes, because underdiagnosis of cardiovascular conditions is common in many low- and middle-income countries.[13] Obesity was not included as an outcome in the review, as it is less proximally related to CVD than the above risk factors, and has been reviewed recently.[14]

Inclusion/exclusion criteria

Peer-reviewed journal articles published in English, Spanish, French or Portuguese were eligible for inclusion (non-English language articles had to have a title and abstract in English as the search was not translated). The search was restricted to studies published since 2003, when a previous review conducted on this topic identified no studies from low- and middle-income countries.[3] Studies had to be conducted in low- and middle-income countries, which for practicality was defined according to the World Bank's country classification in the year that the study was published.[15] Studies reporting only pooled data from both low- or middle- and high-income countries were not eligible. Studies using proportional mortality as an outcome, or measuring the outcome on an ecological level, were excluded; all other study designs (prospective, case-control, cross-sectional) were eligible.

Search strategy

Three major biomedical databases were searched (MEDLINE, Embase and Global Health, all through Ovid). Details of the search strategy are given in Supplementary Material Table S1. Titles and abstracts were screened for relevance by the main reviewer, with a 20% subsample

independently screened by a second reviewer. Reference lists of eligible articles and relevant reviews identified by the main search were hand searched for additional articles. Discrepancies were resolved in discussion with a third reviewer.

Data extraction

Data from eligible articles were extracted into a pre-made data extraction form and double checked for accuracy by a second reviewer. Where possible, associations were extracted adjusted for: i) age and sex, and ii) age, sex and at least one indicator of socioeconomic position in adulthood. When the association adjusted for adult socioeconomic position was not reported, but authors reported the association stratified by adult socioeconomic position (for example in a social trajectory analysis), stratified estimates were extracted, as they allow similar inferences to be made. Due to the diversity in exposures and outcomes across eligible studies, it was anticipated that only a qualitative evidence synthesis would be possible. It was pre-decided to group study results by outcome. For each class of outcome, a vote-counting approach was used to summarise directions of associations after adjusting for adult socioeconomic position (i.e. positive, inverse, or null if not significant at the 95% level). If there were multiple associations reported using the same data for the same class of outcome (e.g. in the case of multiple eligible exposure variables, or slightly different outcome definitions), the association was counted as positive/inverse if more than half of the reported associations were positive/inverse. Sex-stratified associations were extracted where available.

Quality assessment

Risk of bias within studies was assessed independently by two reviewers, with discrepancies resolved in discussion with a third reviewer. Included articles were rated based on an adapted version of the Newcastle-Ottawa Scale for assessing quality of observational studies.[16] Study results were interpreted alongside their risk of bias, giving more weight to studies of higher quality in the discussion. Risk of bias across studies (i.e. publication bias) was not formally assessed because of heterogeneity in study exposures and outcome, but the potential impact of publication bias on conclusions is addressed in the discussion.

Results

The search was executed on 19/09/2020 and returned 5891 articles (3568 after de-duplication). Screening of titles and abstracts returned 56 articles for full-text screen, of which 26 were eligible for inclusion. A further 3 articles were identified through hand searches of the reference lists of relevant articles, giving a total of 29 articles included in the review. Figure 1 shows the flow chart of article selection.

Overview of studies

Characteristics and key findings of eligible articles are given in Table 1 (full extracted results in Supplementary Material Table S2). The 29 eligible articles analysed data from 20 unique datasets or studies. Nine of these studies were from the Americas (4 from Brazil, 2 from Mexico, 1 from Colombia, 1 from Jamaica, 1 from multiple Latin American cities), 6 were from Asia (3 from India, 2 from China, 1 from Indonesia), 3 were from Africa (1 from South Africa, 1 from Ghana, 1 from Botswana), 1 was from Russia, and 1 included data from multiple world regions. All of the included studies were from middle-income countries (7

lower middle-income and the rest upper middle-income); no studies were from low-income countries. Six of the studies collected prospective measures of childhood socioeconomic position, while the rest relied on retrospectively recalled measures of childhood socioeconomic position. Across all included studies there were over 150,000 unique participants. Two of the studies had under 1000 participants, 9 had between 1000 and 5000 participants, and 9 had over 5000 participants.

The most commonly measured indicator of childhood socioeconomic position was parental education (9/20 studies). Other indicators used were: parental occupation (3 studies); household conditions, assets or income in infancy (3 studies) or childhood (7 studies); subjectively assessed socioeconomic position in childhood (i.e. high/medium/low, 3 studies); and a composite of multiple measures (1 study). Only 4 of the included studies reported CVD as an outcome, 3 of which used self-reported diagnosis or symptoms of heart disease, and 1 of which measured prevalent coronary heart disease using ECG. Three articles, all based on the same study from Brazil (ELSA-Brasil), reported on subclinical measures of CVD (carotid intima-media thickness and carotid-femoral pulse wave velocity). Fourteen studies reported on hypertension or blood pressure as an outcome (2 of which relied on self-reported diagnosis of hypertension), and 11 studies reported on diabetes or impaired fasting glucose as an outcome (5 of which relied on self-reported diagnosis of diabetes). Other outcomes included lipid levels (5 studies), metabolic syndrome (2 studies) and CVD risk score (1 study). In total, studies reported 46 associations between socioeconomic position in childhood and these different outcomes. Of these, 39 associations were adjusted for at least one marker of socioeconomic position in adulthood, of which 6 were also adjusted for at least one marker of adult health (most commonly overweight or obesity). Two out of 46 associations were only presented stratified, not adjusted for, adult socioeconomic position (i.e. social trajectory

197 analyses). Findings of the included studies, organised by outcome, are summarised below and
198 in Table 2.
199
200 Cardiovascular disease and subclinical markers
201
202 Four studies reported on CVD outcomes. In a cohort of births from one hospital in China
203 between 1921 and 1954 (N=2033, <20% follow-up rate), paternal education and occupation
204 at birth were not associated with prevalent coronary heart disease diagnosed by ECG and
205 Rose/WHO angina questionnaire.[17] However, the authors only presented the association
206 adjusted for adult CVD risk factors (including hypertension, diabetes, dyslipidaemia), which
207 may have attenuated the association. In two large cross-sectional surveys in Latin America
208 (one in Colombia,[18] one in multiple capital cities in the region[19]), self-reported subjective
209 socioeconomic position in childhood was not associated with self-reported diagnosis of
210 coronary heart disease. On the other hand, in a household survey in a town in southern
211 Russia, self-reported childhood poverty was associated with increased risk of self-reported
212 coronary heart disease symptoms, which was robust to adjustment for the participants'
213 education.[20] Subclinical measures of CVD were only reported in one cross-sectional study of
214 Brazilian civil servants (ELSA-Brasil, N=~13,000). One analysis found an inverse
215 association between maternal education and carotid intima-media thickness (CIMT) in
216 women only,[21] although this disappeared after adjustment for socioeconomic position in
217 adulthood. An analysis of the association between occupational social class trajectory
218 between parents and offspring and CIMT in the same dataset reported consistent findings.[22]
219 Another analysis of the same dataset reported a crude inverse association between maternal
220 education and carotid-femoral pulse wave velocity, a measure of arterial stiffness, although

after adjustment for adult socioeconomic position, the association only remained for black and brown participants.[23]

Hypertension and blood pressure

In 5/6 studies which reported on the association between childhood socioeconomic position and adult hypertension or elevated blood pressure (3 prospective,[24–28] 2 cross-sectional[29,30]), no strong evidence of an association was reported. In 1 cross-sectional study in Mexico, an inverse association was observed in females but not males, which was robust to adjustment for adult socioeconomic position.[31] Five other studies reported on the association between childhood socioeconomic position and blood pressure (assessed as a continuous outcome). There was little evidence of an association in 1 prospective study,[32] while in 2 cross-sectional studies,[33,34] the crude associations disappeared after adjustment for adult socioeconomic position. In a cross-sectional study of Brazilian civil servants (ELSA-Brasil), there was an inverse association between maternal education and systolic blood pressure, which was robust to adjustment for the participants' education and wealth status.[35] In a cross-sectional analysis of two pooled studies from India, household assets in childhood were inversely associated with systolic and diastolic blood pressure after adjusting for adult socioeconomic position.[36] Two cross-sectional surveys from Botswana[37] and Indonesia[38] examined the association of childhood socioeconomic position with self-reported diagnosis of hypertension, both reporting that an inverse association emerged after adjustment for socioeconomic position in adulthood. An analysis of the WHO-SAGE cross-sectional study (conducted in China, Mexico, India, South Africa and Russia, N=38,297) reported the association of CVD risk factors with participants' socioeconomic trajectories between childhood and adulthood.[39] The authors found that the prevalence of measured hypertension

did not vary between socioeconomic trajectory groups, suggesting no association of childhood socioeconomic position with measured hypertension. However, among males only, the prevalence of diagnosed hypertension was highest in the persistent high socioeconomic group and slightly raised in the declining socioeconomic group, suggesting a positive association between childhood socioeconomic position and diagnosed hypertension.

Diabetes and impaired fasting glucose

Two prospective studies examined impaired fasting glucose or diabetes as an outcome, neither finding any association with parental education.[24,25] Three cross-sectional studies examined fasting glucose, insulin or HOMA score (a measure of insulin resistance based on fasting glucose and insulin) as continuous outcomes. In a study of internal migrants in India there was a positive association between household assets in childhood and HOMA score among males only, which was robust to adjustment for household assets in adulthood.[33] However in a larger pooled dataset from India (which included these participants as well as participants from the APCAPS study), the positive associations with fasting glucose, insulin and HOMA score were not robust to adjustment for adult socioeconomic position.[36] In a study of older adults from southern China, there was an inverse association between household assets in childhood and fasting glucose in females only, which was not robust to adjustment for adult socioeconomic position.[34] Three out of four cross-sectional studies which examined the association of childhood socioeconomic position with self-reported diabetes found no clear evidence of an association.[19,37,38] In one nationally representative survey in Mexico, there was some evidence of an inverse association between maternal, but not paternal, education and self-reported diabetes, although the associations of childhood assets with self-reported diabetes were highly inconsistent.[40,41]

Two studies examined the association between diabetes and participants' socioeconomic trajectory between childhood and adulthood. In the ELSA-Brasil study, diabetes risk was highest in the persistent low and declining socioeconomic groups,[42] suggesting that socioeconomic position in adulthood, but not childhood, was inversely associated with diabetes. In the WHO-SAGE study, among men only, prevalence of self-reported diabetes was highest in the declining and persistent high socioeconomic groups, suggesting that childhood socioeconomic position is positively associated with risk of diabetes, independent of adult socioeconomic position.[39]

Other outcomes

Five studies (3 prospective and 2 cross-sectional) reported on the association between childhood socioeconomic position and lipid profile in adulthood. Total and low-density lipoprotein (LDL) cholesterol were examined in 2 studies. In a pooled dataset from India (N=14011), household assets in childhood were positively associated with total and LDL cholesterol, but these associations were not robust to adjustment for adult socioeconomic position.[36] In a birth cohort from Brazil (N=2063), household income at birth was positively associated with total and LDL cholesterol among males only, which was robust to adjustment for adult socioeconomic position.[43] High-density lipoprotein (HDL) cholesterol was positively associated with childhood socioeconomic position in the same study, although was inversely associated in a cross-sectional study from China,[34] and not associated in two other studies in India and Jamaica.[24,25] There was no evidence for an association between childhood socioeconomic position and triglycerides in any of the 5 studies. Two studies looked at metabolic syndrome (defined by International Diabetes Federation criteria). In a cross-

296 sectional study of older adults in southern China (N=9746), metabolic syndrome was
297 inversely associated with childhood assets in women only, which was robust to adjustment
298 for adult socioeconomic position.[34,44] In a birth cohort from Jamaica (N=839), there was no
299 evidence that metabolic syndrome was associated with maternal education.[25]. One cross-
300 sectional study of Brazilian civil servants (ELSA-Brasil, N=13544) found a strong inverse
301 association between maternal education and Framingham Risk Score (a composite of blood
302 pressure, total and HDL cholesterol, diabetes and smoking), which was robust to adjustment
303 for adult socioeconomic position.[45]
304
305 Risk of bias within and between studies
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307 Risk of bias ratings for each article are shown in Figure 2. None of the articles included in the
308 review were judged to be of low risk of bias. Thirteen out of 29 were judged to be at medium
309 risk of bias, while the remaining 16 articles had high risk of bias. The articles with medium
310 risk of bias were generally birth cohort studies with prospectively measured information on
311 childhood socioeconomic position and objective outcome measures, or nationally
312 representative surveys with objective outcome measures. The articles with high risk of bias
313 were generally cross-sectional with self-reported exposures and outcomes, or focussed on
314 specific population subgroups (such as occupational cohorts) that might not generalise to the
315 rest of the population. It was not possible to quantitatively assess risk of bias between studies
316 (i.e. publication bias) in a funnel plot because exposures, analysis approaches and outcomes
317 were highly variable between studies.
318
319 **Discussion**
320

Most of the studies identified examined the association between socioeconomic position in childhood and risk factors for CVD such as hypertension and diabetes; very few studies examined CVD as an outcome. All of the studies identified were from middle-income countries. Overall, the literature identified provided limited evidence for an association between childhood socioeconomic position and CVD risk factors after adjustment for socioeconomic position in adulthood.

These findings contradict previous reviews of the evidence from high-income countries, which have consistently noted independent inverse associations between childhood socioeconomic position and risk of CVD.[3,4] This is surprising because it has been suggested that childhood conditions associated with material deprivation (such as undernutrition and infections) may mediate the association, which would suggest a stronger inverse association in lower income countries.[46] However, previous reviews focussed largely on CVD incidence and mortality, for which evidence is lacking from low- and middle-income countries. The few studies on prevalent coronary heart disease that were identified had major methodological limitations, making it difficult to interpret their findings (for example, adjustment for potential mediators of the association, and use of self-reported disease outcomes). The interpretation of studies of prevalent outcomes is also complicated by the high case fatality rate of CVD in many lower income settings.[47] Recently, a multi-country prospective study from 15 low- and middle-income countries found that adult socioeconomic position was inversely associated with CVD incidence and mortality, even though it was positively associated with most major CVD risk factors.[48] This implies that the conclusions about CVD risk factors in the current review cannot necessarily be extrapolated to CVD incidence and mortality, and that evidence on these outcomes is urgently needed.

Although no strong evidence of an independent association between childhood socioeconomic position and risk of CVD was found, some general patterns across studies were noted. Firstly, studies from countries with higher levels of economic development (i.e. Brazil, Russia, China and Mexico) were more likely to report independent inverse associations between childhood socioeconomic position and CVD risk factors, similar to studies from high-income countries. This suggests that the association between childhood socioeconomic position and CVD risk factors may vary by a country's stage of economic development, as has been observed for adult socioeconomic position.[49] This gives some insight into the mechanisms, as it implies that the association between childhood socioeconomic position and CVD risk may be driven by setting-specific factors (such as the social patterning of childhood physical activity and diet), rather than conditions associated with absolute poverty (such as undernutrition and infections). Further high-quality studies, especially from low-income countries, are needed to confirm this speculation. It is also notable that studies from upper middle-income countries were more likely to report an inverse association that disappeared after adjustment for adult socioeconomic position, suggestive of an indirect pathway linking childhood socioeconomic position and adult CVD (via adult socioeconomic position), consistent with empirical evidence and theory from high-income countries.[50–52] Secondly, a greater proportion of studies reported an inverse association between childhood socioeconomic position and blood pressure than for other CVD risk factors. These included several large studies from Brazil, India and Indonesia, which did not find evidence that childhood socioeconomic position was associated with diabetes or lipid levels.[35,36,38] This is consistent with some early studies from high-income countries that found blood pressure, but not lipid levels, to be inversely associated with childhood socioeconomic position,[53,54] raising the possibility that different mechanisms may be operating for blood pressure compared with other CVD risk factors. Thirdly, several

studies reported differences in the association between childhood socioeconomic position and CVD risk factors between men and women. Studies from Mexico and China found evidence that childhood socioeconomic position was inversely associated with hypertension[31] and metabolic syndrome,[34] respectively, in women only, while in China, India and Brazil, childhood socioeconomic position was positively associated with metabolic syndrome,[34] insulin resistance[33] and LDL cholesterol,[43] respectively, among men only. These observations are consistent with the sex-differences in association between adult socioeconomic position and CVD risk factors seen in several middle-income countries.[55,56] Researchers have speculated that these sex-differences might arise upon economic development due to occupational factors (e.g. men more likely to remain engaged in occupational physical activity), as well as differing cultural pressures for men and women, although how this might translate to childhood socioeconomic position is unclear.[57]

Limitations

A primary limitation of the conclusions drawn from this review is that many of the studies had a high risk of bias. Several studies included only self-reported outcomes, which may be particularly unreliable in low- and middle-income countries where many cardiovascular conditions are undiagnosed. Potential bias in self-reported outcomes was demonstrated in the WHO-SAGE study from 5 middle-income countries, which reported an association between the stable high socioeconomic trajectory and self-reported hypertension, but no association with measured hypertension.[39] To try to limit bias due to self-reported outcomes in this review, findings from self-reported outcomes were presented separately from objectively measured outcomes, and given less weight in the overall interpretation of evidence. Another common limitation of the studies was that many used recalled childhood exposures, which

may be prone to measurement error and thus have attenuated the associations. However, studies have previously found that people are able to recall their childhood socioeconomic conditions with reasonable accuracy,[58] and in the current review, findings did not generally differ between prospective and cross-sectional studies.

Some limitations in this review's methodology are acknowledged. Firstly, it was not possible to formally assess risk of bias across studies (publication bias), because of heterogeneity in exposure and outcome measures and categorisations. Observational studies are at a high risk of selective publication of "significant" results, because they often collect data on many possible exposures and outcomes without pre-specifying the analyses. In this review, however, even a moderate to high amount of publication bias would not substantially alter the main conclusions. Secondly, it was not possible to formally investigate sources of heterogeneity between studies. For example, previous reviews have found that associations vary between different indicators of socioeconomic position, which might have shed light on the mechanisms linking childhood socioeconomic position with risk of CVD.[10] The vote-counting approach used to summarise study results did not take account of study size or strength of association, and did not distinguish between different indicators of socioeconomic position, so must be interpreted with caution. Thirdly, although the major biomedical databases were searched, this review did not include grey literature or articles in most non-English languages. This could have led to some relevant studies being omitted from the review. However, it is unlikely that eligible analyses based on large-scale population-based studies would be absent from the databases and reference lists searched.

Conclusions

Evidence identified in this review demonstrates limited support for an association between childhood socioeconomic position and risk factors for CVD in middle-income countries. This suggests it would be premature to advocate for policies targeting childhood poverty for the prevention of CVD in these settings. Until more evidence is available, interventions focussing on established risk factors in adulthood (e.g. tobacco prevention, promotion of physical activity, and reduction of sodium content of foods) should be prioritised.[59] Evidence on CVD incidence and mortality was completing lacking, suggesting further prospective studies are needed. There is also a need for studies from low-income countries, as evidence from middle-income countries may not generalise to these settings.

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Data availability: All data extraction forms and the data extracted for this review are available in the Supplementary Material (Table S2).

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Figures

Figure 1: Flowchart of included articles**.**

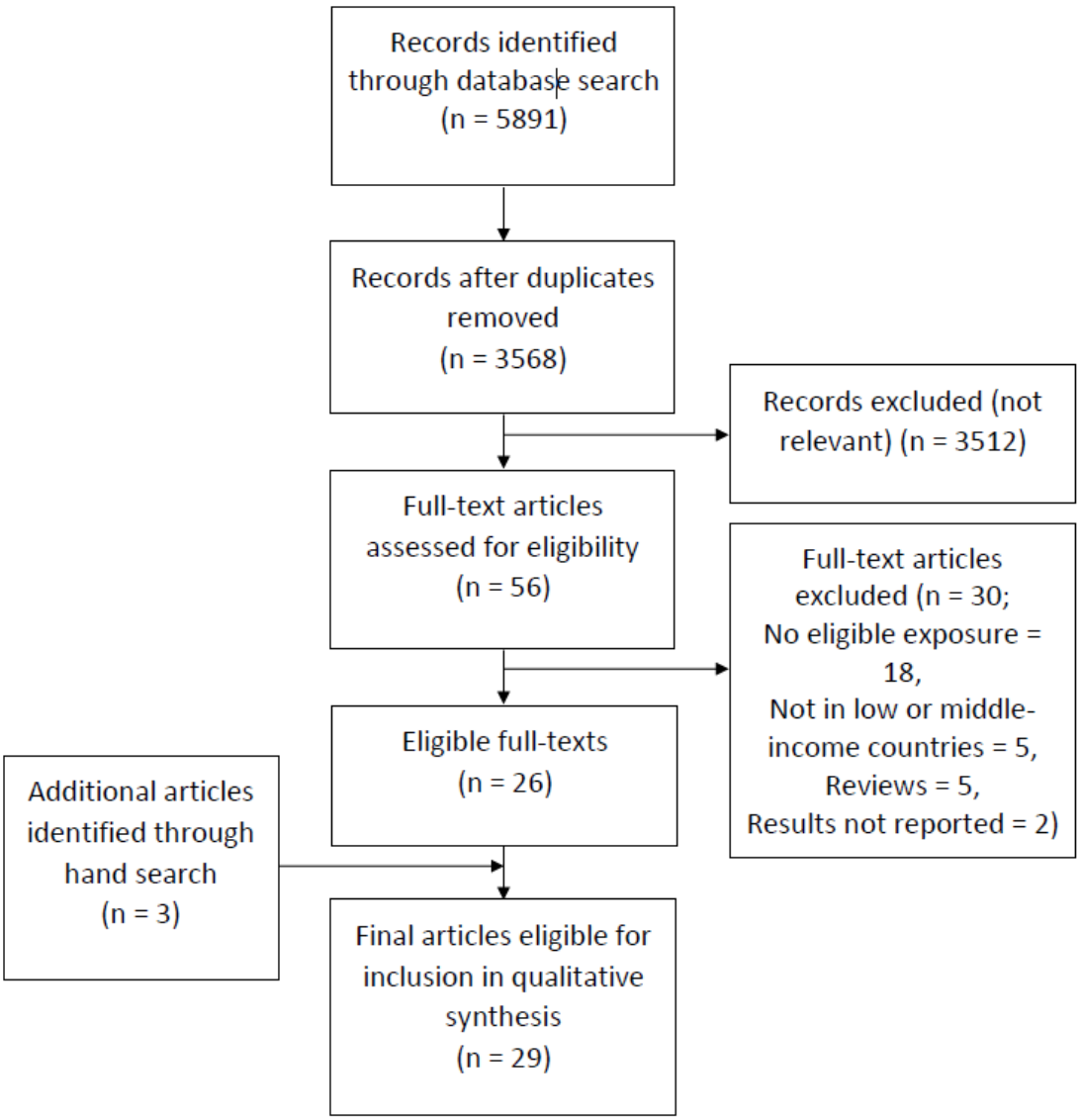
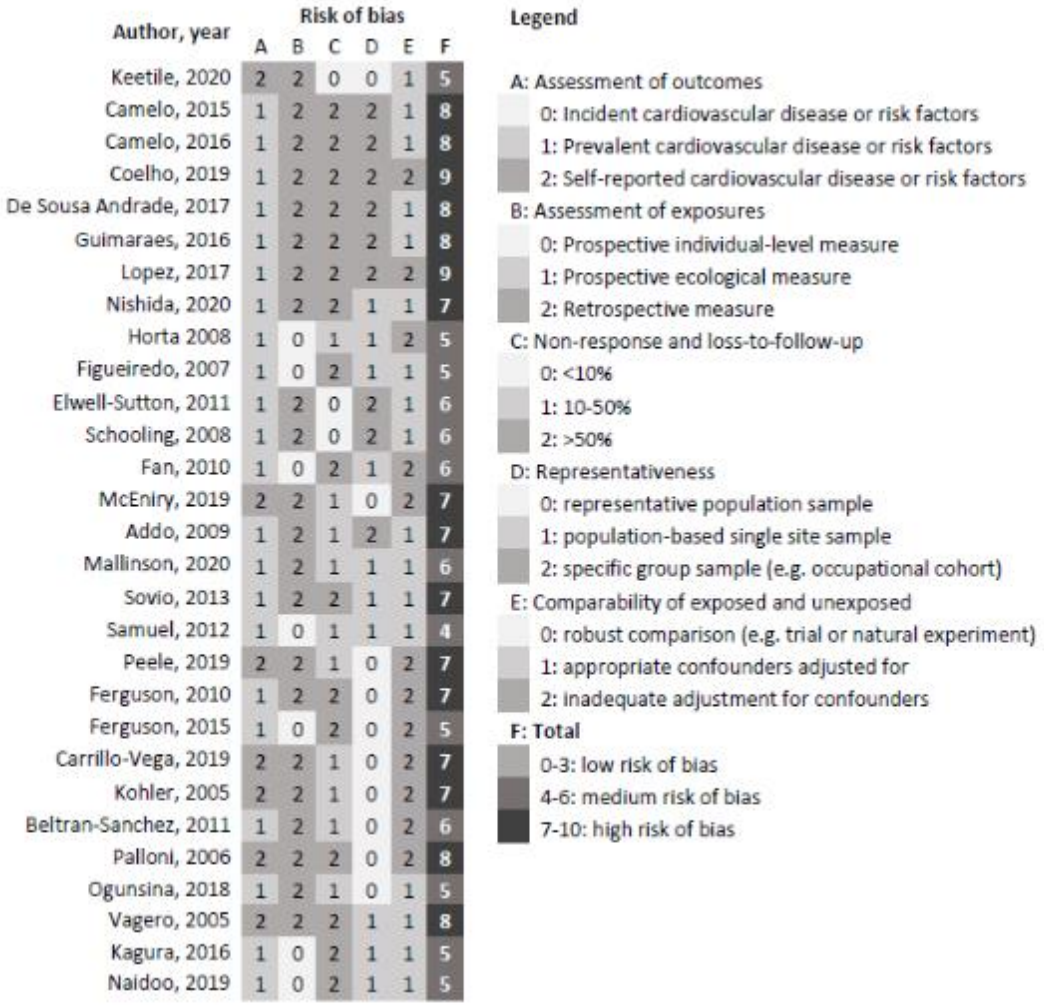


Figure 2: Risk of bias in included articles (n=29)



Author, year	Risk of bias					
	A	B	C	D	E	F
Keetile, 2020	2	2	0	0	1	5
Camelo, 2015	1	2	2	2	1	8
Camelo, 2016	1	2	2	2	1	8
Coelho, 2019	1	2	2	2	2	9
De Sousa Andrade, 2017	1	2	2	2	1	8
Guimaraes, 2016	1	2	2	2	1	8
Lopez, 2017	1	2	2	2	2	9
Nishida, 2020	1	2	2	1	1	7
Horta 2008	1	0	1	1	2	5
Figueiredo, 2007	1	0	2	1	1	5
Elwell-Sutton, 2011	1	2	0	2	1	6
Schooling, 2008	1	2	0	2	1	6
Fan, 2010	1	0	2	1	2	6
McEniry, 2019	2	2	1	0	2	7
Addo, 2009	1	2	1	2	1	7
Mallinson, 2020	1	2	1	1	1	6
Sovio, 2013	1	2	2	1	1	7
Samuel, 2012	1	0	1	1	1	4
Peele, 2019	2	2	1	0	2	7
Ferguson, 2010	1	2	2	0	2	7
Ferguson, 2015	1	0	2	0	2	5
Carrillo-Vega, 2019	2	2	1	0	2	7
Kohler, 2005	2	2	1	0	2	7
Beltran-Sanchez, 2011	1	2	1	0	2	6
Palloni, 2006	2	2	2	0	2	8
Ogunsina, 2018	1	2	1	0	1	5
Vagero, 2005	2	2	2	1	1	8
Kagura, 2016	1	0	2	1	1	5
Naidoo, 2019	1	0	2	1	1	5

Table 1: Description and key findings of included articles (n=29)

Author/ year	Dataset/ study, country	Study design	Recruitment year(s)	N	Participant ages	Exposure(s)	Outcome(s)	Key findings
Keetile, 2020[37]	Non-communicable disease survey in Botswana	Cross-sectional	2016	1178 (50% men)	15-80 (mode age group 25-34)	Composite SEP index, retrospectively reported	Hypertension, self-reported Diabetes, self-reported	Childhood SEP index was positively associated with self-reported hypertension in crude models, and inversely associated in models adjusted for adult SEP. No associations between childhood SEP and diabetes.
Camelo, 2015[21]	ELSA-Brasil	Cross-sectional	2008-10 (baseline)	8806 (46% men)	35-74 (mean age 50)	Parental education, retrospectively reported	Carotid intima-media thickness	Maternal education was inversely associated with CIMT in women but not men, although this association was not robust to adjustment for adult SEP.
Guimaraes, 2016[22]	ELSA-Brasil	Cross-sectional	2008-10 (baseline)	7343 (47% men)	35-74 (mean age 50)	Parental occupation and own occupation, retrospectively reported (trajectory analysis)	Carotid intima-media thickness	Stable low SEP trajectory had the highest CIMT, then downwards trajectory. Upwards trajectory was not different from stable high.
Coelho, 2019[23]	ELSA-Brasil	Cross-sectional	2008-10 (baseline)	13365 (46% men)	35-74 (mean age 51)	Parental education, retrospectively reported	Carotid-femoral pulse wave velocity	Maternal education was inversely associated with pulse wave velocity. After adjustment for adult SEP as well as some behavioural and biological risk factors, the association remained among black and brown participants only.
Camelo, 2016[42]	ELSA-Brasil	Cross-sectional	2008-10 (baseline)	13629 (45% male)	35-74 (mean age 51)	Parental education and own education; parental occupation and own occupation,	Diabetes, undiagnosed	Stable low SEP trajectory had highest diabetes, then downwards SEP trajectory.

						retrospectively reported (trajectory analysis)		Upwards SEP trajectory was not different from stable high.
De Sousa Andrade, 2017[45]	ELSA-Brasil	Cross-sectional	2008-10 (baseline)	13544 (46% men)	35-74 (mean age 51)	Parental education, retrospectively reported	cardiovascular risk score	Maternal education was inversely associated with cardiovascular risk score, which was robust to adjustment for adult SEP.
Lopez, 2017[35]	ELSA-Brasil	Cross-sectional	2008-10 (baseline)	13571 (46% men)	35-74 (mean age 51)	Parental education, retrospectively reported	Blood pressure	Maternal education was inversely associated with systolic blood pressure, which was robust to adjustment for adult SEP and behavioural risk factors.
Nishida, 2020[30]	EpiFloripa Cohort Study, Brazil	Cross-sectional	2012 (second wave)	926 (44% men)	20-65 (mode age group 20-29)	Parental education, retrospectively reported	Hypertension	Parental education was not associated with hypertension (before or after adjustment for adult SEP).
Horta, 2008[32]	Pelotas 1982 birth cohort, Brazil	Prospective	1982, followed-up 2004-5	4291 (51% men)	22-23	Parental education Household income at birth	Blood pressure	Maternal education and household income at birth were not associated with blood pressure in crude models, except for a positive association between maternal education and diastolic blood pressure in women only (results adjusted for adult SEP were not presented).
Figueiredo, 2007[43]	Ribeirao Preto birth cohort, Brazil	Prospective	1978-79, followed up 2002-4	2063 (50% men)	23-25	Household income at birth	Total cholesterol LDL cholesterol HDL cholesterol Triglycerides	Household income at birth was positively associated with HDL cholesterol, and among men only, positively associated with LDL and total cholesterol, all of which were robust to adjustment for

								adult SEP. No associations were seen with triglycerides.
Elwell-Sutton, 2011[44]	Guangzhou Biobank Cohort Study, China	Cross-sectional	2005-8 (phases 2 and 3)	20,086 (27% men)	50+ (mean age 61)	Household assets in childhood, retrospectively reported	Metabolic syndrome	Childhood assets were inversely associated with metabolic syndrome in women but not men, but this association was not robust to adjustment for adult SEP.
Schooling, 2008[34]	Guangzhou Biobank Cohort Study, China	Cross-sectional	2005-6 (phase 1)	9746 (28% men)	50+ (mean age 60)	Household assets in childhood, retrospectively reported	Metabolic syndrome Blood pressure Fasting glucose Triglycerides HDL	Childhood assets were inversely associated with metabolic syndrome in women but not men, which was robust to adjustment for adult SEP and behavioural factors. Childhood assets were inversely associated with SBP (both sexes) and fasting glucose (women only), and positively associated with DBP and triglycerides (both males only), none of which were robust to adjustment for adult SEP and behavioural risk factors. Childhood assets were inversely associated with HDL in males only, which was robust to adjustment for adult SEP.
Fan, 2010[17]	Peking Union Hospital births, China	Prospective	1921-54, followed up 2002-4	2033 (50% men)	50-84 (mean age 60)	Parental education, retrospectively reported Parental occupation, retrospectively reported	Coronary heart disease, prevalent	Parental occupation and education were not associated with prevalent CHD (measured by ECG), although associations were only

								presented adjusted for adult behavioural and biological risk factors.
McEniry, 2019[18]	SABE Colombia	Cross-sectional	2014-15	14657 (46% men)	60+ (mode age group 60-64)	Subjective SEP in childhood, retrospectively reported	Coronary heart disease, self-reported	Subjective SEP in childhood was not associated with reported diagnosis of heart disease (before or after adjustment for adult SEP).
Addo, 2009[29]	Survey of civil servants in Ghana	Cross-sectional	2006	1015 (60% men)	Mean age 44	Household assets in childhood, retrospectively reported	Hypertension	Childhood assets were not associated with hypertension (before or after adjustment for adult SEP).
Mallinson, 2020[36]	APCAPS and Indian Migration Study, India	Cross-sectional	2010-12/ 2005-07	14011 (56% men)	Mean age 38	Household assets in childhood, retrospectively reported	Blood pressure Total cholesterol LDL cholesterol Triglycerides Fasting glucose Insulin HOMA	Childhood assets were not associated with blood pressure in crude models, although were inversely associated after adjustment for adult SEP. Childhood assets were positively associated with total cholesterol, LDL cholesterol, triglycerides, fasting glucose, insulin and HOMA in crude models, but these associations were not robust to adjustment for adult SEP.
Sovio, 2013[33]	Indian Migration Study, India	Cross-sectional	2005-07	7067 (58% men)	15-76 (mean age 41)	Household assets in childhood, retrospectively reported	Blood pressure HOMA	Childhood assets were not associated with SBP or HOMA score, except for a positive association with HOMA score in males, which was robust to adjustment for adult SEP.
Samuel, 2012[24]	Vellore birth cohort, India	Prospective	1969-73, followed up 1998-2002	2218 (52% men)	26-32 (mean age 28)	Parental education	High TC:HDL ratio High triglycerides	Paternal education was not associated with high total:HDL cholesterol, high

							Hypertension Diabetes/IGT/IFG	triglycerides, hypertension or diabetes/IFG/IGT after adjustment for adult SEP and physical activity (crude models not shown).
Peele, 2019[38]	Indonesian Family Life Survey	Cross-sectional	2014-15	6530 (47% men)	50+ (mean age 60)	Household conditions in childhood, retrospectively reported	Hypertension, self-reported Diabetes, self-reported	Childhood assets were not associated with self-reported hypertension in crude models, but inversely associated after adjustment for adult SEP. Childhood assets were not associated with self-reported diabetes.
Ferguson, 2010[25]	Jamaica 1986 birth cohort	Prospective	1986, followed up 2005-7	839 (45% men)	18-20	Parental education	Metabolic syndrome High blood pressure Low HDL High Triglycerides IFG	Parental education was not associated with metabolic syndrome, high blood pressure, impaired fasting glucose, low HDL or high triglycerides in crude models (adjusted models not presented).
Ferguson, 2015[28]	Jamaica 1986 birth cohort	Prospective	1986, followed up 2005-7	794 (46% men)	18-20	Parental occupation	Blood pressure	Maternal occupation was not associated with blood pressure in crude models, but after adjustment for height, BMI and birthweight, there was an inverse association with SBP among males.
Carrillo-Vega, 2019[41]	Mexican Health and Aging Study	Prospective	2012 and 2015	8848 (44% men)	50+ (mean age 64)	Household conditions in childhood, retrospectively reported	Diabetes incidence and prevalence, self-reported	Possession of shoes in childhood, but not child hunger, was inversely associated with incidence of self-reported diabetes between the two survey waves, but not with prevalent diabetes, in models adjusted

								for adult SEP, health behaviours and comorbidities (crude models not shown).
Kohler, 2005[40]	Mexican Health and Aging Study	Cross-sectional	2001	6423 (49% men)	50+ (mean age 61)	Parental education, retrospectively reported Household conditions in childhood, retrospectively reported	Diabetes, self-reported	Maternal, but not paternal, education was inversely associated with self-reported diabetes, robust to adjustment for adult SEP and overweight. Inconsistent associations were seen for household conditions and hunger in childhood.
Beltran-Sanchez, 2011[31]	Mexican Family Life Survey	Cross-sectional	2002	14280 (~50% men)	20+ (mode age group 20-39)	Household assets in childhood, retrospectively reported	Hypertension	Household possession of a toilet in childhood was inversely associated with hypertension in females but not males, which was robust to adjustment for adult SEP and overweight.
Palloni, 2006[19]	SABE (Chile, Brazil, Cuba, Mexico, Uruguay)	Cross-sectional	2000	4540	60-74 (mean age not stated)	Subjective SEP in childhood, retrospectively reported	Coronary heart disease, self-reported Diabetes, self-reported	Subjective SEP in childhood was not associated with self-reported heart disease or diabetes in models adjusted for adult SEP, obesity and height (crude models not shown).
Ogunsina, 2018[39]	WHO-SAGE (China, Mexico, India, South Africa, Russia)	Cross-sectional	2007-10	38297 (42% men)	18+ (mode age group 40-64)	Parental education and own education, retrospectively reported (trajectory analysis)	Hypertension, measured and self-reported Diabetes, self-reported	Stable high SEP trajectory was associated with higher prevalence of self-reported, but not measured, hypertension, among men only. Stable high or downwards SEP trajectories were associated with higher self-reported diabetes, among men only.

Vagero, 2005[20]	Household survey in Russia	Cross-sectional	1998	1972	18-70 (mean age not stated)	Subjective SEP in childhood, retrospectively reported	Coronary heart disease, self-reported symptoms	Subjective SEP in childhood was inversely associated with self-reported heart disease symptoms in models adjusted for adult SEP (crude models not shown).
Kagura, 2016[27]	Birth to Twenty Cohort, South Africa	Prospective	1990, followed up 2008	838 (48% men)	18	Household assets at birth	Blood pressure Hypertension	Household asset score in infancy was not associated with blood pressure or hypertension in models adjusted for SEP trajectory (crude models not shown).
Naidoo, 2019[26]	Birth to Twenty Cohort, South Africa	Prospective	1990, followed up 2013	1540 (49% men)	23	Parental education	Elevated blood pressure	Maternal education was not associated with elevated blood pressure (before or after adjustment for adult SEP).
SEP is socioeconomic position; LDL is low-density lipoprotein; HDL is high-density lipoprotein; TC is total cholesterol; HOMA is homeostasis model assessment; IGT is impaired glucose tolerance; IFG is impaired fasting glucose.								

Table 2: Summary of directions of association between childhood socioeconomic position and CVD risk in included studies.

	Direction of association with childhood socioeconomic position[a]		
Outcome	**Inverse**	**Null**	**Positive**
Prevalent coronary heart disease		China (Peking hospital)	
Self-reported coronary heart disease	Russia	Colombia Multiple cities (SABE)	
Subclinical measures of cardiovascular disease	Brazil (ELSA-Brasil)	Brazil (ELSA-Brasil)	
Hypertension and blood pressure	Mexico F (MxFLS) Brazil (ELSA-Brasil) India (APCAPS/IMS)	Mexico M (MxFLS) Brazil (EpiFloripa) Brazil (Pelotas) Jamaica Ghana South Africa China (GBCS) India (Vellore) India (IMS) Multi-country (SAGE)	
Self-reported hypertension	Botswana Indonesia	Multi-country F (SAGE)	Multi-country M (SAGE)
Diabetes and fasting glucose		India F (IMS) India (APCAPS/IMS) India (Vellore) Jamaica China (GBCS) Brazil (ELSA-Brasil)	India M (IMS)
Self-reported diabetes		Mexico (MHAS) Multiple cities (SABE) Botswana Indonesia Multi-country F (SAGE)	Multi-country M (SAGE)
Total or low-density lipoprotein cholesterol		Brazil F (RPBC) India (APCAPS/IMS)	Brazil M (RPBC)
Lower high-density lipoprotein cholesterol	Brazil (RPBC)	China F (GBCS) Jamaica India (Vellore)	China M (GBCS)
Triglycerides		Brazil (RPBC) Jamaica China (GBCS) India (Vellore) India (APCAPS/IMS)	
Metabolic syndrome	China F (GBCS)	China M (GBCS) Jamaica	
Cardiovascular risk score	Brazil (ELSA-Brasil)		
Total both sexes (N=39)	**8**	**31**	**0**
Total males (N=7)	**0**	**2**	**5**
Total females (N=7)	**2**	**5**	**0**

MxFLS is Mexican Family Life Survey; GBCS is Guangzhou Biobank Cohort Study; IMS is Indian Migration Study; MHAS is Mexican Health and Aging Study; RPBC is Ribeirao Preto Birth Cohort.
[a]We report the directions of association based on the models adjusted for adult socioeconomic position (and minimal other factors) where available. If multiple associations were reported for the same outcome and

dataset, a direction was assigned if more than half of the reported associations went in that direction. Sex-specific directions of association are reported only if available in the original studies and the directions of association differed by sex.