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CONTEMPORARY REVIEW

# The Role of Social Determinants of Health in Cardiovascular Diseases: An Umbrella Review

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**ABSTRACT:** Cardiovascular disease (CVD) is the leading cause of mortality worldwide. Addressing social determinants of health (SDoH) may be the next forefront of reducing the enormous burden of CVD. SDoH can be defined as any social, economic, or environmental factor that influences a health outcome. Comprehensive evidence of the role of SDoH in CVD is lacking, nevertheless. This umbrella review aims to give a comprehensive overview of the role of SDoH in CVD. We searched systematic reviews (with or without meta-analyses) using 8 databases and included review reference lists. Four themes (economic circumstances, social/community context, early childhood development, and neighbourhood/built environment) and health literacy in the health/health care theme were considered. Seventy reviews were eligible. Despite the quality of the included reviews being low or critically low, there was consistent evidence that factors relating to economic circumstances and early childhood development themes were associated with an increased risk of CVD and CVD mortality. We also found evidence that factors in the social/community context and neighbourhood/built environment themes, such as social isolation, fewer social roles, loneliness, discrimination, ethnicity, neighborhood socioeconomic status, violence, and environmental attributes, had a role in CVD. SDoH factors without (or with minimal) evidence synthesis for CVD were also identified. In sum, this umbrella review offers evidence that SDoH, especially economic circumstance and early childhood development, play a significant role in CVD. This calls for the strengthening of nonmedical interventions that address multiple factors simultaneously and the inclusion of SDoH in future CVD risk prediction models.

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**Key Words:** social context cardiovascular disease ■ social determinants of health ■ socioeconomic status ■ umbrella review



Cardiovascular disease (CVD) causes 17.9 million deaths worldwide annually.[1] Between 1990 and 2019, there was an alarming increase in total CVD morbidity and mortality.[2] CVD cases increased from 271 million in 1990 to 523 million in 2019, and CVD mortality increased from 12.1 million to 18.6 million.[2] CVD is a highly fatal condition; for instance, one person in the United States dies because of CVD every 34 seconds.[3]

There has been increasing recognition that social determinants of health (SDoH) significantly contribute to morbidity, mortality, and health inequality.[4–7] According to the World Health Organization, SDoH are any situation or circumstance in which individuals are born, grow, live, work, and age.[8,9] SDoH can also be described as any environmental factor that affects a person's health, quality of life, or the progression of a disease in a complex and interconnected manner.[10] There are multiple theoretical frameworks for SDoH, such as the World Health Organization conceptual SDoH framework,[11] the social-ecological framework,[12] and the Healthy

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## Nonstandard Abbreviations and Acronyms

| | |
|---|---|
| **AMSTAR** | Assessing the Methodological Quality of Systematic Review |
| **SDoH** | social determinants of health |

People 2020 and 2030 frameworks.[13,14] According to Healthy People 2020 and 2030 frameworks,[13,14] SDoH are a broad concept and can be classified into 5 main domains/themes: economic stability, education access and quality, social and community context, neighbourhood and built environment, and health and health care domains. Economic stability includes employment/occupation, income, food insecurity, and housing instability. The education access and quality theme include early childhood development and enrollment in higher education. Social support, social capital, social isolation, loneliness, discrimination, and race and ethnicity all fall under the social and community context theme. The neighborhood and built environment theme contains neighborhood socioeconomic status (SES) and environmental attributes, such as food environment, conflict, and violence, whereas the health and health care theme is defined by access to health services, access to primary care, quality of care, health insurance coverage, and health literacy.[13,14]

There are disparities in CVD occurrence and outcomes as a result of the complex and entangled relationships between SDoH and CVD.[15,16] SDoH do not necessarily have a 1-way causal relationship with health; they can be considered as upstream factors (the causes of the causes).[17] For instance, during the course of a person's life, poor social health influences a variety of health behaviours, including substance abuse, being overweight, and eating poorly.[15,18,19] They are linked to well-known traditional CVD risk factors as well. For example, there is evidence that SDoH are related to high blood pressure, inflammation, chronic stress, and excess cholesterol.[7,19,20] In addition, a lack of health literacy and difficulty in accessing medical services means that diseases are diagnosed late, which can lead to life-threatening consequences, like mortality attributable to CVD.[7,21]

Numerous systematic reviews and meta-analyses have been conducted, focusing on the roles of specific SDoH characteristics in CVD,[22–26] and none of these has compared the evidence for different domains of SDoH and thus indicated which areas could best be targeted for the interventions. Besides, an umbrella review, also called an overview of reviews or a systematic review of systematic reviews, gathers data from earlier reviews to provide user-friendly summaries for decision makers and, therefore, it is incredibly helpful to put the evidence into action.[27,28] Therefore, we aimed to provide the first comprehensive overview of the current evidence in the role of SDoH in CVD by undertaking an umbrella review.

# METHODS

The Preferred Reporting Items for Overviews of Reviews,[29] a guideline for overviews of reviews of health care interventions, is used for reporting (Table S1). The protocol was registered in International Prospective Register of Systematic Reviews (registration number CRD42022346994).

## Eligibility Criteria

Participants from the general population, at-risk population groups, or both were included. There were no restrictions based on the demographic characteristics of participants, such as age and sex.

The exposure of interest for our review was SDoH. We first considered the SDoH factors and categorizations described in the Healthy People 2020 and 2030 frameworks,[13,14] as well as other literature.[7,19,30–32] As CVD occurs later in life, SDoH factors can be conceptualized as occurring before and directly contributing to CVD. The causal pathway is likely most clear for the SDoH in early childhood (specific to early childhood SES and adverse events related to abuse, neglect, and violence), and for this reason we considered it to be a stand-alone theme.[30] There is evidence that economic stability and economic development of an individual or a society as a whole is correlated with education.[32] Furthermore, according to the American Psychological Association,[33] education is a measure of the SES along with income, social class, and financial security. We also followed the guidance of other literature[30,31] that has incorporated education into the economic stability theme, which we retitled economic circumstance. Hence, in this review we assessed SDoH under 4 themes: (1) economic circumstance; (2) social and community context; (3) early childhood development; and (4) neighbourhood and built environment. In addition, health literacy, which is considered part of the health and health care domain, was considered in this review (Figure 1).

The outcome of interest was composite CVD incidence or prevalence and mortality, as well as subtypes: coronary artery/heart diseases; ischemic heart disease; heart failure; myocardial infarction; atrial fibrillation; angina; peripheral arterial disease; cardiomyopathy; and stroke (Figure 1).

Systematic reviews with or without meta-analyses that examined the association between SDoH and CVD or CVD-specific mortality were included. For our study, we define systematic review as a systematic review if the article identifies itself as a systematic review

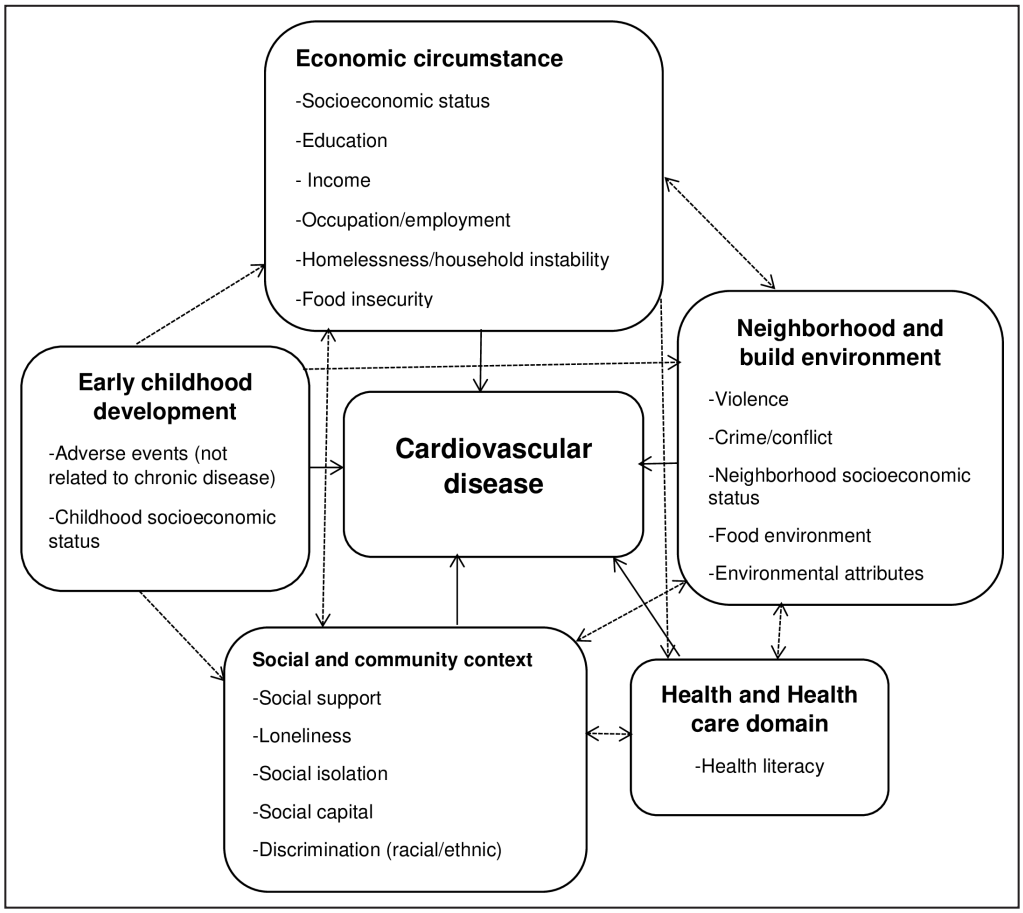


**Figure 1. Conceptual framework indicating the domains of the social determinants of health and their association with cardiovascular disease.**
Adapted from Healthy People 2020 and 2030 frameworks.[13,14]

or meta-analysis and at least the eligibility criteria, information sources (implementing systematic search using at least one database), selection process, and data collection process from the Preferred Reporting Items for Systematic reviews and Meta-Analyses checklist[34] had to be stated. There were no restrictions based on setting/country and study design (systematic reviews of both observational and interventional studies were eligible). Narrative and literature reviews and abstract-only reviews were excluded. The latter was excluded only after having first conducted a hand search and contacting authors twice (when emails were available) to get the published full-text review.

## Search Strategy

Seven databases (Medline, Embase, CINAHL, Scopus, PsycINFO, the Joanna Briggs Institute Database of Systematic Reviews and Implementation Reports, and the Cochrane Database of Systematic Reviews) were searched from their inception to August 2, 2022. Keywords and medical subject headings related to SDoH and CVD were searched and used, with the support from a specialist librarian. The detailed search terms for the Medline database are found in Table S2. In addition, to ensure that all relevant studies were not overlooked, a hand search was conducted using Epistemonikos (a systematic review repository),[35] and reference lists of retrieved articles were checked. We did not restrict our search based on the year of publication and publication language (articles published in non-English languages were translated using DeepL translator, https://www.deepl.com/translator).

## Study Selection and Data Extraction

The identified articles were exported into EndNote X9.3 and deduplicated before importing into Covidence[36] (a web-based software for screening and data extraction) to screen for eligible articles. Two reviewers (A.B.T. and H.L.H.) independently screened articles, and disagreements were resolved by discussion. As calculated by Covidence, our proportionate agreement was as follows: title/abstract, 0.91 (Cohen $\kappa$, 0.82); and full text, 0.79 (Cohen $\kappa$, 0.47). After securing the final number of studies to be included in our umbrella review, data

were extracted by 2 reviewers (A.B.T. and H.L.H.). The Joanna Briggs Institute data extraction tool for umbrella review was used, and data related to study details, search details, appraisal instruments, and analysis were extracted.[23]

### Methodological Quality

The quality of the included systematic reviews was assessed using Assessing the Methodological Quality of Systematic Review (AMSTAR) version 2 tool,[37] a modified version of the AMSTAR tool.[38] The AMSTAR tool was established to evaluate systematic reviews of randomized trials. However, AMSTAR 2 is designed to evaluate "systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both."[37] AMSTAR 2 has 16 items in total, with 7 critical and 9 noncritical domains. The overall confidence was rated as high quality (if the review had no weakness or had only 1 noncritical weakness), moderate quality (if there were ≥2 noncritical weaknesses), low quality (if the review had only 1 critical weakness without considering noncritical weaknesses), or critically low quality (if there were ≥2 critical weaknesses with or without noncritical weaknesses). Further information about the critical and noncritical domains and the rating of the overall confidence is available elsewhere.[37] Two reviewers (A.B.T. and H.L.H.) assessed independently, and disagreements were resolved through discussion.

## DATA SYNTHESIS AND STATISTICAL ANALYSIS

The general characteristics of the included systematic reviews with or without meta-analyses were presented descriptively. We narrated our findings qualitatively based on themes of SDoH. For systematic reviews without meta-analysis, association between a SDoH characteristic and CVD was presented graphically with distinct highlighting for the presence, absence, or inconsistent associations (Figure S1). For systematic reviews with meta-analysis, the exposure of interest, author and year, number of primary studies that contributed to the meta-analysis, pooled effect size, and heterogeneity ($I^2$) were presented using forest plots (Figures S2 through S8).

The overall effects of a specific SDoH characteristic on CVD and CVD mortality were summarized and reported. Although we retained the terminology used by the authors of the included systematic reviews, we grouped CVD outcomes according to the *International Classification of Diseases, Tenth Revision, Clinical Modification* (*ICD-10-CM*), codes[39] to increase interpretability. Finally, because of the high heterogeneity of the included meta-analyses, insufficient data, limited number of meta-analyses per subtypes of CVD, different effect size measures used, and the necessity of considering overlapping articles that was not feasible in this review, we did not conduct statistical pooling and assess credibility of evidence using the preexisting criteria.[40]

### Amendments Since the Protocol

Initially, we aimed to assess all domains of SDoH and their effect on CVD and CVD mortality. However, the health and health care domain was removed, with the exception of health literacy, because health care quality and accessibility is a broad concept that varied between different countries and conditions. Also, the theme of education access and quality was amended to merge education into the economic circumstance theme because it is highly related to economic status and to create early childhood development as a standalone theme.

In the protocol, we stated whether to include systematic reviews with or without meta-analysis. However, because there was not enough information to address our objective and assess the methodological quality, abstract-only systematic reviews were excluded.

We had the plan to use ASRreview software (a machine learning tool) for article screening,[41] which is helpful for screening eligible articles at the title and abstract stage only. However, we found Covidence to be better for screening eligible studies at the title and abstract screening as well as full-text screening stages. We also planned to stratify our findings based on sex and age. Unfortunately, there were no reviews specific to children/youths (almost all were among adults, and some did not report the age group), and almost all reviews did not report the findings based on sex. It was also difficult to report our findings based on countries, such as low-, middle-, and high-income countries (as initially planned), because reviews have no clear demarcation.

## RESULTS

### Screening Result

A total of 17 132 studies were identified using the 7 databases (Figure 2). After the removal of duplicates (n=5867), 11 265 studies underwent title and abstract screening, and 286 studies proceeded to full-text review. Of these, 5 studies[42–46] were translated into English because they were published in other languages. Finally, from database searching, 63 studies were identified as eligible. The excluded articles (and the reasons for exclusion) at the full-text screening stage are provided in Table S3. From references of the retrieved articles and through conducting a hand search using Epistemonikos, we identified an additional 7 eligible studies.[47–53] Therefore, a total of 70 studies were included.

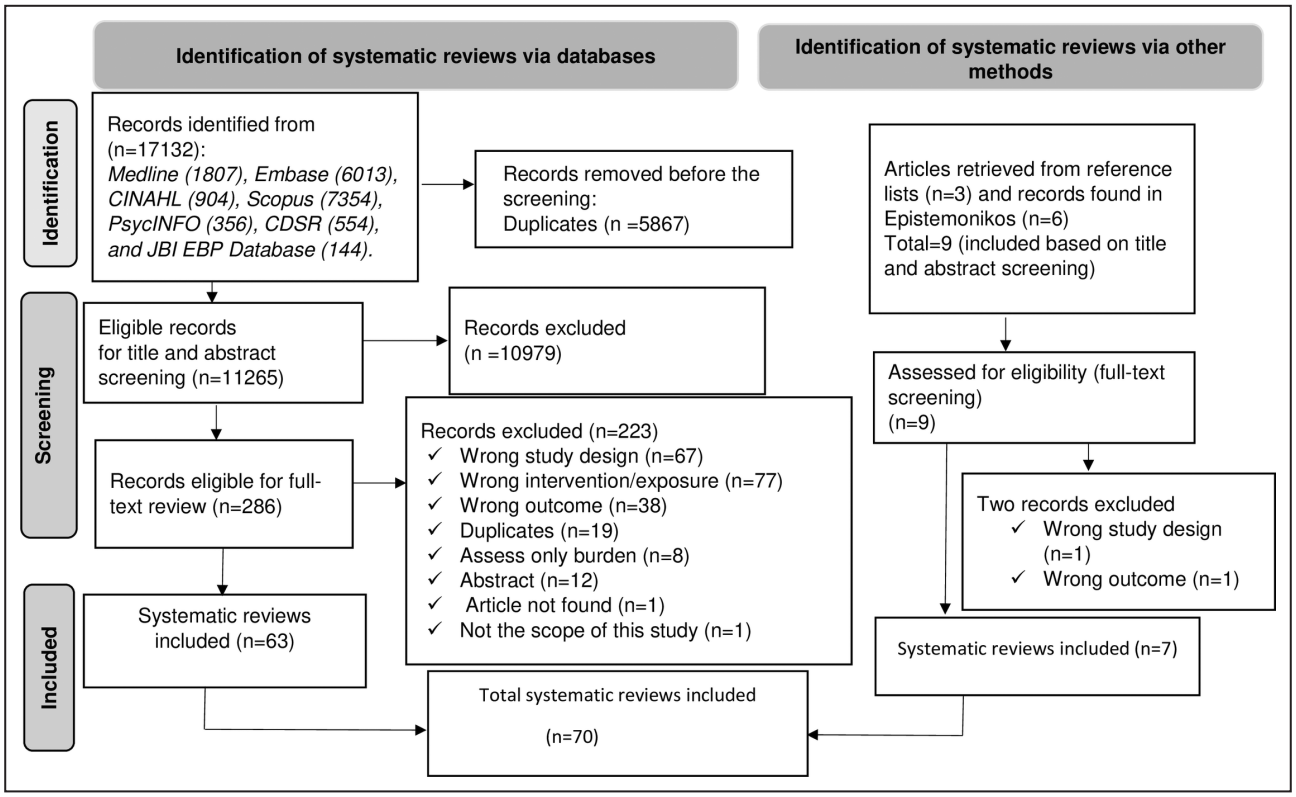


**Figure 2. Flow diagram for selection of studies adapted from the Preferred Reporting Items for Overviews of Reviews flow diagram.**
CDSR indicates Cochrane Database of Systematic Reviews; and JBI, Joanna Briggs Institute.

## General Characteristics of the Included Reviews

Of the 70 reviews, 30 (43%) included a meta-analysis. Ten reviews did not report information about the country of the included studies. Of those that did report, most of the reviews included studies from at least 2 countries. However, 11 reviews included studies from a single country: 9 reviews from the United States,[49,50,54–60] 1 review from South Korea,[61] and 1 review from Australia.[47] Most (n=39; 56%) of the reviews were published in the past 5 years, with 24 (24%) published in the past 2 years. There were 1,[62] 3,[62–64] and 7[53,62–67] reviews published before 2000, 2005, and 2011, respectively. Nine (13%) of the review authors implemented 1 database search, whereas most authors used ≥2. Cohort study design was the most frequently used in the primary studies included in each review. The general characteristics of the included reviews are found in Table S4.

## Description of the Identified Reviews per Themes of SDoH

Of the 70 reviews identified, the greatest proportion included components of social and community context (33%) and economic circumstance (32%), followed by early childhood development (18%) and neighborhood and built environment (17%). Few reviews assessed >1 theme; for instance, 4 reviews assessed both economic circumstance and social and community context themes (Figure 3). The number of reviews per each SDoH characteristic is presented in Table 1.

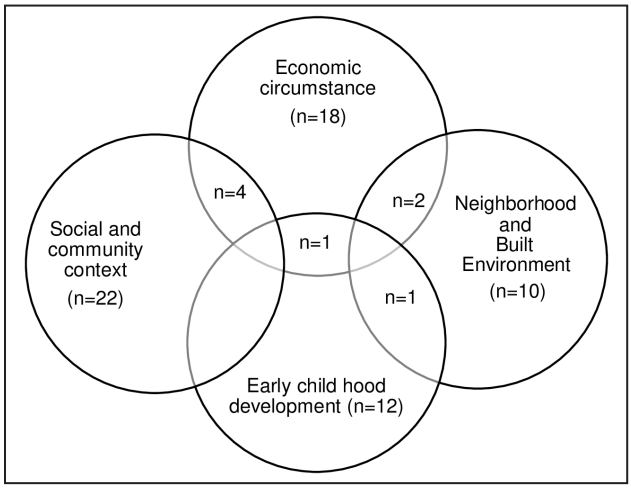


**Figure 3. Graphical presentation of the identified reviews per themes/domains of social determinants of health.**

**Table 1. Number of Systematic Reviews by SDoH Characteristic**

| SDoH characteristic | Total (reference) | Without meta-analysis (reference) | With meta-analysis (reference) |
|---|---|---|---|
| 1. Economic circumstance | 25[24,42,43,57,61,62,66,71–88] | | |
| Composite socioeconomic status | 9 | 6[24,42,43,61,74,75] | 3[71–73] |
| Education | 11 | 4[61,62,82,83] | 7[71,76–81] |
| Occupation | 10 | 5[61,62,82–84] | 5[71,76,77,79,81] |
| Income | 9 | 3[42,61,82] | 6[71,76,77,79–81] |
| Job insecurity | 4 | 3[66,86,87] | 1[85] |
| Homelessness or household instability | 2 | 1[57] | 1[88] |
| Food insecurity | 1 | 1[57] | … |
| 2. Social and community context | 26[25,42,47,50,51,55,56,58,60,63,66–69,75,87,89–98] | | |
| Poor/lack of social support | 7 | 3[63,66,67] | 4[67,68,89,90] |
| Loneliness, social isolation, or both | 3 | 2[60,91] | 1[25] |
| Social capital | 4 | 3[92–94] | 1[58] |
| Discrimination | 1 | 1[56] | … |
| Ethnicity and race | 11 | 4[42,50,75,98] | 7[47,51,55,69,95–97] |
| 3. Early childhood development | 14[48,52,53,64,65,78,99–106] | | |
| Early childhood socioeconomic status | 7 | 6[64,65,99–102] | 1[78] |
| Early childhood adverse events | 8 | 3[48,102,106] | 5[52,53,103–105] |
| 4. Neighborhood and built environment | 13[26,49,54,59,70,77,81,106–111] | | |
| Violence during adulthood | 6 | 5[54,59,106,108,109] | 1[107] |
| Conflict | 1 | 1[70] | … |
| Environmental attributes | 2 | 2[49,110] | … |
| Neighborhood socioeconomic status | 4 | 1[26] | 3[77,81,111] |

SDoH indicates social determinants of health.

## Measurement of Variables Under SDoH: Evidence From the Included Reviews

The methods used to measure the variables under each SDoH are summarized in Table S5. In most of the reviews, there was no information about the cut points that were used to categorize variables under SDoH as high, low, good, or poor, and they likely differed across primary studies and reviews. Despite the different cut points that may exist, for our review, we used the categories/terms, such as high and low, made by the author of the included reviews.

## Outcome Measures

Different reviews reported different CVD outcomes. Even a single review could report many CVD subtypes. For this umbrella review, we used the definition CVD, or subtype, given by the authors. In addition, we included all CVD measurements, including self-report, record (such as from hospital and death registries), imaging, or diagnosis based on clinical examination. If the included review reported CVD (either by including at least 2 CVD subtypes or without mentioning the subtype), we considered it as composite CVD.

## Assessment of Quality

According to the AMSTAR 2 tool, 77% (n=54) of the reviews were identified as critically low quality and 20% (n=14) of the reviews were identified as low quality (Table S6). Only one review[68] was graded as medium quality, and one review[69] was graded as high quality.

As for the critical domains of the AMSTAR 2 tool, only 4 reviews (6%) reported a list of excluded studies. Sixteen reviews (23%) had a registered protocol. A third of review authors (33%) incorporated the risk of bias while interpreting or discussing the results of their review. Most review authors used a comprehensive literature search strategy (59%; n=41), and used a satisfactory technique to assess the risk of bias in individual studies (56%; n=39).

For the noncritical domains of the AMSTAR 2 tool, only one review[70] reported the funding source for the included primary studies. In most (84%; n=59) of the reviews, the reason for the selection of study designs was not explained. Study selection and data extraction were conducted in duplicate in only 44% (n=31) and 25% (n=18) of reviews, respectively. Three-fourths (76%; n=53) of the reviews provide satisfactory explanations and discussion about the heterogeneity observed in the results of the study.

## Summary Findings

A thorough narration of the findings is found in Data S1 with additional display of reviews without meta-analyses (Figure S1) and with meta-analyses (Figures S2 through S8) separately. Here, we compiled and condensed the findings from reviews with and without meta-analysis (Table 2).

## Factors Relating to Economic Circumstance and CVD

Composite SES[24,42,43,61,71–75]: Lower composite SES was associated with a higher risk of composite CVD[61] and CVD mortality.[24] Besides, it was associated with an increased risk of CVD subtypes, like stroke[24,73] and mortality attributable to stroke,[71] coronary heart disease,[24] heart failure,[74] heart disease,[43] myocardial infarction,[24] and cardiomyopathy.[42] However, the association between composite SES with atrial fibrillation was inconsistent.[75] Subjective social status (adjusted for objective statuses) was not associated with coronary heart disease.[72]

Education[61,62,71,76–83]: In almost all reviews, lower education level was associated with a higher risk of CVDs (composite CVD,[80,81] stroke, coronary heart disease,[80,81] myocardial infarction,[79] and ischemic heart disease[61,62]) and CVD mortality (mortality attributable to composite CVD[76,80] and stroke[71]). However, in 2 reviews,[82,83] education was not consistently associated with composite CVD[83] and atrial fibrillation.[82]

Income[42,61,71,76,77,79–82]: In most of the reviews, lower level of income was associated with CVD.[42,61,71,77,79,80] It was associated with higher risk of coronary heart disease,[80] heart failure,[77] myocardial infarction,[61,79] cardiomyopathy,[42] stroke (borderline significant),[80] and stroke mortality.[71] Of the 3 reviews that assessed the association between income and composite CVD mortality, 2 reported existence of association,[61,80] and the other one[76] found no association. A low income level was not constantly linked to atrial fibrillation.[82]

Occupation[61,62,71,76,77,79,81–84]: Low occupation level was associated with a higher risk of composite CVD[61,81,84] and CVD mortality.[61,84] Specific to CVD subtypes, occupation was associated with a higher risk of heart failure,[77] myocardial infarction,[61,79] ischemic heart disease,[62,84] angina,[61] atrial fibrillation,[82] stroke,[61,84] and stroke mortality.[71] There was no association between lower occupation and stroke and coronary heart disease in one review that assessed the effect in men and women separately.[81] In addition, in one review,[83] occupation was not consistently associated with composite CVD.

Job insecurity[66,85–87]: There were only a few systematic reviews assessing job insecurity with CVD, and these fell within the *ICD-10-CM* code of ischemic heart disease. In general, the association between job insecurity and coronary/ischemic heart disease was not consistent.[66,86,87] Only one review reported a modest association between perceived job insecurity and incident coronary heart disease.[85]

Homelessness, household instability, or both[57,88] was associated with a higher risk of composite CVD[57,88] and composite CVD mortality.[57] However, household instability was inconsistently associated with stroke[57] and was not associated with heart disease,[57] ischemic heart disease,[57] and mortality attributable to cardiomyopathy.[57]

Food insecurity[57] was associated with an increased risk of CVD (composite CVD, coronary heart disease, myocardial infarction, and heart failure) and composite CVD mortality.

## Factors Relating to Social and Community Context and CVD

Poor/lack of social support[63,66–68,87,89,90] was associated with a higher risk of myocardial infarction,[66] but there was no association with composite CVD[68] or CVD mortality.[67] Furthermore, there were inconsistent relationships with stroke[68,89] and ischemic[66,87,90]/coronary heart disease.[63,68] In the one review that conducted a separate analysis for men and women,[90] social support was not associated with ischemic heart disease.

Loneliness, social isolation, or both[25,60,91]: High loneliness and social isolation were associated with an increased risk of stroke.[25,60,91] However, there was an inconsistent relationship between loneliness and heart disease subtypes.[25,60,91]

Social capital[58,92–94]: Low social capital index, measured by both social network and social cohesion, was associated with higher mortality attributable to ischemic heart disease[94] and coronary heart disease,[94] but not stroke[94] and mortality attributable to composite CVD.[93,94] Low social network was associated with a higher risk of composite CVD mortality.[58] Considering CVD subtypes, social network had no association with stroke[58] and coronary heart disease.[58] As for social cohesion, perceived social cohesion was not associated with stroke and coronary heart disease.[58] Moreover, fewer social roles were linked to higher composite CVD and composite CVD mortality.[92]

Discrimination[56]: Lifetime perceived racial discrimination was associated with a higher risk of composite CVD, myocardial infarction, stroke, and angina. It was also associated with a higher risk of mortality attributable to composite CVD.

Ethnicity and race[42,47,50,51,55,69,75,95–98]: There were racial and ethnic differences in CVD and CVD mortality. For instance, mortality attributable to ischemic heart disease was lower among Afro-Caribbean compared with White individuals,[98] Hispanic Americans had reduced risks of composite CVD, coronary heart disease, stroke, and heart failure than White people,[69] and Chinese individuals had a lower risk of coronary artery disease compared with White and South Asian

**Table 2. Summary of Findings: Systematic Reviews Assessing the Association Between SDoH and CVD Outcomes (n=70)**

| SDoH | CVD outcomes (based on *ICD-10*: I00–I99)* | | | | | | |
|---|---|---|---|---|---|---|---|
| | CVD (composite or unspecified) | | Cerebrovascular disease | | Ischemic heart disease | | |
| | Composite cardiovascular disease | Composite cardiovascular disease mortality | Stroke | Stroke mortality | Coronary artery/ heart disease | Coronary artery/ heart disease mortality | ischemic heart disease |
| Theme 1: economic stability | | | | | | | |
| Low composite socioeconomic status[24,42,43,61,71–75] | +(1) | +(1) | +(2) | +(2) | +(1), ±(1) | | |
| Low education[61,62,71,76–83] | +(3), ±(1) | +(2) | +(4) | +(1) | +(3) | | +(2) |
| Low income[42,61,71,76,77,79–82] | n(1) | +(1), n(1), +(1) | +(1) | +(1) | +(1) | | |
| Lower occupation level[61,62,71,76,77,79,81–84] | +(4), ±(1) | +(2), n(1) | +(2), n(2) | +(1) | n(2) | | +(1) |
| Job insecurity[66,85–87] | | | | | +(1), n(1) | | ±(1), n(1) |
| Homelessness[57,88] | +(2) | +(1) | ±(1) | | | | |
| Food insecurity[57] | +(1) | +(1) | | | +(1) | | |
| Theme 2: social and community context | | | | | | | |
| Low/poor social support[63,66–68,87,89,90] | n(1) | n(1) | +(1), n(1) | | +(1), n(1) | | +(2), n(2) |
| Loneliness and social isolation[25,60,91] | | | +(3) | | +(2) | | n(1) |
| Low social capital index[93,94] | | n(2) | n(1) | | | +(1) | |
| Social capital (few social roles)[92] | +(1) | +(1) | | | | | |
| Social capital index (low social network)[58] | | +(1) | n(1) | | n(1) | | |
| Social capital index (low social cohesion)[58] | | | n(1) | | n(1) | | |
| Discrimination[56] | +(1) | +(1) | +(1) | | | n(1) | |
| Disparities in ethnicity and race[42,47,50,51,55,69,75,95–98] | +(1), ±(1), n(1) | +(1) | ±(1), n(1) | | +(3), n(1) | | +(1), ±(1) |
| Theme 3: early childhood development | | | | | | | |
| Childhood socioeconomic disadvantage[64,65,78,99–102] | +(1) | +(1) | +(3) | +(2) | +(1), ±(1) | +(1) | |
| Adverse childhood events[48,52,53,102–106†] | +(5) | | +(2), n(1) | | + | | +(4) |
| Theme 4: neighborhood and built environment | | | | | | | |
| Violence during adulthood[54,59,106–109] | +(3), n(1) | | ±(1), n(1) | | ±(1) | | |
| Conflict[70] | | | ±(1) | n(1) | | | n(1) |
| Adverse environment[49,110‡] | | | +(2) | | +(1), n(1) | | |
| Neighborhood socioeconomic disadvantage[26,77,81,111] | +(2) | +(2) | +(2), n(1) | | +(2) | | |

The numbers in the parentheses indicate the number of reviews. + Indicates poorer/worse social determinant associated with an increased risk of CVD outcome (poorer SDoH→worse CVD outcome); ±, an approximately equal number of null and increased risk findings. CVD indicates cardiovascular disease; *ICD-10*, *International Classification of Diseases, Tenth Revision*; n, null/no association; and SDoH, social determinants of health.

*World Health Organization. *ICD-10*. 2019. I00 to I99 indicate diseases of the circulatory system.

†Childhood adverse events, such as lower childhood cumulative adverse events and adverse events specific to abuse, neglect, and violence.

‡Inaccessibility of health care facilities, environmental noise, proximity to a major road/high traffic density, high crime rate, reduced access to food stores and parks/recreation, and increased access to fast-food restaurants.



individuals.[97] Furthermore, compared with White and White European individuals, Asians had a lower risk of peripheral arterial diseases.[47,96]

## Factors Relating to Early Childhood Development and CVD

Lower childhood SES[64,65,78,99–102]: Lower childhood SES was associated with a higher risk of composite CVD[65,102–104] and stroke[78,101,102] in later life. However, childhood SES had a less consistent association with coronary heart disease,[100,102] heart failure,[101] and heart disease.[99] As for mortality, lower childhood SES was associated with a higher risk of mortality attributable to composite CVD,[64] stroke,[64] and coronary heart disease.[64]

Adverse childhood events[48,52,53,102–106]: Adverse childhood events were associated with a higher risk of later-life composite CVD,[53,102–104,106] coronary heart

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|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Other forms of heart disease | | | | | | Diseases of arteries |
| Ischemic heart disease mortality | Myocardial infarction | Mortality due to myocardial infarction | Angina | Heart Failure | Heart disease | Heart disease mortality | Atrial fibrillation | Cardiomyopathy | Mortality due to cardiomyopathy | Peripheral arterial disease |
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disease,[102] heart failure,[102] myocardial infarction,[105] and ischemic heart disease.[48,52,53,106] However, they had an inconsistent association with stroke.[102,103]

## Factors Relating to Neighborhood and Built Environment and CVD

Violence during adulthood[54,59,106–109]: Violence was associated with a higher risk of composite CVD,[54,107–109] but had inconsistent association with CVD subtypes: stroke,[59,106] coronary heart disease,[106] heart failure,[106] and myocardial infarction.[59,106]

Conflict[70]: There was an association between conflict and an increased risk of mortality from ischemic heart disease and heart disease. However, it had an inconsistent association with the occurrence of stroke and heart disease. In addition, there was no association between conflict and myocardial infarction,

ischemic heart disease, angina pectoris, and mortality attributable to stroke.

Environmental attributes[49,110]: Environmental attributes (proximity to a major road, reduced access to food stores, no recreational areas, increased access to fast-food restaurants, far from a health care facility, and high traffic density) were associated with a higher risk of coronary heart disease,[110] myocardial infarction,[110] heart failure,[110] stroke,[49,110] and angina.[110] However, food environments, assessed among adults with low SES, such as access to grocery stores and fast-food restaurants, were not associated with coronary heart disease.[49]

Neighborhood SES[26,77,81,111]: Lower neighborhood SES was associated with a higher risk of composite CVD,[81] stroke,[81] coronary heart disease,[81] heart failure,[77] and composite CVD mortality.[111] However, in one review,[26] neighborhood SES was not associated with stroke.

# DISCUSSION

This umbrella review provides a comprehensive overview of the current evidence of the role of SDoH in CVD, including mortality attributable to CVD. We identified 70 eligible systematic reviews, of which 30 undertook meta-analyses. Overall, there was evidence that lower or worse SDoH characteristics in the 4 themes of SDoH (economic circumstance, social and community context, early childhood development, and neighborhood and built environment) were associated with CVD and CVD mortality.

However, our review also identified areas within the 4 SDoH themes that were understudied and warranted further study. In particular, we only identified 2 systematic reviews assessing homelessness or household instability as well as environmental attributes and their association with CVD. In addition, we only identified single systematic reviews that assessed the role of food insecurity, conflict, or discrimination in regard to CVD. We did not also identify any systematic reviews that examined the association between health literacy and CVD.

## Economic Circumstance

This umbrella review provided evidence that economic instability is linked with a higher likelihood of CVD and CVD mortality. Most reviews reported the detrimental influence of composite SES, education, income, occupation, and homelessness on CVD. Food insecurity was also associated with CVD, despite the fact that the finding was from a single systematic review. Our findings are in line with the Health Evidence Network Synthesis Report,[112] which revealed that SDoH is a contributor to health and health disparities, and identified the 4 overarching policy themes: enhancing early child development, promoting fair employment and decent work, providing social protection, and improving living environment.

Several pathways are possible for the association between economic instability and CVD.[7] Economic instability can lead to chronic stress, which, in turn, stimulates the sympathetic nervous system and the adrenal cortex and then results in an increased level of stress hormones, such as catecholamines, independent predictors for the development of CVD.[7,113,114] People with economic instability could have more trouble getting medical care in a timely manner and paying for their prescription medications, especially if they have to pay out of pocket.[115–118] It may also be attributable to the mediating role of conventional CVD risk factors, such as high blood pressure and diabetes, because they are unlikely to be treated efficiently and promptly among economically instable individuals.[119] The limited dietary alternatives and basic necessities (food, shelter, and clothing), inadequate sleep quality and quantity, heavy drinking and excessive alcohol intake, and illegal drug use are also more prevalent in people with economic instability, such as homeless people and people with food insecurity, and these might contribute to the high occurrence of CVD.[120] Economically instable people are also forced to eat less-nutritious and high-energy items,[121] with a higher intake of sugar-sweetened beverages and processed meats, and this might result in CVD.[122–124] However, in this theme, we identified inconsistent evidence for the association between job insecurity and CVD. Notably, the reviews were different in scope. For instance, 2 reviews were interested in people working in the formal economy or people at work and observed no association with ischemic heart disease.[86,87] However, the other review was interested in self-reported job insecurity in the general population and observed an association with coronary heart disease.[85] This is in contrast to the notion that job insecurity can induce stress[125] and jeopardize the ability to meet crucial demands, including economic safety and social status, which, in turn, has an impact on CVD.[125–127] We also noted that there was no consistent evidence of an association between composite SES, education, and income with the specific CVD subtype, atrial fibrillation. This is somewhat unexpected and could be because atrial fibrillation is difficult to diagnose and socioeconomically privileged individuals may have the time and financial resources to visit a physician and obtain expensive heart rate monitoring.[128]

## Social and Community Context

This umbrella review found evidence that social role, social isolation, loneliness, ethnicity, and discrimination were associated with a higher risk of CVD. However, there were also reviews in this theme that reported

an inconsistent or null association. For example, social support was not associated with CVD in most reviews, and social capital was not associated with CVD subtypes.

A report from the National Academies of Sciences, Engineering, and Medicine identifies poor social health (particularly social isolation and loneliness) as a CVD risk factor, accounting for a one-third increase in CVD, a 4 times increase in risk of death, and an increased risk of hospitalization and emergency department visits.[129] Preclinical studies also reported a link between a higher level of blood pressure, heart rate, and cortisol levels with social support and social isolation.[130,131] Poor social health also increases the risk of developing CVD through a variety of psychological, physiological, and emotional mechanisms.[19] It is hypothesized that poor social health, such as loneliness, is related to depression, anger, and hostility, as well as reduced buffering of external stressors.[132] The negative psychological exposures can amplify harmful physiological reactions, like activated hypothalamic-pituitary-adrenal axis and elevated levels of inflammatory markers.[7] These inflammatory markers and the cardiometabolic changes in response to stressors that happened because of poor social health, particularly loneliness, could increase blood pressure and result in variability in heart rate.[132,133] People with poor social or community engagement are also more likely to have elevated behavioral CVD risk factors, such as smoking, substance abuse, and low physical activity.[19] Furthermore, poor social health affects people's ability to receive medical support,[134] and this can result in an advanced stage of any disease condition, such as CVD.

The ethnic and racial disparity in CVD has been attributed to population differences in societal factors (including discrimination), which impact substantially on people's health.[135] Notably, our umbrella review is limited as we were unable to make generalizations based on the terminology of ethnic and racial groups described by the review authors. For example, individuals who identified as Black in terms of race may also identify as Hispanic in terms of ethnicity, and many studies did not define specific racial or ethnic groupings in this way.

## Early Childhood Development

In this umbrella review, adverse childhood experiences, including cumulative adverse events, adverse events specific to abuse and neglect, and lower SES, were associated with an increased risk of later-life CVD.

This is in line with a report by Child Welfare Information Gateway[136] explaining that the disruption of neurodevelopment attributable to early childhood adverse experiences increases the risk for the following: (1) physical health consequences, such as diabetes, stroke, health attack, malnutrition, and high blood pressure; (2) psychological consequences, such as diminished cognitive skills, poor mental and emotional health, posttraumatic stress, and social difficulties; and (3) behavioral consequences, like engaging in aversive and self-destructive behaviors, like smoking and substance abuse. Our finding also agrees with the aforementioned health evidence network synthesis report[112] and with a guideline that urges early access to supporting services for children to help them reach their full potential later in life and avoid serious conditions, like CVD.[137] Unfavorable early childhood experiences may also hinder regular emotional and psychosocial development and increase susceptibility to a range of behavioral, mental, and physical health difficulties in later life, which, in turn, raises the risk of CVD. For instance, it has been demonstrated that exposure to extremely stressful events during childhood can result in engaging in aversive and self-destructive behaviors, like substance abuse, physical inactivity, sleep disorder, and early-onset obesity and type 2 diabetes.[138–141] It can also be rationalized by the possibility that negative childhood experiences led to an increased carotid intima-media thickness, one of the most prevalent CVD biomarkers,[142] as well as alterations in nervous, neuroendocrine, and immune systems that undergo age-dependent maturation.[141,143,144] These systems are important for stress regulation. However, adverse experiences could result in chronic stress and, in turn, result in activation of the hypothalamic-pituitary-adrenal axis and then dysregulation and excessive release of glucocorticoid hormones, such as cortisol.[145] Through the above mechanisms, unfavourable childhood experiences could harm several physiological systems, including the cardiovascular system, in later life.[141]

## Neighborhood and Built Environment

There was evidence that poor neighborhood SES, violence (for composite CVD), and environmental attributes were associated with an increased risk of CVD. Notably, the evidence for environmental attributes was for CVD subtypes, except stroke mortality, in which the finding was inconsistent, highlighting the opportunity for a composite CVD systematic review. However, there was inconsistent evidence for the role of violence and conflict in CVD subtypes.

Our finding of neighborhood socioeconomic disadvantage being associated with CVD is aligned with a study by Gary-Webb et al[146] that identified living in neighborhoods with socioeconomic disadvantage is associated with poorer health status (physical health, mental health, and global health composite scores). Similarly, the aforementioned health evidence network synthesis report revealed that living environment is an important factor for health and health inequality.[112]

Living in a socially deprived neighborhood is associated with increased stress and poorer lifestyle factors (smoking, physical inactivity, and unhealthy diet), which all increase the of risk of CVD.[147] This is aligned with our finding for environmental attributes, especially food environments, and CVD. It has been commonly claimed that the accessibility of affordable, culturally appropriate, healthful foods close to people's places of residence and workplaces influences food choices, which, in turn, affects CVD risk factors and outcomes.[148] Hence, a study on food environment policy implementation recommends an urgent need of tackling the burden of obesity and diet-related noncommunicable diseases through prioritizing actions toward healthy food environments.[149]

## Strengths and Limitations

This is the first umbrella review to assess the role of SDoH in CVD. We comprehensively reviewed the evidence by incorporating 4 themes of SDoH, including health literacy in the health and health care domain. All CVD outcomes, including subtypes and mortality, were assessed. Furthermore, our findings are based on systematic reviews, which rank first in the hierarchy of evidence.

All interpretations should be used with caution, however, as this umbrella review does have some limitations. First, except for 2 reviews (1 medium quality[68] and 1 high quality[69]), all reviews were graded as low and critically low quality based on the AMSTAR 2 quality assessment tool. Reviews with inadequate methods are difficult to understand, tend to overestimate the overall treatment effect, and may draw the wrong conclusions. Second, the terminology and measurement of SDoH factors within and between reviews varied greatly. As social determinants can be context specific (relating to a time or place), measurement recommendations similar to biological factors, such as blood pressure, cannot necessarily be created. However, research translation could be improved by SDoH factors being clearly defined and tested in sensitivity analyses. Third, we identified several SDoH factors; however, SDoH is abroad concept, and there are likely other SDoH factors that should be considered. It is also unlikely that one systematic review (eg, there was only one systematic review for conflict) would provide strong and enough evidence to saturate SDoH areas, as researchers bring a different lens to research that is reflected in eligibility criteria, outcomes, and interpretation of findings. Also, the lack of or few systematic reviews likely demonstrate a lack of primary studies and the need for further research. Fourth, primary studies may have been included in >1 review, and it was not feasible to assess this. Fifth, although most reviews in the economic circumstance theme report the absence of publication bias, most reviews in other themes report that there was a publication bias or did not report any information about publication bias, which limits the interpretation of our findings. Sixth, given the nature of the topic, the systematic reviews predominantly included observational studies with few randomized controlled trials, and observational studies are more prone to bias and confounding. For example, in our review, economic circumstance may influence the neighborhood that the person lives in. Therefore, it is difficult to distinguish the contribution of each factor, or SDoH in this case, even if analyses have controlled for potential confounders. We acknowledge that the individual studies had differences in populations and comparison groups as well, and these differences could help explain the somewhat inconsistent findings. Despite these differences, overall, we found evidence that SDoH are important contributors to CVD and CVD mortality. These differences between included reviews also increase the generalization of our findings and could be considered a strength of this umbrella review. Last, because studies in the included systematic review are observational, there may be survival bias. That is, those in the most impoverished or worse SDoH may have died at an early age because of these impoverished conditions and were not considered in the study. In addition, there might be healthy volunteer bias; people with existing medical conditions are less likely to volunteer and participate in epidemiological studies. Therefore, our results may be influenced by survival bias and the healthy volunteer effect; the first is especially relevant for the early childhood development theme.

## Implications for Practice

There is an urgent need to focus on implementing cost-effective policies and interventions to reduce premature mortality attributable to noncommunicable disease.[1] The World Health Organization has a sustainable development goal (number 3, target 4) of reducing premature mortality attributable to noncommunicable diseases by a third by 2030.[150] CVD is by far the most common noncommunicable disease[151]; therefore, efforts to reduce CVD will likely have the greatest impact.

This umbrella review provides simple yet comprehensive evidence about the roles of SDoH in CVD outcomes and demonstrates that the massive burden of CVD could be lessened by recognizing and addressing unfavorable SDoH. Our evidence suggests the importance of taking a system view of risk factors for CVD. The breadth of SDoH factors linked with CVD identified in this umbrella review along with the interconnections that are known to exist between these SDoH factors (and other CVD risk factors) imply that addressing one factor in isolation is unlikely to make much difference. There is a need for policies and interventions to take a holistic and integrated approach, tackling SDoH at macro and meso levels, and considering the knock-on

consequences that changes in one factor will have in others. A complex adaptive systems approach with interconnected policies across each of the 4 theme areas we identified, as well as the health and health care theme, would greatly benefit health and well-being across many domains.

More immediately, this evidence can be used to inform the development of CVD prevention interventions, as well as selection of targeted subpopulations to increase the impact of such interventions. The evidence found could be used by policy makers and health care professionals to set appropriate guidelines and policies and to improve patient outcomes through nonmedical interventions, such as social prescribing.[152] Because SDoH are currently overlooked in predicting health outcomes, including CVD,[153–156] and because our review identified that SDoH factors have a role in CVD and CVD mortality, we recommend that future clinical CVD prediction models should include the SDoH.

## CONCLUSIONS

This comprehensive umbrella review provides overwhelming evidence that SDoH are important contributors to CVD and CVD mortality. We identified consistent evidence that economic circumstance and early childhood development themes play a role in CVD and CVD mortality. Specifically, we identified evidence that childhood adverse events, childhood abuse or neglect, childhood SES, neighborhood SES, violence, environmental attributes, education, income, occupation, food insecurity, homelessness, composite SES, social role, social isolation, loneliness, ethnicity, and discrimination play roles in CVD and CVD mortality. However, as we only identified 1 or 2 systematic reviews assessing homelessness or household instability, food insecurity, neighborhood conflict, environmental attributes, or discrimination with CVD, further studies and synthesis are required. In addition, we identified a complete lack of evidence synthesis for health literacy with CVD or CVD mortality.

Although our findings are constrained by the included reviews' low methodological quality, the implications of our findings are clear; we provide evidence that detecting and addressing SDoH will likely benefit CVD risk factors and outcomes. This evidence should be used to inform CVD prevention policies and interventions through each stage of development, including selection of targeted subpopulations. Given that the identified SDoH factors are interconnected with each other and other CVD risk factors, our evidence suggests the importance of taking a system view with a holistic and integrated approach. Furthermore, incorporating SDoH into CVD risk prediction models could be helpful to set nonmedical interventions and to lower the social inequities in health.

## ARTICLE INFORMATION

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None.

### Supplemental Material

Data S1
Tables S1–S6
Figures S1–S8

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155. Lans A, Kanbier LN, Bernstein DN, Groot OQ, Ogink PT, Tobert DG, Verlaan JJ, Schwab JH. Social determinants of health in prognostic machine learning models for orthopaedic outcomes: a systematic review. *J Eval Clin Pract*. 2023;29:292–299.
156. Hammond G, Johnston K, Huang K, Joynt Maddox KE. Social determinants of health improve predictive accuracy of clinical risk models for cardiovascular hospitalization, annual cost, and death. *Circ Cardiovasc Qual Outcomes*. 2020;13:e006752. doi: 10.1161/CIRCOUTCOMES.120.006752

# Supplemental Material

**Data S1.**

## Supplemental Results: Full narration of findings

### Factors relating to economic stability and CVD

**Composite SES:** Findings from systematic reviews without meta-analysis showed that lower composite SES was associated with a higher risk of composite CVD[61] and mortality from CVD.[24] When examined by subtype of CVD, lower composite SES was associated with a higher risk of stroke,[24] coronary artery disease,[24] heart failure,[74] heart disease,[43] myocardial infarction,[24] and cardiomyopathy.[42] Of the systematic review without meta-analysis findings, only a study by Allan et al.[75] reported an inconsistent relationship between lower SES and atrial fibrillation (**Figure S1**). Of the three systematic reviews with meta-analysis,[71-73] two of them reported that lower composite SES was associated with a higher risk of stroke[73] (pooled hazard ratio (HR)=1.31; 95%CI: 1.16, 1.48, $I^2$= 48% and p = 0.02) and stroke mortality[71] (pooled RR=1.31; 95%CI: 1.16, 1.48, $I^2$=69.5% and p=0.001). Besides, the overall lower SES (combined education, occupation, income, and composite SES), as compared with the higher SES, was associated with a higher risk of stroke mortality[71] (pooled OR=1.39 (95% CI, 1.31, 1.48, $I^2$ = 89.9% and p= 0.001). The other systematic review with meta-analysis reported that subjective social status, adjusted for objective socioeconomic status, was not significantly associated with coronary artery disease (pooled odds ratio (OR)=1.12; 95%CI: 0.52, 2.16, $I^2$=0.0% and p=0.509).[72]

**Education:** Two systematic reviews without meta-analysis found an inconsistent association between education and composite CVD[83] and atrial fibrillation,[82] and two systematic reviews without meta-analysis[61, 62] revealed that the risk of ischemic heart disease was higher among lower education group (**Figure S1**). When we take into account systematic reviews with meta-analysis, two of them (one meta-analysis[81] reported a separate effect size for male and female) indicated that having a lower educational level was significantly associated with composite CVD, pooled OR ranges from 1.2-1.50.[80, 81] Lower education level was also significantly associated with a higher risk of composite CVD mortality,[76, 80] stroke[78, 80, 81] and stroke mortality[71], coronary artery disease,[80, 81] and acute myocardial infarction[79] (**Figure S2**).

**Occupation/employment:** In all systematic reviews without meta-analysis, except one that showed a non-significant association between occupation and composite CVD,[83] lower occupation or unemployment status was significantly associated with higher risks of composite CVD[61, 84] and CVD mortality,[61, 84] angina pectoris,[61] acute myocardial infarction,[61] stroke,[61, 84] ischemic heart disease,[62, 84] and atrial fibrillation[82] (**Figure S1**). As shown in the forest plot (**Figure S3**), the results of systematic reviews with meta-analysis evaluated that

having lowest occupation level was associated with CVD and CVD mortality (effect estimates >1 in all studies). The findings were significant in five studies and they all revealed increased risk of composite CVD,[81] stroke mortality,[71] acute myocardial infarction,[79] and heart failure[77] among people with the lower occupational status (**Figure S3**).

**Income:** Two systematic reviews without meta-analysis found an increased risk of composite CVD mortality,[61] myocardial infarction,[61] and cardiomyopathy.[42] However, one systematic review without meta-analysis found an inconsistent finding for an association between a lower level of income and the risk of atrial fibrillation[82] (**Figure S1**). Looking at the findings from systematic reviews with meta-analysis, all revealed that lower income level was associated with higher risks of CVD. Of these, the majority found a significant association. A lower level of income was significantly associated with a higher risk of CVD mortality[76, 80] and stroke mortality,[71] risk of stroke (borderline significant),[80] coronary artery disease,[80] acute myocardial infarction,[79] and heart failure[77] (**Figure S4**).

**Job insecurity:** Two systematic reviews without meta-analysis found a non-significant high risk, as well as insufficient evidence of association between job insecurity and ischemic heart disease.[66, 86] One systematic review without meta-analysis also found a non-significant positive association between self-reported job insecurity at baseline and incident coronary heart disease[87] (**Figure S1**). Besides, a finding from one systematic review with meta-analysis (the only identified meta-analysis) revealed a modest association between perceived job insecurity and incident coronary heart disease (pooled relative risk (RR)=1.19; 95%CI: 1.00, 1.42, $I^2$ = 24.6%, and P=0.170).[85]

**Food insecurity and homelessness/household instability:** According to findings from a systematic review without meta-analysis, composite CVD, CVD mortality, heart failure, coronary heart disease, and myocardial infarction were significantly higher among food-insecure individuals.[57] This review also reported an increased risk of composite CVD and CVD mortality, but not significant for CVD subtypes, among individuals with housing insecurity[57] (**Figure S1**). Additionally, a systematic review with meta-analysis[88] found a strong significant positive association between homelessness and composite CVD (pooled OR=2.96; 95%CI: 2.80, 3.13, $I^2$ = 99.1 % and P<0.001).

### Factors relating to social and community context and CVD

**Poor social support:** According to a systematic review without meta-analysis by Barth et al.,[67] low structural social support was not significantly associated with myocardial infarction (RR ranges from 1.01 to 1.2). However, low functional social support was associated with the incidence of myocardial infarction (RR range from 1.00 to 2.23). There was a significantly

higher risk of developing ischemic heart disease among those with lack of social support in both males and females.[66] There was also a higher risks of coronary heart disease among people with lack of social support[63] (**Figure S1**). According to findings from systematic reviews with meta-analysis, lack of social support had no a statistically significant association with composite CVD and CVD mortality.[90] A study by Freak-Poli et al.[68] also revealed a non-significant association between social support and composite CVD, stroke, and coronary heart disease. However, there was a statistically significant association between lack of social support and stroke[66, 89] (**Figure S4**).

**Loneliness and/or social isolation:** High loneliness and social isolation were associated with an increased risk of incident coronary heart disease,[91] heart disease,[60] and stroke.[91, 60] However, a non-significant association between loneliness and mortality from ischemic heart disease was also reported[91] (**Figure S1**). Systematic reviews with meta-analysis, as stated in the forest plot (**Figure S4**), revealed a statistically significant association between social isolation and loneliness and increased risk of coronary heart disease and stroke.[25]

**Social capital (social role, social cohesion, and social network):** According to a systematic review without meta-analysis by Chin et al.,[92] fewer social role were linked to higher composite CVD and CVD mortality. However, there was no statistically significant association between the social capital index (social cohesion and social network) and composite CVD mortality[93, 94] (**Figure S1**). One systematic review with meta-analysis evaluated interpersonal-level resilience resources (social networks) and found that social network was associated with lower odds of stroke, coronary heart disease, and CVD mortality (the finding was significant for CVD mortality only).[57] It also examined neighbourhood-level resilience resources (perceived social cohesion) and found perceived social cohesion as an important factor for lower odds of stroke and coronary heart disease, however, the findings were not statistically significant (**Figure S4**).

**Discrimination:** Only one systematic review without meta-analysis examined the association between discrimination and CVD and found men and women who self-reported lifetime racial discrimination had a greater risk of incident composite CVD and CVD mortality than those reporting no lifetime racial discrimination. It was also associated with a greater likelihood of reporting myocardial infarction, angina, and stroke[56] (**Figure S1**).

**Ethnicity and/or race:** The identified systematic reviews without meta-analysis revealed being in a certain race or ethnic group was associated with a higher risk of CVD.[42, 75, 98] As compared to Whites; Asians, Chinses, African-Americans, Hispanics, and Non-Hispanic Blacks had a statistically significant lower risk for atrial fibrillation.[75] Mortality due to ischemic

heart disease was lower among Afro-Caribbean as compared to Caucasians.[98] However, one systematic review without meta-analysis found an inconsistent and no evidence of race-based disparities in CVD[50] (**Figure S1**). Systematic reviews with meta-analysis also examined the link between ethnicity and CVD. A review by Ezzatvar et al.[69] revealed that Hispanic Americans had reduced risks of composite CVD, coronary artery disease, stroke, and heart failure than White people. Two systematic reviews with meta-analysis also revealed a lower risk of coronary heart disease[69] and Atrial fibrillation[51] among Blacks as compared to Whites. A lower risk of composite CVD mortality among Hispanics compared to non-Hispanics was also reported.[55] Besides, Chinese had a lower risk of coronary artery disease as compared to whites and south Asians, respectively.[97] Furthermore, as compared to Caucasians and White Europeans, Asians had a lower risk of peripheral arterial diseases[47, 96] (**Figure S6**).

### Factors relating to early childhood development and CVD

**Adverse childhood events:** Adversity during childhood was associated with a higher risk of composite CVD, coronary heart disease, stroke, and heart failure, with additional adversity increased the risk by 30%-70%.[102] Violence during childhood was associated with a higher risk of later life CVD (ischemic heart disease, myocardial infarction, and stroke).[106] One systematic review without meta-analysis also found a dose-response relationship between childhood adverse exposures and ischemic heart disease[48] (**Figure S1**). Considering findings from systematic reviews with meta-analysis, being exposed to adverse events during childhood was significantly associated with adulthood composite CVD,[104] myocardial infarction,[105] and ischemic heart disease.[52] Besides, being exposed to childhood abuse and neglect was associated with a higher risk of composite CVD[53, 103] and ischemic heart disease,[103] respectively. Furthermore, there was a borderline significant association between childhood neglect and a higher risk of later life stroke[103] (**Figure S7**).

**Childhood SES:** From the majority of systematic reviews without meta-analysis findings, lower childhood SES were associated with a higher risk of composite CVD,[65, 102] coronary heart disease,[102] and stroke,[101, 102] but not associated with heart failure.[101] Besides, CVD mortality,[64, 102] coronary heart disease mortality,[64] and mortality from stroke[64] were higher among adults with poor childhood SES. However, two systematic reviews without meta-analysis reported an inconsistent and null, respectively, association between childhood SES and CVD (coronary heart disease and heart disease)[99, 100] (**Figure S1**). When we consider the finding from systematic review with meta-analysis, lower childhood SES was associated with higher risks of stroke[78] (pooled HR= 1.31; 95%CI: 1.03, 1.68 and pooled OR= 1.28; 95%CI: 1.12, 1.46) (**Figure S7**).

## Factors relating to neighbourhood and built environment and CVD

**Violence during adulthood:** Findings from the majority of systematic reviews without meta-analysis revealed that intimate partner violence was associated with an increased risk of CVD.[54, 108, 109] Besides, sexual abuse in the military was significantly associated with being treated for a myocardial infarction but not being treated for a stroke.[59] However, one systematic review without meta-analysis found a mixed finding (null and increased risk) between adulthood violence and myocardial infarction, coronary heart disease, myocardial infarction, and stroke[106] (**Figure S1)**. A systematic review with meta-analysis also reported a mixed finding with different measures of association.[107] It revealed that the hazard of having composite CVD was 1.32 times higher among individuals with a history of sexual violence as compared to their counterparts. However, using OR as a measure of association, a history of sexual violence was not significantly associated with CVD (**Figure S8**).

**Conflict:** A systematic review without meta-analysis found that there was a significant association between armed conflict and an increased risk of mortality from chronic ischemic heart disease and heart disease[70] but not mortality due to stroke[70]. The same study also revealed no significant association between armed conflict and myocardial infarction, ischemic heart disease, and angina pectoris. In addition, conflict had an inconsistent association with heart disease and stroke[70] (**Figure S1)**.

**Environmental attributes:** A systematic review without meta-analysis revealed that there was a significant positive association between environmental attributes (proximity to a major road, reduced access to food stores, no recreational areas, and increased access to fast-food restaurants, far from a healthcare facility, and high traffic density) and coronary heart disease, myocardial infarction, heart failure, stroke, and angina.[110] Besides, fast food restaurant availability was found as a significant factor for stroke.[49] However, food environments, assessed among adults with low SES, such as access to grocery stores, and fast food restaurants were not associated with coronary heart disease[49] (**Figure S1**).

**Neighbourhood SES**: One systematic review without meta-analysis studied the association between neighbourhood SES and the incidence of stroke.[26] This study found that a higher neighbourhood disadvantage was associated with a higher risk of stroke, however, the findings were not statistically significant (**Figure S1)**. Additionally, three systematic reviews with meta-analysis report that neighbourhood socioeconomic disadvantage was associated with a higher risk of CVD mortality, incidence of heart failure, coronary heart disease, and stroke.[77, 81, 111] Of these, one considers male and female participants separately and found a similar significant finding[81] (**Figure S8**).

**Table S1. PRIOR Checklist**

| **Section** Topic | # | **Item** | **Location reported (Page number)** |
|---|---|---|---|
| **TITLE** | | | |
| Title | 1 | Identify the report as an overview of reviews. | 1 |
| **ABSTRACT** | | | |
| Abstract | 2 | Provide a comprehensive and accurate summary of the purpose, methods, and results of the overview of reviews. | 2 |
| **INTRODUCTION** | | | |
| Rationale | 3 | Describe the rationale for conducting the overview of reviews in the context of existing knowledge. | 6; in the last paragraph of the introduction section |
| Objectives | 4 | Provide an explicit statement of the objective(s) or question(s) addressed by the overview of reviews. | 6; last paragraph last sentence of the introduction section |
| **METHODS** | | | |
| Eligibility criteria | 5a | Specify the inclusion and exclusion criteria for the overview of reviews. If supplemental primary studies were included, this should be stated, with a rationale. | 6 and 7 |
| | 5b | Specify the definition of 'systematic review' as used in the inclusion criteria for the overview of reviews. | 7 |
| Information sources | 6 | Specify all databases, registers, websites, organizations, reference lists, and other sources searched or consulted to identify systematic reviews and supplemental primary studies (if included). Specify the date when each source was last searched or consulted. | 8 |
| Search strategy | 7 | Present the full search strategies for all databases, registers and websites, such that they could be reproduced. Describe any search filters and limits applied. | Table S2 |
| Selection process | 8a | Describe the methods used to decide whether a systematic review or supplemental primary study (if included) met the inclusion criteria of the overview of reviews. | 7, 8, and Figure 2 |
| | 8b | Describe how overlap in the populations, interventions, comparators, and/or outcomes of systematic reviews was identified and managed during study selection. | N/A; limitation of the review and it is stated in the limitation section |

| | | | |
|---|---|---|---|
| | | | (page 25) |
| Data collection process | 9a | Describe the methods used to collect data from reports. | 8 |
| | 9b | If applicable, describe the methods used to identify and manage primary study overlap at the level of the comparison and outcome during data collection. For each outcome, specify the method used to illustrate and/or quantify the degree of primary study overlap across systematic reviews. | N/A |
| | 9c | If applicable, specify the methods used to manage discrepant data across systematic reviews during data collection. | N/A |
| Data items | 10 | List and define all variables and outcomes for which data were sought. Describe any assumptions made and/or measures taken to identify and clarify missing or unclear information. | 6, 7, 12, and 13 |
| Risk of bias assessment | 11a | Describe the methods used to *assess* risk of bias or methodological quality of the included systematic reviews. | 9 |
| | 11b | Describe the methods used to *collect* data on (from the systematic reviews) and/or *assess* the risk of bias of the primary studies included in the systematic reviews. Provide a justification for instances where flawed, incomplete, or missing assessments are identified but not re-assessed. | Collected from systematic reviews and reported in Table S4 |
| | 11c | Describe the methods used to *assess* the risk of bias of supplemental primary studies (if included). | N/A |
| Synthesis methods | 12a | Describe the methods used to summarize or synthesize results and provide a rationale for the choice(s). | 9 and 10 |
| | 12b | Describe any methods used to explore possible causes of heterogeneity among results. | N/A |
| | 12c | Describe any sensitivity analyses conducted to assess the robustness of the synthesized results. | N/A |
| Reporting bias assessment | 13 | Describe the methods used to *collect* data on (from the systematic reviews) and/or *assess* the risk of bias due to missing results in a summary or synthesis (arising from reporting biases at the levels of the systematic reviews, primary studies, and supplemental primary studies, if included). | N/A |
| Certainty assessment | 14 | Describe the methods used to *collect* data on (from the systematic reviews) and/or *assess* certainty (or confidence) in the body of evidence for an outcome. | N/A (reason stated in data synthesis section; page 10) |
| **RESULTS** | | | |
| Systematic review and supplemental primary study selection | 15a | Describe the results of the search and selection process, including the number of records screened, assessed for eligibility, and included in the overview of reviews, ideally with a flow diagram. | 11 and Figure 2 |
| | 15b | Provide a list of studies that might appear to meet the inclusion criteria, but were excluded, with the main reason for exclusion. | Supplementary Table S3 |

| | | | |
|---|---|---|---|
| Characteristics of systematic reviews and supplemental primary studies | 16 | Cite each included systematic review and supplemental primary study (if included) and present its characteristics. | 11, Table 1, and Table S4 |
| Primary study overlap | 17 | Describe the extent of primary study overlap across the included systematic reviews. | N/A; limitation of the study |
| Risk of bias in systematic reviews, primary studies, and supplemental primary studies | 18a | Present assessments of risk of bias or methodological quality for each included systematic review. | 13, 14, and Table S6 |
| | 18b | Present assessments (*collected* from systematic reviews or *assessed* anew) of the risk of bias of the primary studies included in the systematic reviews. | Table S4 |
| | 18c | Present assessments of the risk of bias of supplemental primary studies (if included). | N/A |
| Summary or synthesis of results | 19a | For all outcomes, summarize the evidence from the systematic reviews and supplemental primary studies (if included). If meta-analyses were done, present for each the summary estimate and its precision and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect. | 14-18 and Table 2; Supplementary result, and Figures S1-S8 |
| | 19b | If meta-analyses were done, present results of all investigations of possible causes of heterogeneity. | N/A |
| | 19c | If meta-analyses were done, present results of all sensitivity analyses conducted to assess the robustness of synthesized results. | N/A |
| Reporting biases | 20 | Present assessments (*collected* from systematic reviews and/or *assessed* anew) of the risk of bias due to missing primary studies, analyses, or results in a summary or synthesis (arising from reporting biases at the levels of the systematic reviews, primary studies, and supplemental primary studies, if included) for each summary or synthesis assessed. | N/A |
| Certainty of evidence | 21 | Present assessments (*collected* or *assessed* anew) of certainty (or confidence) in the body of evidence for each outcome. | N/A |
| **DISCUSSION** | | | |
| Discussion | 22a | Summarize the main findings, including any discrepancies in findings across the included systematic reviews and supplemental primary studies (if included). | 18-24 |
| | 22b | Provide a general interpretation of the results in the context of other evidence. | 18-24 |

| | | | |
|---|---|---|---|
| | 22c | Discuss any limitations of the evidence from systematic reviews, their primary studies, and supplemental primary studies (if included) included in the overview of reviews. Discuss any limitations of the overview of reviews methods used. | 24-26 |
| | 22d | Discuss implications for practice, policy, and future research (both systematic reviews and primary research). Consider the relevance of the findings to the end users of the overview of reviews, e.g., healthcare providers, policymakers, patients, among others. | 26 and 27 |
| **OTHER INFORMATION** | | | |
| Registration and protocol | 23a | Provide registration information for the overview of reviews, including register name and registration number, or state that the overview of reviews was not registered. | 6 |
| | 23b | Indicate where the overview of reviews protocol can be accessed, or state that a protocol was not prepared. | 6 |
| | 23c | Describe and explain any amendments to information provided at registration or in the protocol. Indicate the stage of the overview of reviews at which amendments were made. | 9 and 10 |
| Support | 24 | Describe sources of financial or non-financial support for the overview of reviews, and the role of the funders or sponsors in the overview of reviews. | 29 |
| Competing interests | 25 | Declare any competing interests of the overview of reviews' authors. | 29 |
| Author informati on | 26a | Provide contact information for the corresponding author. | 1 |
| | 26b | Describe the contributions of individual authors and identify the guarantor of the overview of reviews. | N/A (based on the journal guideline) |
| Availability of data and other materials | 27 | Report which of the following are available, where they can be found, and under which conditions they may be accessed: template data collection forms; data collected from included systematic reviews and supplemental primary studies; analytic code; any other materials used in the overview of reviews. | N/A (based on the journal guideline) |

**Table S2. The search strategy used for the Medline database (August 02, 2022)**

| # | Query | The number of articles found |
|---|---|---|
| 1 | "Social Determinants of Health"/ or Socioeconomic Factors/ or Social Environment/ or social factors/ or Income/ or Residence Characteristics/ or Social Segregation/ or Poverty/ or unemployment/ or Occupations/ or job security/ | 322,701 |
| 2 | literacy/ or health literacy/ or educational status/ or health education/ | 126,842 |
| 3 | food supply/ or famine/ or food deserts/ or food insecurity/ or food security/ | 15,941 |
| 4 | social integration/ or social cohesion/ or social interaction/ or Social Support/ | 78,531 |
| 5 | Environmental Exposure/ or environment/ or built environment/ or food environment/ or altitude/ or climate/ | 187,081 |
| 6 | culturally competent care/ or health services accessibility/ | 85,535 |
| 7 | culture/ or acculturation/ or cultural characteristics/ or cultural diversity/ | 67,281 |
| 8 | sociological factors/ or psychosocial deprivation/ or "ethnic and racial minorities"/ or minority groups/ or social capital/ or social change/ or social conditions/ or social environment/ or environmental attributes/ or social isolation/ or loneliness/ or social norms/ or sociodemographic factors/ | 110,749 |
| 9 | Social Discrimination/ or Racism/ or ageism/ or systemic racism/ or sexism/ or racial groups/ or ethnicity/ or Adverse childhood experiences/ | 100,921 |
| 10 | housing/ or housing for the elderly/ or public housing/ or refugee camps/ or Homeless Persons/ | 30,408 |
| 11 | crime/ or recidivism/ or sex offenses/ or violence/ or ethnic cleansing/ or genocide/ | 57,612 |
| 12 | violence/ or domestic violence/ or gender-based violence/ or gun violence/ or intimate partner violence/ or spouse abuse/ or physical abuse/ | 51,876 |
| 13 | homeless persons/ or homeless youth/ or vulnerable populations/ or working poor/ or social problems/ or minority groups/ or social marginalization/ or poverty areas/ or Cultural Deprivation/ or Medically Underserved Area/ or medical indigency/ | 64,390 |
| 14 | (travel distance or residence).mp. | 84,547 |
| 15 | (Disadvantaged or minorities or poverty or destitution or destitute or homeless* or marginali#ed or marginali#ation* or inequalities or inequities or Impoverish* or extremely poor or underpriv?leg* or unemployment or Illiteracy or Underserved or Indigency or Indigent).mp. | 176,588 |
| 16 | ((socioeconomic* or socio-economic* or economic* or financial* or social* or cultural* or education* or housing) adj1 (disadvantage or deprivation or insecur* or precarity or precarious* or vulnerab* or hardship* or inequit* or disparit* or isolat* or adversity or instabilit* or unstable or deprivation* or discrimination* or incarcerat*)).mp. | 43,907 |
| 17 | ((poor* or Informal* or vulnerab* or insecure* or precarious* or overcrowd* or over-crowd* or unstabl*) adj (home? or housing or housed)).mp. | 1,561 |

| | | |
|---|---|---|
| 18 | ((ow* or lack* or "lack of" or limited or unstable or diminished) adj (socioeconomic or socio-economic* or economic* or income or literacy or education* or finances)).mp. | 1,968 |
| 19 | (working class* or blue collar worker* or migrant worker* or low skill* or unskilled worker* or newly arrived migrant* or new migrant* or working poor or job security).mp. | 5,925 |
| 20 | ((socioeconomic* or economic* or financial* or money or monetary) adj (challenge* or pressure* or strain* or stress* or cris#s)).mp. | 9,206 |
| 21 | (social determinant* or social preference* or social network* or social capital or social isolation or social participation or social support or social health or social environment* or geographic disparit* or socioeconomic determinant* or neighbo?rhood segregation* or neighbo?rhood deprivation* or neighbo?rhood status or neighbo?rhood effect* or racial disparit* or socioeconomic status* or Discrimination or stigmati?ation or economic recession or violence or loneliness or ethnic minorit* or social inequality* or food insecurity or supermarket or grocery or community engagement or community participation or social engagement).mp. | 496,921 |
| 22 | (child* socioeconomic adj (status* or position* or condition* or circumstance*)).mp. | 557 |
| 23 | ((adverse childhood adj (development or experience*)) or early life stress *).mp. | 4,123 |
| 24 | ((health care adj (quality or access*)) or quality of care).mp. | 60,262 |
| 25 | or/1-24 | 1,388,495 |
| 26 | cerebrovascular disorders/ or brain ischemia/ or Cardiovascular Diseases/ or Heart Failure/ or congestive heart failure/ or Heart Diseases/ or Myocardial Infarction/ or Myocardial Ischemia/ or Coronary Artery Disease/ or Coronary Disease/ or Stroke/ or Angina, Stable/ or Angina Pectoris/ or Angina, Unstable/ or Arrhythmias, Cardiac/ or Cardiomyopathies/ or Peripheral Vascular Diseases/ | 1,001,910 |
| 27 | ((cardiovascular or cerebrovascular or coronary or heart or cardiac) adj3 (disease* or isch?emia or infact* or failure)).mp. | 910,041 |
| 28 | (cerebrovascular accident* or arrhythmia* or angina pectoris or unstable angina or stable angina or coronary syndrome or acute coronary syndrome or stroke or cardioembolic stroke or isch?emic stroke or lacunar stroke or h?emorrhagic stroke or adverse cardiac event or myocardial infarction or myocardial isch?emia or heart attack* or cardiovascular mortality or cardiovascular death or out-of-hospital cardiac arrest or cardiomyopath*).mp. | 816,512 |
| 29 | (Peripheral adj2 Disease*).mp. | 40,321 |
| 30 | or/26-29 | 1,520,854 |
| 31 | (meta-analy* or metaanaly* or metanalys#s).mp,pt. | 235,893 |
| 32 | (systematic* adj3 (review* or overview*)).mp,pt. | 245,905 |
| 33 | (quantitative* adj5 (review* or overview* or synthes#s)).mp. | 9,086 |
| 34 | (methodologic* adj5 (review* or overview*)).mp. | 7,147 |
| 35 | (integrative research review* or research integration).mp. | 143 |

| | | |
|---|---|---|
| 36 | or/31-35 | 368,128 |
| 37 | 25 and 30 and 36 | 1,807 |

**Note:** Search strategies used for other databases will be provided on request

**Table S3. Records excluded at full-text screening stage and reasons for exclusion.**

| Bibliography of the excluded articles, listed alphabetically by first author | Exclusion reason |
|---|---|
| 1. Abell J. Racial disparities in cardiovascular risk associated with body mass index in men and women: A subject-level meta-analysis. Dissertation Abstracts International: Section B: The Sciences and Engineering. 2008;68(7-B):4416. | Wrong study design |
| 2. Abell JE, Egan BM, Wilson PWF, Lipsitz S, Woolson RF, Lackland DT. Differences in cardiovascular disease mortality associated with body mass between Black and White persons. American journal of public health. 2008;98(1):63-6. | Wrong study design |
| 3. Abesamis CJ, Fruh S, Hall H, Lemley T, Zlomke KR. Cardiovascular Health of Filipinos in the United States. Journal of Transcultural Nursing. 2016;27(5):518-28. | Wrong study design |
| 4. Addo J, Ayerbe L, Mohan KM, Crichton S, Sheldenkar A, Chen R, et al. Socioeconomic status and stroke: an updated review. Stroke (00392499). 2012;43(4):1186-91. | Wrong study design |
| 5. Ahmad N, Bhopal R. Is coronary heart disease rising in India? A systematic review based on ECG defined coronary heart disease. Heart. 2005;91(6):719-25. | Assess only burden |
| 6. Al-Rousan T, AlHeresh R, Saadi A, El-Sabrout H, Young M, Benmarhnia T, et al. Epidemiology of cardiovascular disease and its risk factors among refugees and asylum seekers: Systematic review and meta-analysis. International Journal of Cardiology: Cardiovascular Risk and Prevention. 2022;12:200126. | Wrong intervention |
| 7. Al-Shakarchi N, Evans H, Luchenski S, Story A, Banerjee A. Cardiovascular disease in the homeless: a systematic review of observational and interventional studies. The Lancet. 2019;394(Supplement 2):S16. | Duplicate |
| 8. Aldridge RW, Story A, Hwang SW, Nordentoft M, Luchenski SA, Hartwell G, et al. Morbidity and mortality in homeless individuals, prisoners, sex workers, and individuals with substance use disorders in high-income countries: a systematic review and meta-analysis. Lancet. 2018;391(10117):241-50. | Wrong outcome |
| 9. Ali Shah SI, Hamza M, Saeed M, Haq I. Psychosocial risk factors of myocardial infarction:turning threat to opportunity. Nepalese Heart Journal. 2020;17(2):1-5. | Wrong study design |
| 10. Alizadeh G, Gholipour K, Azami-Aghdash S, Dehnavieh R, Jafarabadi M, Azmin M, et al. Social, economic, technological, and environmental factors affecting cardiovascular diseases: A systematic review and thematic analysis. International Journal of Preventive Medicine. 2022;13(1):78. | Wrong study design |
| 11. Allan V, Honarbakhsh S, Casas JP, Wallace J, Hunter R, Schilling R, et al. Are cardiovascular risk factors also associated with the incidence of atrial fibrillation? A systematic reviewand field synopsis of 23 factors in 32 initially healthy cohorts of 20 million participants. Europace. 2016;18(Supplement 2):ii5. | Duplicate* |
| 12. Allan V, Honarbakhsh S, Casas JP, Wallace J, Hunter RJ, Schilling RJ, et al. Are cardiovascular risk factors associated with the incidence of atrial fibrillation? A systematic review and field synopsis of 23 factors in 32 initially healthy cohorts of 20 million participants. European Heart Journal. 2016;37(Supplement 1):602. | Duplicate |
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| 136. Li-yuan SUN, Eun-whan LEE, Aqeela Z, Jae-hyun P. Risk Factors of Cardiovascular Disease and Their Related Socio-Economical, Environmental and Health Behavioral Factors: Focused on Low-Middle Income Countries- A Narrative Review Article. Iranian Journal of Public Health. 2015;44(4):435-44. | Wrong study design |
| 137. Linden W. Review: depression, social isolation, and certain life events are associated with the development of coronary heart disease. ACP Journal Club. 2003;139(3):81-. | Wrong study design |
| 138. Liu GD, Wang H, Huang ZG. Social isolation, chronic diseases and prevention in old age. Journal of the American Geriatrics Society. 2019;67(Supplement 4):S663. | Abstract |
| 139. Liu J, Varghese BM, Hansen A, Zhang Y, Driscoll T, Morgan G, et al. Heat exposure and cardiovascular health outcomes: a systematic review and meta-analysis. The Lancet Planetary Health. 2022;6(6):e484-e95. | Wrong intervention |

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| 140. Liu XX, Ma XL, Huang WZ, Luo YN, He CJ, Zhong XM, et al. Green space and cardiovascular disease: A systematic review with meta-analysis. Environmental Pollution. 2022;301. | Wrong intervention |
| 141. Lu Y, Hajifathalian K, Ezzati M, Rimm E, Danaei G. Racial disparities in coronary heart disease risk among united states adults. Circulation. 2014;129(SUPPL. 1). | Wrong study design |
| 142. Luo Q, Li S, Guo Y, Han X, Jaakkola JJK. A systematic review and meta-analysis of the association between daily mean temperature and mortality in China. Environmental research. 2019;173:281-99. | Wrong intervention |
| 143. Luttik ML, Jaarsma T, Moser D, Sanderman R, van Veldhuisen DJ. The importance and impact of social support on outcomes in patients with heart failure: an overview of the literature. Journal of Cardiovascular Nursing. 2005;20(3):162-9. | Wrong study design |
| 144. Ma Y, Zhang Y, Cheng B, Feng F, Jiao H, Zhao X, et al. A review of the impact of outdoor and indoor environmental factors on human health in China. Environmental Science and Pollution Research. 2020;27(34):42335-45. | Wrong intervention |
| 145. Malwane M, Abad J, Riddle M, Thompson M. ADVERSE CHILDHOOD EXPERIENCES (ACE) and COMORBIDITIES among ADULTS with DIABETES MELLITUS: META-ANALYSIS of the ASSOCIATION between ACE and DIABETIC DEPRESSION. Journal of Investigative Medicine. 2021;70:291. | Abstract [a] |
| 146. Manfredini R, De Giorgi A, Tiseo R, Boari B, Cappadona R, Salmi R, et al. Marital status, cardiovascular diseases, and cardiovascular risk factors: A review of the evidence. Journal of Women's Health. 2017;26(6):624-32. | Wrong intervention |
| 147. Martinez-Garcia M, Salinas-Ortega M, Estrada-Arriaga I, Hernandez-Lemus E, Garcia-Herrera R, Vallejo M. A systematic approach to analyze the social determinants of cardiovascular disease. PloS one. 2018;13(1):e0190960. | Wrong study design |
| 148. Marzuki MF, Yueting K, Awang Mahmud AB, Moy FM. Systematic review of life course social determinants of health and their association with adulthood metabolic syndrome. Journal of Health and Translational Medicine. 2020;23(Supplement 1):254-65. | Wrong outcome |
| 149. Mau MK, Sinclair K, Saito EP, Baumhofer KN, Kaholokula JK, Mau MK, et al. Cardiometabolic health disparities in native Hawaiians and other Pacific Islanders. Epidemiologic Reviews. 2009;31:113-29. | Wrong outcome |
| 150. McEwing R, McLachlan A, Lund M, Carrucan-Wood L. The impact of health literacy on the health outcomes of the heart failure population. Heart Lung and Circulation. 2017;26(Supplement 1):S8. | Wrong study design |
| 151. McHutchison CA, Backhouse EV, Shenkin SD, Cvoro V, Wardlaw JM. Early life risk factors and stroke in later life: Systematic review and meta-analysis. European Stroke Journal. 2016;1(1 Supplement 1):736. | Duplicate* |
| 152. McMichael AJ, McGuinness B, Lee J, Minh HV, Woodside JV, McEvoy CT. Food insecurity and brain health in adults: A systematic review. Critical reviews in food science and nutrition. 2021:1-16. | Wrong outcome |
| 153. Medina EL, Loques Filho O, Mesquita CT. Health social networks as online life support groups for patients with cardiovascular diseases. Arquivos brasileiros de cardiologia. 2013;101(2):e39-45. | Wrong study design |
| 154. Medina-Ramon M, Schwartz J. Temperature, temperature extremes, and mortality: a study of acclimatisation and effect modification in 50 US cities. Occupational and environmental medicine. 2007;64(12):827-33. | Wrong study design |
| 155. Meyer JF, Larsen SB, Blond K, Damsgaard CT, Bjerregaard LG, Baker JL. Associations between body mass index and height during childhood and adolescence and the risk of coronary heart disease in adulthood: A systematic review and meta-analysis. Obesity reviews : an official journal of the International Association for the Study of Obesity. 2021;22(9):e13276. | Wrong intervention |

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| 156. Mezzoiuso AG, Gola M, Rebecchi A, Ricco M, Capolongo S, Buffoli M, et al. Indoors and health: results of a systematic literature review assessing the potential health effects of living in basements. Acta bio-medica : Atenei Parmensis. 2017;88(3):375-82. | Wrong intervention |
| 157. Min LY, Islam RB, Gandrakota N, Shah MK. The social determinants of health associated with cardiometabolic diseases among Asian American subgroups: a systematic review. BMC health services research. 2022;22(1):257. | Wrong outcome |
| 158. Moghadamnia MT, Ardalan A, Mesdaghinia A, Keshtkar A, Naddafi K, Yekaninejad MS. Ambient temperature and cardiovascular mortality: A systematic review and meta-analysis. PeerJ. 2017;2017(8):3574. | Wrong intervention |
| 159. Moledina A, Tang KL. Socioeconomic Status, Mortality, and Access to Cardiac Services After Acute Myocardial Infarction in Canada: A Systematic Review and Meta-analysis. CJC Open. 2021;3(7):950-64. | Wrong outcome |
| 160. Mookadam F, Arthur HM. Social support and its relationship to morbidity and mortality after acute myocardial infarction: systematic overview. Archives of internal medicine. 2004;164(14):1514-8. | Wrong outcome |
| 161. Moslehi S, Dowlati M. Effects of Extreme Ambient Temperature on Cardiovascular Outcomes: A Systematic Review. Journal of Environmental Health and Sustainable Development. 2021;6(4):1407-18. | Wrong intervention |
| 162. Nadimpalli SB, Hutchinson MK. An integrative review of relationships between discrimination and Asian American health. Journal of Nursing Scholarship. 2012;44(2):127-35. | Wrong study design |
| 163. Nag T, Ghosh A. Cardiovascular disease risk factors in Asian Indian population: A systematic review. Journal of Cardiovascular Disease Research. 2013;4(4):222-8. | Wrong study design |
| 164. Nair M, Prabhakaran D. Why do South Asians have high risk for CAD? Global Heart. 2012;7(4):307-14. | Wrong study design |
| 165. Niedhammer I, Bertrais S, Witt K. Psychosocial work exposures and health outcomes: A meta-review of 72 literature reviews with meta-analysis. Scandinavian Journal of Work, Environment and Health. 2021;47(7):489-508. | Wrong study design |
| 166. Ntusi NBA, Mayosi BM. Aetiology and risk factors of peripartum cardiomyopathy: a systematic review. International journal of cardiology. 2009;131(2):168-79. | Wrong study design |
| 167. Ofori-Marfoh CD, Volgman C, Volgman A, Alexander S, Williams K. Race and socioeconomic status are strongly associated with racial disparities in cardiovascular health and outcomes in Chicago. Circulation. 2018;137(Supplement 1). | Abstract[#] |
| 168. Ohman RE, Yang EH, Abel ML. Inequity in Cardio-Oncology: Identifying Disparities in Cardiotoxicity and Links to Cardiac and Cancer Outcomes. Journal of the American Heart Association. 2021;10(24):e023852. | Wrong study design |
| 169. Okeahialam BN. The Urban enviroment as a cardiovascular disease risk factor. TAF Preventive Medicine Bulletin. 2011;10(3):369-72. | Wrong study design |
| 170. Oliveira G, Schimith MD, Silveira VdN. Fatores de risco cardiovascular em mulheres: revisão integrativa da literatura. Enfermagem Brasil. 2019;18(6):799-815. | Wrong study design |
| 171. Ortiz-Prado E, Cordovez SP, Vasconez E, Viscor G, Roderick P. Chronic high-altitude exposure and the epidemiology of ischaemic stroke: a systematic review. BMJ open. 2022;12(4):e051777. | Wrong intervention |

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| 172. Park JW, Mealy R, Saldanha IJ, Loucks EB, Needham BL, Sims M, et al. Multilevel resilience resources and cardiovascular disease in the United States: A systematic review and meta-analysis. Health Psychology. 2022;41(4):278-90. | Duplicate |
| 173. Patil S, Phansalkar S. A systematic review on the studies of climate change and its effect on public health. International Journal of Advanced Science and Technology. 2019;28(16):106-18. | Wrong intervention |
| 174. Pek PP, Blewer AL. Higher socioeconomic status is associated with lower in-hospital cardiac arrest: How can we address this socioeconomic inequality? Resuscitation. 2022;177:52-4. | Wrong outcome |
| 175. Pollitt RA, Rose KM, Kaufman JS. Evaluating the evidence for models of life course socioeconomic factors and cardiovascular outcomes: a systematic review. BMC public health. 2005;5:7. | Not the scope of this study |
| 176. Power M, Roberts L, Cooke J, Chandrasekhar J. 543 Review of Frequency and Outcomes of Culturally and Linguistically Diverse Patients Presenting With Myocardial Infarction. Heart Lung and Circulation. 2020;29(Supplement 2):S281-S2. | Wrong outcome |
| 177. Prasad D, Kabir Z, Dash A, Das B. Abdominal obesity, an independent cardiovascular risk factor in Indian subcontinent: A clinico epidemiological evidence summary. Journal of Cardiovascular Disease Research. 2011;2(4):199-205. | Wrong study design |
| 178. Pullar J, Allen L, Townsend N, Williams J, Foster C, Roberts N, et al. The impact of poverty reduction and development interventions on non-communicable diseases and their behavioural risk factors in low and lower-middle income countries: A systematic review. PloS one. 2018;13(2):e0193378. | Wrong intervention |
| 179. Rabiei H, Ramezanifar S, Hassanipour S, Gharari N. Investigating the effects of occupational and environmental noise on cardiovascular diseases: a systematic review and meta-analysis. Environmental Science and Pollution Research. 2021;28(44):62012-29. | Wrong intervention |
| 180. Rahbar MH, Medrano M, Diaz-Garelli F, Gonzalez Villaman C, Saroukhani S, Kim S, et al. Younger age of stroke in low-middle income countries is related to healthcare access and quality. Annals of clinical and translational neurology. 2022;9(3):415-27. | Wrong outcome |
| 181. Rau R, Buyken D. Current status of knowledge about health risk from mental workload: Evidence based on a systematic review of reviews. Der aktuelle Kenntnisstand uber Erkrankungsrisiken durch psychische Arbeitsbelastungen: Ein systematisches Review uber Metaanalysen und Reviews. 2015;59(3):113-29. | Wrong study design |
| 182. Rosland A-M, Heisler M, Piette J. The impact of family behaviors and communication patterns on chronic illness outcomes: a systematic review. Journal of Behavioral Medicine. 2012;35(2):221-39. | Wrong intervention |
| 183. Saleem M, Durrani AK, Adeeb M, Siddique AR. Psychosocial risk factors of cardiovascular disease in Pakistani adolescents and young adults: A Systematic Review. JPMA The Journal of the Pakistan Medical Association. 2020;70(9):1601-4. | Wrong intervention |
| 184. Seddon ME, Marshall MN, Campbell SM, Roland MO. Systematic review of studies of quality of clinical care in general practice in the UK, Australia and New Zealand. Quality in health care : QHC. 2001;10(3):152-8. | Wrong outcome |
| 185. Sedrez JA, Da Silva Kasten AP, De Oliveira Chaise F, Candotti CT. Risk factors for cardiovascular and musculoskeletal work-related diseases samong prehospital emergency care workers: A systematic review. Revista Brasileira de Medicina do Trabalho. 2017;15(4):355-63. | Wrong intervention |
| 186. Shah KSV, Shah A, Bhopal R. Systematic review and meta-analysis of out of hospital cardiac arrest and race or ethnicity: Black U.S. Populations fare worse. Journal of the American College of Cardiology. 2012;59(13 SUPPL. 1):E1907. | Duplicate |

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| 187. Shah KSV, Shah ASV, Bhopal R. Systematic review and meta-analysis of out-of-hospital cardiac arrest and race or ethnicity: black US populations fare worse. European journal of preventive cardiology. 2014;21(5):619-38. | Wrong outcome |
| 188. Shah N, Marie-Mitchell A. Socioeconomic factors impact the influence of adverse childhood experiences on health outcomes. Journal of Investigative Medicine. 2019;67(1):190. | Abstract |
| 189. Shahid I, Usman MS, Dadabhoy R, Shurjeel Q, Kumar P, Siddiqi TJ. Meta-Analysis of Racial Disparity in Outcomes of Acute Myocardial Infarction. The American journal of cardiology. 2022;176:139-41. | Wrong outcome |
| 190. Shaikh K, Nakanishi R, Kim N, Budoff MJ. Coronary artery calcification and ethnicity. Journal of Cardiovascular Computed Tomography. 2019;13(6):353-9. | Wrong outcome |
| 191. Shor E, Roelfs D. Climate shock: Moving to colder climates and immigrant mortality. Social science & medicine (1982). 2019;235:112397. | Wrong intervention |
| 192. Shor E, Roelfs D, Vang ZM. The "Hispanic mortality paradox" revisited: Meta-analysis and meta-regression of life-course differentials in Latin American and Caribbean immigrants' mortality. Social Science and Medicine. 2017;186:20-33. | Wrong intervention |
| 193. Simoni JM, Smith L, Oost KM, Lehavot K, Fredriksen-Goldsen K. Disparities in Physical Health Conditions Among Lesbian and Bisexual Women: A Systematic Review of Population-Based Studies. Journal of homosexuality. 2017;64(1):32-44. | Wrong intervention |
| 194. Smaardijk VR, Lodder P, Kop WJ, Maas A, Mommersteeg P. Sex and gender-sensitive risks of psychosocial factors for ischemic heart disease incidence and prognosis: A systematic review and meta-analysis. Psychosomatic Medicine. 2018;80(3):A63-A4. | Duplicate* |
| 195. Smaardijk VR, Lodder P, Kop WJ, van Gennep B, Maas AH, Mommersteeg PM. Sex-and gender-stratified risks of psychological factors for incident ischemic heart disease: systematic review and meta-analysis. Journal of the American Heart Association. 2019;8(9):e010859. | Wrong outcome |
| 196. Sohail QZ, Chu A, Rezai MR, Donovan LR, Ko DT, Tu JV. The Risk of Ischemic Heart Disease and Stroke Among Immigrant Populations: A Systematic Review. The Canadian journal of cardiology. 2015;31(9):1160-8. | Wrong intervention |
| 197. Spyrou AT, Aggelopoulou Z, Trikilis J, Mystakidou K. Psychological support and coronary heart disease patients outcomes. European Heart Journal: Acute Cardiovascular Care. 2013;2(SUPPL. 1):124. | Wrong study design |
| 198. Steptoe A, Kivimäki M. Stress and cardiovascular disease: An update on current knowledge. 2013. p. 337-54. | Wrong study design |
| 199. Stubbs A, Szoeke C. The Effect of Intimate Partner Violence on the Physical Health and Health-Related Behaviors of Women: A Systematic Review of the Literature. Trauma, violence & abuse. 2021:1524838020985541. | Assess only burden |
| 200. Sun Z, Chen C, Xu D, Li T. Effects of ambient temperature on myocardial infarction: A systematic review and meta-analysis. Environmental pollution (Barking, Essex : 1987). 2018;241:1106-14. | Wrong intervention |
| 201. Swiatoniowska-Lonc NA, Slawuta A, Dudek K, Jankowska K, Jankowska-Polanska BK. The impact of health education on treatment outcomes in heart failure patients. Advances in clinical and experimental medicine : official organ Wroclaw Medical University. 2020;29(4):481-92. | Wrong intervention |

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| 202. Tang K, Rashid R, Ghali WA. Association between subjective social status and cardiovascular disease and cardiovascular risk factors: A systematic review and meta-analysis. Journal of General Internal Medicine. 2015;30(SUPPL. 2):S104-S5. | Duplicate |
| 203. Taouk Y, Spittal MJ, LaMontagne AD, Milner AJ. Psychosocial work stressors and risk of all-cause and coronary heart disease mortality: A systematic review and meta-analysis. Scandinavian Journal of Work, Environment & Health. 2020;46(1):19-31. | Wrong intervention |
| 204. Tay L, Tan K, Diener E, Gonzalez E. Social relations, health behaviors, and health outcomes: a survey and synthesis. Applied psychology Health and well-being. 2013;5(1):28-78. | Wrong study design |
| 205. Te Vazquez J, Feng SN, Orr CJ, Berkowitz SA. Food Insecurity and Cardiometabolic Conditions: a Review of Recent Research. Current nutrition reports. 2021;10(4):243-54. | Wrong study design |
| 206. Thomas MK, Lammert LJ, Beverly EA. Food Insecurity and its Impact on Body Weight, Type 2 Diabetes, Cardiovascular Disease, and Mental Health. Current Cardiovascular Risk Reports. 2021;15(9):15. | Wrong study design |
| 207. Thompson D, Reid J, Ski C. Psychological interventions for patients with coronary heart disease and their partners: A systematic review. Cardiology (Switzerland). 2013;126(SUPPL. 2):173. | Wrong outcome* |
| 208. Tweed EJ, Sumpter C, Thomson R, Lewer D, Southworth P, Kirolos A, et al. THE HEALTH OF PEOPLE EXPERIENCING MULTIPLE FORMS OF SOCIAL EXCLUSION: A SYSTEMATIC REVIEW. Journal of Epidemiology and Community Health. 2019;73(Supplement 1):A20-A1. | Wrong outcome* |
| 209. Ugowe FE, Jackson LR, 2nd, Thomas KL. Racial and ethnic differences in the prevalence, management, and outcomes in patients with atrial fibrillation: A systematic review. Heart rhythm. 2018;15(9):1337-45. | Wrong study design |
| 210. van Nieuwenhuizen BP, Oving I, Kunst AE, Daams J, Blom MT, Tan HL, et al. Socio-economic differences in incidence, bystander cardiopulmonary resuscitation and survival from out-of-hospital cardiac arrest: A systematic review. Resuscitation. 2019;141:44-62. | Wrong outcome |
| 211. Virtanen M, Heikkila K, Jokela M, Ferrie JE, Batty GD, Vahtera J, et al. Long working hours and coronary heart disease: A systematic review and meta-analysis. American Journal of Epidemiology. 2012;176(7):586-96. | Wrong intervention |
| 212. Vitalis A, Lip GYH, Kay M, Vohra RK, Shantsila A. Ethnic differences in the prevalence of peripheral arterial disease: a systematic review and meta-analysis. Expert review of cardiovascular therapy. 2017;15(4):327-38. | Assess only burden |
| 213. Wang X, Cao Y, Hong D, Zheng D, Richtering S, Sandset EC, et al. Ambient temperature and stroke occurrence: A systematic review and meta-analysis. International Journal of Environmental Research and Public Health. 2016;13(7). | Wrong intervention |
| 214. Weilnhammer V, Schmid J, Mittermeier I, Schreiber F, Jiang L, Pastuhovic V, et al. Extreme weather events in Europe and their health consequences – A systematic review. International Journal of Hygiene and Environmental Health. 2021;233. | Wrong intervention |
| 215. Welton NJ, Caldwell DM, Adamopoulos E, Vedhara K. Mixed treatment comparison meta-analysis of complex interventions: Psychological interventions in coronary heart disease. American Journal of Epidemiology. 2009;169(9):1158-65. | Wrong intervention |
| 216. Winter-Smith J, Selak V, Harwood M, Ameratunga S, Grey C. Cardiovascular disease and its management among Pacific people: a systematic review by ethnicity and place of birth. BMC cardiovascular disorders. 2021;21(1):515. | Assess only burden |
| 217. Woods JA, Katzenellenbogen JM, Davidson PM, Thompson SC. Heart failure among Indigenous Australians: A systematic review. BMC Cardiovascular Disorders. 2012;12(1). | Wrong intervention |

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| 218. Woodward M, Peters SAE, Batty GD, Ueshima H, Woo J, Giles GG, et al. Socioeconomic status in relation to cardiovascular disease and cause-specific mortality: a comparison of Asian and Australasian populations in a pooled analysis. BMJ open. 2015;5(3):e006408. | Wrong study design |
| 219. Worrall-Carter L, Edward K-L, Page K. Women and cardiovascular disease: at a social disadvantage? Collegian. 2012;19(1):33-7. | Wrong study design |
| 220. Xiaoyue L, Logan J, Alhusen J. Cardiovascular Risk and Outcomes in Women Who Have Experienced Intimate Partner Violence: An Integrative Review. Journal of Cardiovascular Nursing. 2020;35(4):400-14. | Wrong study design |
| 221. Xibei BL, Ayatollahi Y, Takashi Y, Jaradat M, Shen JJ, Sun Jung K, et al. Health Literacy and Mortality in Patients With Heart Failure: A Systematic Review and Meta-Analysis. Research in Gerontological Nursing. 2019;12(2):1-10. | Wrong outcome |
| 222. Xu H, Wen LM, Rissel C. The relationships between active transport to work or school and cardiovascular health or body weight: A systematic review. Asia-Pacific Journal of Public Health. 2013;25(4):298-315. | Wrong intervention |
| 223. Zhang TN, Wu QJ, Liu YS, Lv JL, Sun H, Chang Q, et al. Environmental Risk Factors and Congenital Heart Disease: An Umbrella Review of 165 Systematic Reviews and Meta-Analyses With More Than 120 Million Participants. Frontiers in Cardiovascular Medicine. 2021;8. | Wrong study design |
| 124. Lago-Peñas S, Rivera B, Cantarero D, Casal B, Pascual M, Blázquez-Fernández C, et al. The impact of socioeconomic position on non-communicable diseases: what do we know about it? Perspectives in Public Health. 2021;141(3):158-76. | Wrong study design |
| 125. LaFave S, Suen J, Seau Q, Bergman A, Fisher M, Thorpe R, et al. Racism and Older Black Americans' Health: a Systematic Review. Journal of Urban Health. 2022:1-27. | Wrong outcome |

Abstract includes meeting, poster, oral, and concurrent session abstracts; *initially abstract-only review but full text found through hand search or from the author; ** initially abstract-only review and two papers from the author (both were not eligible); #, unpublished (information from the author) abstracts.

## Table S4. General characteristics of the included systematic reviews and meta-analyses.

| Study details | | | Search details | | | | Type of SDOH & CVD assessed | | Quality |
|---|---|---|---|---|---|---|---|---|---|
| Author/ year | Year of publication for included studies (last search date) | Population (age); Sample size (% male) | Databases searched (n); the name the of database | The number of primary articles included; systematic reviews (Meta Analyses) | Countries (n); the name of countries | Study designs | Exposure | Outcome | Quality Appraisal Tool for primary studies |
| **Economic stability (total number of reviews=25)** | | | | | | | | | |
| Agisilaou 2020 [42] | 2010-2020 (January 2020) | General reproductive age women; 11-7,156,393 (NR) | 2; Medline and CINHAL | 24 (NA) | 14; USA, Denmark, Australia, Taiwan, Canada, Israel, Pakistan, Ireland, China, Nigeria, Japan, Korea, Singapore, and Indonesia. | Case-control, Cohort, cross-sectional, and case study. | Composite SES and Monthly earnings | Cardiomyopathy | Effective public health practice project quality assessment tool |
| Allan 2017 [75] | NR (October 1, 2015) | General population (NR); 20,420,175 (NR) | 1; PubMed | 73 (NA) | 10; Denmark, Taiwan, Japan, Sweden, Iceland, USA, Netherlands, Norway, | Prospective cohort | SES (Education, occupation, and income) | Atrial fibrillation | NR |

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| | | | | | Australia, and Germany | | | | |
| Al-Shakarchi 2020 [88] | 1988-2016 (December 31, 2018) | General population (adult); 28-28,033 (55-100%) | 1; Embase | 17 (9) | 7; USA, Canada, Sweden, Scotland, Netherlands, Finland, and Poland | case-control and Cohort | Homelessness | CVD | NOS |
| Backholer 2017 [81] | NR (September 14, 2015) | General population (all age groups); around 22 million individuals (38-71%, for reported only) | 1; PubMed | 44 (44) | 18; Asia, France, Australia, Denmark, UK, Norway, Netherlands, Sweden, Spain, Finland, Israel, Japan, Italy, Russia, India, Europe, Australia, and USA | Cohort | SES (area-level deprivation, education, occupation, and income) | Coronary heart disease, Stroke, and cardiovascular disease | NOS |
| Birhanu 2022 [83] | 2003-2021 (August 2021) | General population (adults); 1034-461,211 (0-100%) | 6; Medline, Embase, PsycINFO, | 130 (36) | 4 (China, Republic of Korea, LICs & HICs, Turkish, India) + LICs & HICs+MICs | Prospective cohort studies | Education and occupation | CVD | NOS |

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| | | | Web of Science, Scopus, and CINHAL | | | | | | |
| Eller 2009 [66] | 1977-2008 (NR) | General population (adults); 300-958,096(0-100%) | 1; Medline | 33 (NA) | 11 countries: Denmark, Finland, USA, England, Germany, Belgium, Japan, Belgium, France, Spain, Sweden | Cohort and case-control | Job insecurity | Coronary heart disease | Assessed (quality assessment criteria developed by authors) |
| Gonzalez 1998 [62] | 1960-1993 (1993) | General population (adults); 195->1000000 (0-NR) | 4; Index Medicus, Medline, Sociological Abstracts, Social Scisearch | 34 (NA) | 9; USA, UK, Sweden, Denmark, Finland, Netherlands, Belgium, Russia, and India. | Cohort and case-control | Educational status and Occupation | Ischemic Heart Disease | NR |
| Salgado-Barreira 2014 [43] | 1983-2010 (June 2012) | Urban population; NR (NR) | 5; Medline, Embase, IME (Spanish Media Index), ICYT (Index of Sciences and | 24 (NA) | 12; Ireland, Australia, Spain, Panama, USA, Netherlands, Brazil, England, China, India, | Ecological study | SES | Mortality due to Heart disease | NOS |

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| | | | Technologies), and ISOC (Index of Social Science and Humanities) | | Canada, Argentina | | | | |
| Hawkins 2012 [74] | 1996-2011 (NR) | General population (adults), 128-114,917 (NR) | 4; PubMed, Embase, CINAHL, and the Cochrane Library | 28 (NA) | 11; Sweden, Denmark, USA, Scotland, Canada, Italy, Japan, England, Brazil, Spain, and the Netherlands | Cohort and repeated cross-sectional | SES | Heart Failure | NR |
| Kerr 2011 [73] | 1980-2008 (September 2008) | General population (adult); 1,165-60, 518 (NR-100%) | 3; Embase, Medline, and the Cochrane Library | 17 (12) | 10; USA, China, Finland, Sweden, New Zealand, Scotland, England, Netherlands, Israel, and Italy | cohort and case-control studies | SES | stroke incidence (fatal or non-fatal) | NR |
| Khaing 2017 [80] | 1982–2016 (July 31, 2016) | General population (Adult); 128-4,157,202 (35.9-78%) | 2; Medline and Scopus | 72 (72) | 13; Australia, USA, Germany, Japan, Sweden, Finland, Denmark, Netherlands, Lithuania, | Cohort | Education and income | CVD, Myocardial infarction, Coronary heart disease, stroke, and CVD mortality | NOS |

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| | | | | | Greece, India, Iran, and Vietnam | | | | |
| Lee 2021 [61] | 2009-2019 (July 2019) | General population (adult), 91->1 billion (0-100%) | 4; PubMed, CINAHL, EMBASE, and Cochrane | 42 (NA) | 1; South Korea | Cross-sectional, Cohort, and matched case-control | SES (Education, income, occupation, geographical Environment) | CVD (acute myocardial infarction, Stroke, cerebrovascular disease) and 10-year mortality from (AMI, congestive heart failure, and CVD) | JBI tool |
| Manfique-Garcia 2011 [79] | 1996-2009 (April 2009) | General population (adults); 81 – 2,693,384 (NR) | 2; PubMed and Embase | 65 articles and 70 original studies (70) | 21; Sweden, Italy, Denmark, Czech Republic, Netherlands, Lithuania, England, Argentina, USA, Germany, Pakistan, Costa Rica, Japan, Greece, France, | Case-control and Cohort | SES (Education, occupation, and income) | Acute myocardial infarction | NR |

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| | | | | | Finland, Spain, India, Brazil, Iran, and Canada | | | | |
| McHutchison 2017 [78] | 1990-2015 (November 2015) | General population (adult); 112-1,135,383 (NR) | 3; Medline, PsycINFO, and Embase | 90 (90) | NR; NR | NR | Education | later life stroke | Assessed/tool not specified |
| MorettiAnfossi 2022 [86] | 1982-2020 (May 26, 2020) | General population (adults); NR (NR) | 6; Embase Medline, PubMed, Scopus, Web of Science, APA PsycInfo | 86 (NA) | 3 regions; North America, Europe, and Asia | Case-control and cohort | Job insecurity | Cerebrovascular disease and Ischemic heart disease | Navigation Guide Tool |
| Parekh 2022 [57] | 2010-2021 (June 1, 2021) | General population (adults); 445-1,852,790 (44-87, for reported only) | 1; PubMed/Medline | 19 (NA) | 1; USA | Cross-sectional and Cohort | housing instability and Food insecurity | Ischemic heart disease, Cardiomyopathy, stroke, Coronary heart disease, CVD, CVD and Stroke mortality | Study Quality Assessment Tools (SQAT) |
| Saif-Ur-Rahman 2021 [84] | 2004-2021 (August 15, 2015) | Diabetic and those at risk of diabetes (adults); (48-4,398,117) | 3; PubMed, Web of Science, and Cochrane library | 5 (NA) | 5; Finland, USA, Singapore, Sweden, and | Cross-sectional, Comparative Cross-sectional, | Occupation | Ischemic heart disease, Stroke, and CVD mortality | JBI quality assessment tool |

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| | | | | | the Republic of Korea | and Cohort study | | | |
| Theorell 2016 [87] | 1985-2014(December 2014) | General population (adult); 149-2,945,078 (0%-100%) | 3; PubMed, Embase, and PsycInfo | 96 (NA) | More than 52 countries; All regions/including Africa | Case-control and prospective Cohort | Job insecurity | Fatal Coronary heart disease, myocardial infarction and angina | NR |
| Vathesatogkit 2014 [76] | 1996-2013 (May 2013) | General population (Adult); 1245-575,377 (1 370 023 individuals and 71, 818 total deaths) (0-100%) | 5; PubMed, Embase, CINAHL, Social Science Research Network and the Cochrane Library | 45 (30) | 9; China, Bangladesh, India, Korea, Japan, Taiwan, Vietnam, Thailand, and Singapore | Cohort | SES (Education, income, occupation) | CVD mortality | NR |
| Virtanen 2013 [85] | 1982-2004 (better to say a year of study) (October 2012) | General population (Adults); 263-36,910 (0%-100%) | 2; Medline and Embase | 4+ 13 unpublished datasets (15) | 6; German, Finland, Denmark, USA, Sweden, and Belgium | Prospective design (cohort study) | Job insecurity | Incidence of Coronary heart disease | NR |
| Wang 2020 [71] | 1982-2017 (July 2017) | General population (all age groups); 806- 30, 235,757 (NR-100%) | 3; Medline, Embase, and Web of Science | 27 (27) | 12 (Australia, Finland, Canada, China, Sweden, Italy, Denmark, New Zealand, USA, | prospective cohort | SES (as a composite, Education, occupation, and income) | stroke mortality (ischemic stroke and hemorrhagic stroke) | NOS |

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| | | | | | UK, Argentina, and Korea) and multi-country study from the European region | | | | |
| Williams 2018 [24] | 1990-2015 (April 27, 2015) | General population; 35-148,173 (NR) | 6; Medline, Embase, Global Health, Web of Science Core Collection, Global Health Library, and ProQuest | 57 (NA) | 17; Ethiopia, Kosovo, Kenya, Nigeria, Mongolia, India, Tanzania, Uganda, EL Salvador, Guatemala, Honduras, Indonesia, Vietnam, Morocco, Pakistan, Bangladesh, and Burkina Faso. Also, countries in Low and LMIC. | Cross-sectional, cohort studies, and Case-control | SES (Education, income, occupation, and composite SES) | Stroke, Angina, CVD, CAD, IHD, and CVD mortality. | NOS |

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| Potter 2019 [77] | 2001-2018 (August 2018) | General population (adult);2314-3,992,417 (37.3%/NR-100%) | 2; Medline and Embase | 14 (11) | 6; USA, UK, Denmark, Sweden, Scotland, and Israel | Cohort and randomised control trial | SES (Education, poverty, Neighborhood deprivation index, Index of multiple deprivation, Income, Occupation, Carstairs index) | Incident Heart Failure | NOS |
| Lunde 2018 [82] | 2000-2017 (January 19, 2018) | General population (all age groups); 204-Unknown (all Danish or Swedish population aged 35-84 and 25-74 years, respectively) (0%-NR) | 2; Medline and Embase | 12 (NA) | 9; USA, Sweden, Denmark, Italy, Scotland, Ireland, Belgium, China, and Australia | Cohort, cross-sectional, and case-control | SES (Education and family income) | Atrial fibrillation | Cochrane tool |
| Tang 2016 [72] | 2008-2013 (July 2015) | General population (adult); 981 to | 7; PubMed, Medline, Embase, | 10 (9) | 6; USA, England, china, japan, South | Cross-sectional | Subjective Social Status | Angina and Myocardial infarction | Assessed (Author-defined |

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|---|---|---|---|---|---|---|---|---|---|
| | | 8152 (26.8-66) | CINAHL, PsycINFO, SocINDEX, and Web of Science | | Korea, and Taiwan | and longitudinal | | | quality assessment criteria) |
| **Social and community context (total number of reviews=26)** | | | | | | | | | |
| Agisilaou 2020 [42] | Stated above | | | | | | Ethnicity | Stated above | |
| Allan 2017 [75] | Stated above | | | | | | Ethnicity | Stated above | |
| Barth 2010 [67] | 1992-2007 (March 2007) | General population (adult); 194-45,414 (51.5-100%) | 4; Medline, PsycInfo, PSYNDEX, and Web of Science | 32 (25) | 6 + 1 international; Sweden, USA, Netherlands, UK, Belgium, and Canada | Prospective Cohort | Social support (functional and structural) | Myocardial infarction and cardiac mortality | NR |
| Chin 2020 [92] | 1984-2017 (June 2018) | General population (adult); 327-76, 362 (0%-100%) | 2; PsycINFO and PubMed | 19 (NA) | 5; USA, Finland, Sweden, Russia, and Denmark | Prospective Cohort | Social role | Stroke, Heart failure, CVD and CVD mortality | Assessed but the tool is not reported |
| Choi 2014 [93] | 1979-2013 (October 08, 2012) | General population (all age groups); 7217-2805679 (NR) | 3; Medline, Embase, and PsycINFO | 13 (NA) | 14; USA, UK, Finland, Sweden, Japan, New Zealand, and the Netherlands | prospective Cohort | Social capital | CVD mortality | NR |

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| Cortes-Bergoderi 2013 [55] | 1950-2009 (May 2013) | General population (NR); 3765-32,109,620 (NR) | 4; Embase, Medline, Web of Science, and Scopus | 18 (18) | 1; USA | Cohort | Ethnicity | CVD mortality | The modified tool recommended by Stroup and colleagues[#] |
| Eller 2009 [66] | Stated above | | | | | | Social support | | |
| Ezzatvar 2021[69] | 1996-2020 (May 2021) | Patients with diabetics (adults); 267-443,932 (33.2%-100%) | 2; PubMed and Embase | 23 (21) | 4; USA, Canada, UK, and New Zealand | Prospective Cohort | Ethnicity | CVD, stroke, Coronary artery disease, and Heart Failure | The Quality Assessment Tool for Observational Cohort and Cross-sectional Studies |
| Francis 2015 [98] | 1964-2013 (NR) | General population (adult); 227-4,000,198 (NR) | 4; Medline, CENTRAL, LILACS, and PsycINFO | 22 (NA) | 4; UK, USA, Jamaica, Trinidad and Tobago | Cross-sectional, cohort, and case series | Ethnicity | Ischemic heart disease mortality | NR |
| Freak-Poli 2022 [68] | 2003-2020 (June 21, 2020) | General population (adult); 2,805-11,637 (0-48.1%) | 4; Embase, Medline, Web of Science, and Scopus | 5 (4) | 2; Australia and New Zealand | Cohort | Poor social health | Coronary heart disease and Stroke | NOS |
| Ho 2021 [47] | 2001-2019 (August 2021) | Persons with chronic kidney | 7; Medline, Embase, CINAHL, Global | 10 (10) | 1; Australia | Cohort (prospective and | Ethnicity | Peripheral arterial disease | STROBE statement |

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| | | disease (NR); 89 – 6285 (50-64%) | Health Library, Allied and Complementary Medicine Database, and ProQuest Dissertations and Theses Global for articles and grey literature, and PubMed | | | retrospective ) and cross-sectional | | | |
| Jin 2015 [97] | 2001-2013 (December 2014) | General population (all ages except children); NR (NR-100%) | 6; PubMed, PsycInfo, CINAHL, Scopus, Web of Science, and Cochrane library | 8 (8) | 5; Scotland, Sweden, Canada, USA, and Netherlands | Cohort | Ethnicity | Coronary heart disease | NOS |
| Kuper 2002 [63] | 1964-2001 (June 2021) | General population for etiologic study and people with CVD for prognostic studies (adult); 104-33,999 (0%-100%) | 2; Science Citation Index and PubMed; simply bibliographic search | 70 etiologic/92 prognostics[#] (NA) | 15; UK, Finland, USA, Denmark, Lithuania, Netherlands, Scotland, Australia, Canada, Sweden, German, | Prospective cohort | Social support | Coronary heart disease, Myocardial infarction, heart Failure, and angina | NR |

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| | | | | | Belgium, Switzerland, Italy, and Israel | | | | |
| Panza 2019 [56] | 1984-2017 (February 2018) | Socially stigmatised people (adult); 27-26,991 (0%-100%) | 7; PubMed, PsycINFO, CINAHL, Sociological Abstracts, Academic Search Premier, Scopus, and EMBASE | 84 (NA) | 1; USA | Cross-sectional, longitudinal and experimental, and randomised control trail | Perceived discrimination | CVD and Myocardial infarction | NOS and Cochrane collaboration tool |
| Park 2021 [58] | 1983-2019 (September 2020) | General population (adults); 1,122-92,395 (NR-100%) | 4; PubMed, Embase, CINAHL, and PsycINFO | 13 (6) | 1; USA | Prospective cohort | Social Network (Interpersonal-Level Resilience Resources) and social cohesion (Neighborhood-Level Resilience Resources) | Coronary heart disease, Stroke, and CVD mortality | ROBINS-I tool |
| Park 2022 [51] | 2012-2021 (September 1, 2021) | HIV/AIDS patients (15 and above); 80-30,533 (>80%) | 5; PubMed, Embase, Medline, Cochrane library, and Google Scholar | 7 (7) | 2; USA and Taiwan | Retrospective and cross-sectional | Ethnicity | Atrial fibrillation | NR |

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| Petitte 2015 [91] | 2000-2014 (2014) | General population (adult); 16-11,290 (NR) | 6; Academic Search Complete, CINAHL, ERIC, Medline, PsycARTICLES, and PsycINFO | 33 (NA) | 13; Netherlands, USA, UK, Israel, Sweden, Turkey, Malaysia, Ireland, Canada, Finland, Greece, Colombia, and Norway | Cross-sectional, Correlational, Experimental, quasi-experimental, and Cohort | Loneliness | Coronary heart disease and Ischemic heart disease mortality | NR |
| Rodgers 2019 [94] | 2007-2018 (January 2019) | General population (13 and above years); 182-1,517,336 (NR) | 3; PubMed, Embase, and PsycInfo | 145 (NA) | More than 139 countries including countries in Africa | Ecological, Cross-sectional, and prospective | Social capital score | Stroke and mortality due to CVD and Coronary heart disease | NR |
| Sebastianski 2014 [96] | 1991-2013 (April 2013) | General population (NR); 90-80,375 (NR) | 5; Medline Embase, BIOSIS Previews, PubMed, Web of Science, and Scopus | 15 (15) | 4; USA, Malaysia, UK, and Canada | Cross-sectional | Ethnicity | Peripheral arterial disease | Assessed but the tool is not reported |
| Smaardijk 20019 [90] | 2000-2017 (January 17, 2018) | General population (mean age | 3; PubMed, Embase, and PsycINFO | 62 (NA) | 4 regions; North America, Europe, | Prospective cohort | social support | Incident Ischemic heart disease | NR |

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| | | 18.3-80.2 years); 76-4 545 327 (0%-100%) | | | Oceania, and Asia | | | | |
| Zaman 2013 [95] | 1996-2010 (January 2012) | General population (adult); 111 555 South Asians and 4 197 923 white subjects (73.9% in SA and 64.9% in White) | 1; Medline | 9 (9) | 4; England, Wales, UK, and Canada | Cohort | Ethnicity | Coronary artery disease | NR |
| Theorell 2016 [87] | Stated above | | | | | | Social support at work | Fatal coronary heart disease, myocardial infarction, angina and stroke | Stated above |
| Tibirica 2022 [60] | 1992-2021(October 26, 2021) | General population (older adults, 57 & above) (15.6- | 3; PsycInfo, Embase, and PubMed | 17 (NA) | 1; USA | Cross-sectional, cohort, and case-control | Loneliness and social isolation | Heart disease and Stroke | Scale to Assess Scientific Quality of |

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| | | 49.2);122 - 7607 | | | | | | | Investigations (SASQI) |
| Valtorta 2016 [25] | 1983-2014 (May 2015) | General population (adult); 98-47 713 (0%-100%) | 16; Medline, Embase, CINAHL Plus, PsycINFO, ASSIA, Web of Science, Cochrane Library, Social Policy, and Practice, National Database of Ageing Research, Open Grey, HMIC, ETHOS, NDLTD, NHS Evidence, SCIE and National Institute for Health and Care Excellence (NICE) | 23 (23) | 7; Russia, Sweden, USA, Northern Ireland, Japan, Denmark, France, and Australia | Cohort | Loneliness and/or social isolation | Coronary heart disease and Stroke | Assessed/tool not reported |
| Lightbody 2017 [89] | 2001-2016 (January 2017) | General population (adult); 25- | 5; MEDLINE, EMBASE, CINAHL, PsycINFO, and | 46 (46) | NR; NR | Cohort studies and case-control | Social support | Stroke (ischemic stroke, hemorrhagic | NIH tool |

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| | | 26,949 (0-100%) | the Cochrane Database of Systematic Reviews | | | | | stroke, subarachnoid hemorrhage, and/or TIA) | |
| Oramasionwu 2012 [50] | 2003-2009 (May 31, 2010) | Patients infected with HIV (adult); 885-316,963 (0%-90%) | 1; Medline | 5 | 1; USA | Cohort | Race | Unspecified CVD Cardiomyopathy, IHD, CAD, MI, angina, CHF, and stroke | NR |
| **Neighborhood and build environment (total number of reviews=13)** | | | | | | | | | |
| Backholer 2017 [81] | Stated above | | | | | | Area level deprivation | Stated above | |
| Jakubowski 2021 [107] | 1994-2020 (March 1, 2021) | General population (adult); 830579 (0-22.9%) | 2; PubMed and PsycINFO | 45 (45) | 10; United States, UK, Multi-country studies across (the Americas, Europe, and Asia), South Africa, Mexico, Ireland, Brazil, New Zealand, and Canada | Cohort and cross-sectional | Sexual violence | CVD, CHD, IHD, MI, and stroke | NOS |

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| Jawad 2019 [70] | 1992-2018 (February 2019) | Population exposed to author-defined Conflict (adult); 35-35835 (for those that report sample size) (NR-100%) | 5; Medline, Embase, PsycInfo, Global Health and Web of Science | 65 (NA) | NR; NR | Cross-sectional, Ecological, Cohort, and case-control | Armed conflict | Acute MI, Angina pectoris, chronic IHD, unspecified heart disease, and unspecified stroke, and their mortality | NOS |
| Kraft 2020 [49] | 2004-2015 (June 2017) | Low-Socioeconomic Status, Racial/ Ethnic Minority, and Rural Populations (all age groups); 132-1,477,828 (35% adult and 17.7% youth) | 4; PubMed, Medline, Web of Science, and Google Scholar | 43 (NA) | 1; USA | Cross-sectional and Cohort | Built environment; Grocery stores, Convenience stores, and fast food restaurants | Stroke and CHD | NR |
| Malambo 2016 [110] | 2005-2015 (April 2015) | General population (adult); 102- | 6; Masterfile Premier, CINAHL, Global Health, Health | 18 (NA) | 7; USA, New Zealand, Japan, Australia, | Cohort and Cross-sectional | Build environment (high crime rate, proximity | MI, angina, Coronary heart disease, stroke, | STROBE and PRISMA checklists |

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|---|---|---|---|---|---|---|---|---|---|
| | | 4,319,674 (0%-NR) | Source: Nursing/Academic, Medline and Science Direct | | Canada, Sweden, and China | | to a major road, food, stores, parks/recreation, fast food restaurants, bars/pubs, PA and healthcare facilities). | and heart failure | |
| Burnette 2020 [54] | 1983-2017 ( December 2017) | US indigenous people (all ages) ; 30-127,475 (0%-NR) | 8; Google Scholar, EBSCO, PsycINFO, SocINDEX with Full Text, The Educational Resource Information Center (ERIC), Academic Search Complete, PubMed, and JSTOR | 51 (NA) | 1; USA | Cross-sectional and longitudinal | Intimate partner violence | CVD | NR |
| O'Neil 2018 [109] | 2010-2017 (August 2017) | General population (adult); 34-9976 (NR) | 6; CINAHL, Ovid Medline, PubMed, Scopus, | 4 (NA) | NR; NR | Longitudinal, repeated measure design and | Intimate partner violence | CVD | NR |

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|---|---|---|---|---|---|---|---|---|---|
| | | | ProQuest, Google Scholar | | | cross-sectional | | | |
| Pate 2021 [108] | 2012-2018 (December 2018) | General population (NR); 23200 (0%) | 3; Scopus, Web of Science, and SAGE | 29 (NA) | NR; NR | NR | Intimate partner violence | Heart disease, heart attack, and stroke | NR |
| Peer 2020 [59] | 1999-2018 (October 1, 2019) | General population (adult); 85,5206 (0%) | 3; PubMed, Scopus, and Web of Science | 9 (NA) | 1; USA | Cross-sectional and longitudinal | Sexual abuse | Heart attack and Stroke | Assessed by adapting the criteria developed by Suglia and colleagues |
| Sanchez-Santos 2013 [111] | 1998-2011 (August 31, 2012) | General population (adult); 1129-409,775 (NR-100%) | 1; PubMed | 21 (21) | 6; England, Scotland, Wales, USA, Sweden, and UK | Cohort | Neighborhood SES | Mortality due to vascular disease (Majority coronary heart disease and Stroke) | NR |
| Kim 2021[26] | 2007-2018 (May 19, 2018) | General population (adult); 4619-3,644,309 (NR) | 4; ProQuest Dissertation & Theses, PsycInfo, PubMed, and Web of Science | 8 (NA) | 3; US, Sweden, and Japan | NR | Neighborhood SES | Stroke | Modified NOS |
| Potter 2019 [77] | Stated above | | | | | | Neighborhood SES | Stated above | |

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|---|---|---|---|---|---|---|---|---|---|
| Suglia 2015 [106] | 1999-2013 (August 2013) | General population (adult); 56-70156 (0%-50%) | 2; PubMed and Web of Science | 15 (NA) | 6 (USA, Canada, Netherlands, Norway, Spain, South Africa) and Multi-country | Cross-sectional and prospective cohort | Violence | CVD (Myocardial infarction, stroke, angina, and congestive heart failure | NR |
| **Early childhood development (total number of reviews=14)** | | | | | | | | | |
| Bijker 2016 [101] | 1989-2014 (NR) | Ethnic minority populations (adult); 134-20,661 (NR) | 2; PubMed and Embase | 19 (NA) | 2; USA, Australia | Cohort and cross-sectional | Early-life SES | Heart Failure and stroke | NR |
| Galobardes 2006 [65] | NR (September 2004) | General population (adult); NR (NR) | 4; Medline, Embase, and ISI Web of Science | 40 (NA) | 9; UK, Finland, Sweden, Norway, Germany, Denmark, US, China, and the Czech Republic | Cohort, case-control, and cross-sectional | childhood SES | CVD, Stroke, Myocardial infarction, Angina, Coronary heart disease, and CVD mortality | NR |
| Galobardes 2004 [64] | NR (NR) | General population (adult); NR (NR) | NR (Stated as a adequate electronic search was conducted) | 29 (NA) | 8; United Kingdom, Sweden, Finland, Norway, Denmark, the Netherlands, the United | Cohort, case-control, cross-sectional | childhood SES | CVD and CVD mortality | NR |

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| | | | | | States, and Russia | | | | |
| Hughes 2017 [104] | 1998-2016 (May 6, 2016) | General population (adult); 210-53998 (NR) | 5; unspecified electronic databases | 37 (37) | 17; USA, UK, Finland, Canada, China, New Zealand, Philippines, Saudi Arabia, Sri Lanka, Albania, Latvia, Lithuania, Macedonia, Montenegro, Romania, Russia, and Turkey. | cohort and cross-sectional | Adverse childhood event | CVD, coronary heart disease, heart attack, and ischemic heart disease | Standard principles of quality assessment |
| Jacquet-Smailovic 2021 [105] | 1998-2019 (August 31, 2019) | General population (adult); 394 to 79,810 (40%-100%) | 5; PubMed, Medline, PsycINFO, ScienceDirect, and ProQuest | 10 (10) | 2; USA and UK | Cross-sectional and Cohort | Adverse childhood event | Myocardial infarction | National Heart, Lung and Blood Institute (NHLBI) Quality Assessment Tool |
| Mallinson 2021 [100] | 2005-2020 (September 19, 2020) | General population (adults); 794- | 3; Embase, Medline, and Global Health databases | 29 (NA) | >19 regions ; Colombia, Jamaica, multiple Latin | Cross-sectional and Cohort | childhood SES | Coronary heart disease | NOS |

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|---|---|---|---|---|---|---|---|---|---|
| | | 20,086 (27%-60%) | | | American cities, India, China, Indonesia, South Africa, Ghana, Botswana, Russia, and 1 included data from multiple world regions. | | | | |
| McEniry 2013 [99] | 2005-2011 (NR) | General population (adult, 45 and older); 1434-26,820 (NR) | 1; PubMed | 20 (NA) | 5; China and Latin America (4 countries and major cities) | Cohort | Childhood SES | Heart disease | Assessed (tool not specified) |
| Norman 2012 [103] | 1993-2012 (June 26, 2012) | General population (adult); 164-136,549 (0%-100%) | 3; Medline, Embase, and PsycINFO | 124 (124) | >18 (majority from the US and Canada); China, US, UK, Canada, Netherlands, New Zealand, South Africa, Japan, Israel, South Korea, Thailand, Denmark, | Cross-sectional, cohort and case-control | Child Physical Abuse, Emotional Abuse, and Neglect | CVD, stroke, and ischemic heart disease | NOS |

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|---|---|---|---|---|---|---|---|---|---|
| | | | | | India, Philippines, France, Australia, and Italy | | | | |
| Petruccelli 2019 [52] | 1990-2016 (September 30, 2016) | General Population (all age group); 36 - 2,313,988 (NR) | 6; Medline, Medline Daily, Epub Ahead of Print, In-Process & Other Non-indexed citations; ERIC® (Educational Resource Information Collection); HAPI (Healthcare and Psychosocial Instruments); and Scopus databases | 96 (NA) | 9; US, England, Canada, Ireland, Finland, Norway, Sweden, Australia, and the Philippines | Cohort and case-control | Adverse childhood event | Ischemic heart disease | NOS |
| Pool 2021 [102] | 1992-2018 (June 2018) | General population (NR); 126-2,298,130 (NR) | 5; Medline, Embase, PsycINFO, CINAHL, and Web of Science | 210 (NA) | NR; NR | Longitudinal | childhood SES and childhood psychosocial adversity | CVD, coronary heart disease, and stroke) | NR |

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|---|---|---|---|---|---|---|---|---|---|
| Suglia 2015 [106] | Stated above | | | 15 (NA) | | | childhood violence exposure | Stated above | |
| McHutchison 2017 [78] | Stated above | | | | | | Childhood SES | Stated above | |
| Wegman 2009 [53] | 1988-2005 (March 2017) | General population (adult); 48,801 (4%-100%) | 2; PubMed and PsycINFO | 24 (24) | NR; NR | Retrospective Cohort | Childhood abuse | Heart attack and stroke | NR |
| Kalmakis 2014 [48] | 1998-2012 (January 2013) | General population (adult); 36-68,505 (NR) | 4; PubMed, CINAHL, PsycINFO, and Social Abstracts | 42 (NA) | NR; NR | Correlational and case controls | Childhood abuse | Ischemic heart disease | NR |

[#]Presented format based on stroup DF, Berlin JA, Morton SC, Olkin I, Williamson GD, Rennie D, et al. Meta-analysis of observational studies in epidemiology: a proposal for reporting. Jama. 2000;283(15):2008-12.

**Abbreviations:** CVD, composite Cardiovascular Disease; HICs, High-income Countries; JBI, Joanna Briggs Institute; LICs, Low-Income Countries; MICs, Middle-income Countries; NA, Not Appropriate; NOS, Newcastle-Ottawa Scale; NR, Not Reported; SES, Socioeconomic Status; STROBE, Strengthening the Reporting of Observational Studies in Epidemiology; UK, United Kingdom; and USA, United States of America.

## Table S5. Summary of the included variables under social determinants of health: Evidence from the included reviews

| Construct | Measurement and/or description |
|---|---|
| Socioeconomic status (composite) | A composite variable using education-based measures such as literacy or years of schooling, aggregate measures (combination of education, income, housing, social castes or standardized scales), and income-based measures.[24, 61] Besides the above-mentioned measures, one study includes area-level socioeconomic measures |

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| | (Carstairs and Index of Multiple Deprivation).[71] A study by Salgado-Barreira et al.[43] also reports different measures for socioeconomic status.<br>Subjective social status: according to the author of the systematic review,[72] the included primary studies used a 10-rung ladder, a nine-rung ladder, the societal ladder, and the community ladder to measure subjective social status. People with a higher subjective social status were those who have the most money, the most education, and the most respected jobs. Those under lower subjective social status have the least money, the least education, and the least respected jobs or no job. |
| Education | The majority of the reviews used years of schooling to measure education and the cut point to say high and low levels of education was different (the cut point could be below and above college, high school, grade eight, etc).[62, 80, 81, 83]<br>In one study, it was categorised into three groups; low (years ≤9), medium (10–12), and high (>12 years of education).[80] However, for this umbrella review, we used the low vs high category to be consistent with other included reviews. |
| Occupation | In the majority of the studies, occupation was measured as manual vs non-manual. Others used employed vs unemployed, white collar vs blue-collar, manufacturing laborer vs officials, and others.[61, 76, 77, 83] Occupation was measured differently between reviews and between primary studies in the included reviews. Manual labourers, unemployed people, and/or blue-collar workers were mainly considered as a low occupational group (low-skilled workers).[61, 62, 82, 84] |
| Income | Most reviews referred to income as high and low without mentioning the cut point utilised to determine high and low.[61] One review used salary income with cut points; low (20,000), medium (20,001 to 40,000), and high for income (>40,000 USA dollar) per year.[80] This study does analyses separately for the three cut points. However, to make in line with the included reviews, we used the cut point that compared high- and low-income levels. |

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| Homelessness/Housing instability and Food insecurity | One review reported housing instability and food insecurity. This review reported different databases and questionnaires used to measure housing instability and food insecurity,[57] too many databases and questionnaires to state here. The other review did say nothing about how homelessness was measured. [88] |
| Job insecurity | Like other social determinants of health variables, the assessment of job insecurity across systematic reviews and within systematic reviews was different. In majorly it was measured: (1) using a global single-item question or a multidimensional dichotomised scale question; (2) using a subscale of the job content questionnaire (job insecurity scale section); (3) Other questionnaires.[85, 86] |
| Loneliness, social isolation, and/or Lack of social support | Measured using: (1) unvalidated 26- item interview (tertiles); (2) Short version of ISSI (quartiles); (3) using a single question(feelings of loneliness in the past 12 months or do you ever feel lonely); (4) using the revised UCLA Loneliness Scale; (5) using social support questionnaire (SSQ6); (6) Berkman–Syme SNI; (7) Duke Social Support Scale; (8) the SSI, and (9) using De Jong Gierveld loneliness scale.[25, 60, 67, 68]<br>In one review, social isolation was divided into structural (participants answered whether they lived alone or not) and functional (feeling of being socially isolated).[67] |
| Social capital and social role | Social capital was measured using indicators; (1) social cohesion: trust, civic/social participation, reciprocity, satisfaction with the environment, voting, helpfulness, collective efficacy, volunteering, crime, and control and (2) Social networks such as social support.[58, 94]<br>The social role was measured using either: (1) an unvalidated 26- item interview (tertiles); (2) a short version of ISSI (quartiles); (3) Berkman-Syme SNI (4 levels); (4) an unvalidated measure of all contacts and close contacts; (4) Berkman-Syme SNI (2 categories); (5) Lubben Social Network Scale (tertiles); (6) Lubben Social Network Scale (4 levels); (7) Berkman-Syme SNI (4 levels for all roles; 3 levels for close roles); and (8) Unvalidated 8-item index (continuous).[92] |
| Discrimination | History of discrimination determined via questionnaire/interview, and laboratory stigma exposure. [56] |

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|---|---|
| Ethnicity | It was mostly based on self-reported, extracted from primary care records, surname analysis, and observation by the administrative staff.[69, 97] |
| Childhood socioeconomic circumstances/status | Childhood socioeconomic status was based on a variety of measures including parental education, parental occupation, home ownership of parents, socioeconomic status of the neighbourhood that a child was exposed to, number of rooms in the childhood home and access to household assets, and family structure characteristics.[64, 65, 101]<br>It was measured during childhood or through recall during adulthood. |
| Adverse childhood events | Adverse childhood events (ACEs) are includes childhood abuse (it may be sexual, emotional, psychological, or verbal abuse), exposure to domestic violence, parental separation or divorce, household criminality, neglect, family financial problems, family conflict or discord, bullying, death of a parent or close relative or friend, and separation from family (for instance; out-of-home care).[52, 104, 105]<br>Measured using different tools such as adverse childhood experiences questionnaire by Felitti et al. (1998), adverse childhood experiences developed by Kaiser Permanent and the Centres for Disease, the Childhood Trauma questionnaire, and the Early Trauma Inventory – Self Report, self-report, conflict tactics scale, gathered adverse childhood events data from official child services and court records, and others. [48, 52] |
| Violence | It can be sexual abuse or assault, sexual harassment, sexual intimate partner violence or dating violence, or military sexual trauma.<br>Measurement tools: the sexual experiences survey and the sexual coercion section of the RCTS, a subset of questions from the revised Conflict Tactics Scales, using criminal records, questions from the Behavioral Risk Factor Surveillance System (BRFSS), and a single question “Has your spouse/significant other ever forced you to have sexual activities?”), military sexual trauma (MST) screening questionnaire, using unvalidated single question (‘Did you ever have an experience where someone used force or the threat of force to have sexual relations with you against your will while you were in the military?’.[59, 106, 108] |

| | |
|---|---|
| | Violence can be happened during childhood; considered in the early childhood development domain or during adulthood; considered in the neighboorhood and built environment domain. |
| Conflict | Include the Croatian War of Independence (1991–1995), Bosnian War (1992–1995), Colombian conflict (1975–2015), Siege of Leningrad (1941–1944), Lebanese Civil War (1975–1991), Georgian-Ossetian Conflict (1989–present), US-led invasion of Iraq (2003–2011), Sudan Civil War (1983–2015), Unspecific conflicts in Uganda, and Other conflicts.[70] |
| Neighborhood socioeconomic deprivation (area level deprivation) | Measured using different tools such as Carstairs and Morris index, Area-level socioeconomic status composite score, Neighbourhood socioeconomic status composite index, census tracts and block groups, small area market statistics, Chocho-Aza units, and postal or zip codes.[26, 77, 81, 111] |
| Variables related to built environment | Geographic information system (GIS) and subjective assessment using Neighborhood Environment Walkability Scale (NEWS) were used to assess the build environment.[110]<br>The common environmental attributes identified were proximity to a major road, access to food stores, recreational areas, access to fast-food restaurants, distance from healthcare facility, and traffic density.<br>Besides, one review was on food environments measured based on relation to participants' residential location, youths' school location or both; objectively or based on participants' perceptions of their food environment.<br>Access is in terms of count or distance relative to participants' residence or school, while availability refers to the in-store availability of food products.[49] |

**Abbreviations:** ISSI, Interview Schedule for Social Interaction; SNI = Social Network Index; RCTS, Revised Conflict Tactics Scale; UCLA, University of California Los Angeles

**Table S6. Quality assessment results of the included systematic reviews and meta-analyses.**

| QUALITY ASSESSMENT | | AMSTAR 2 tool (The 16 items) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | Overall Quality |
| Author | Year | Y/N | Y/PY/N | Y/N | Y/PY/N | Y/N | Y/N | Y/PY/N | Y/PY/N | Y/PY/N | Y/N | Y/N/NM | Y/N/NM | Y/N | Y/N/ | Y/N/NM | Y/N | CL/L/M/H |
| Agisilaou | 2020 | Y | N | N | PY | N | N | N | PY | Y | N | NM | NM | N | N | NM | N | CL |
| Allan | 2017 | Y | N | N | N | Y | N | N | Y | N | N | NM | NM | N | N | NM | Y | CL |
| Al-Shakarchi | 2020 | Y | N | N | N | Y | N | N | Y | Y | N | Y | N | N | Y | N | Y | CL |
| Backholer | 2017 | Y | N | N | N | N | N | N | Y | Y | N | Y | N | N | Y | Y | Y | CL |
| Barth | 2010 | Y | N | Y | PY | Y | Y | N | PY | N | N | Y | N | N | Y | Y | Y | CL |
| Bijker | 2016 | Y | N | N | Y | N | N | N | Y | N | N | NM | NM | N | N | NM | Y | CL |
| Birhanu | 2022 | Y | Y | Y | PY | Y | Y | N | Y | Y | N | Y | Y | Y | Y | Y | Y | L |
| Chin | 2020 | Y | N | N | PY | Y | N | N | Y | N | N | NM | NM | N | Y | NM | Y | CL |
| Choi | 2014 | Y | N | N | PY | Y | N | N | Y | N | N | NM | NM | N | Y | NM | Y | CL |
| Cortes-Bergoderi | 2013 | Y | N | N | Y | Y | N | N | Y | Y | N | Y | N | N | Y | N | Y | CL |
| Eller | 2009 | Y | N | N | N | N | N | N | Y | Y | N | NM | NM | N | N | NM | y | CL |
| Ezzatvar | 2021 | Y | Y | N | Y | Y | Y | Y | Y | Y | N | Y | Y | Y | Y | Y | Y | H |
| Francis | 2015 | Y | N | Y | Y | Y | N | N | Y | N | N | NM | NM | N | N | NM | Y | CL |
| Freak-Poli | 2022 | Y | Y | Y | Y | N | N | Y | Y | Y | N | Y | Y | Y | Y | Y | Y | M |
| Galobardes | 2004 | Y | N | N | N | N | N | N | Y | N | N | NM | NM | N | Y | NM | Y | CL |
| Galobardes | 2006 | Y | N | Y | PY | N | N | N | Y | N | N | NM | NM | N | Y | NM | N | CL |
| Gonzalez | 1998 | Y | N | N | N | N | Y | N | Y | N | N | NM | NM | N | N | N | N | CL |
| Hawkins | 2012 | Y | N | Y | Y | N | N | N | Y | N | N | NM | NM | N | N | NM | Y | CL |
| Ho | 2021 | Y | Y | N | Y | N | N | N | Y | Y | N | Y | N | N | Y | Y | Y | CL |
| Hughes | 2017 | Y | N | N | N | N | N | N | Y | Y | N | Y | N | N | Y | Y | Y | CL |

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Jacquet-Smailovic | 2021 | Y | Y | N | Y | Y | N | N | Y | Y | N | Y | Y | Y | Y | Y | Y | L |
| Jakubowski | 2021 | Y | Y | N | Y | Y | Y | N | Y | Y | N | Y | N | Y | Y | Y | Y | L |
| Jawad | 2019 | Y | Y | Y | Y | Y | N | N | Y | Y | Y | Y | Y | Y | Y | Y | Y | L |
| Jin | 2015 | Y | N | Y | Y | Y | N | N | Y | Y | N | Y | Y | N | Y | Y | Y | CL |
| Kalmakis | 2014 | Y | N | N | PY | N | Y | N | Y | N | N | NM | NM | N | N | NM | Y | CL |
| Kerr | 2011 | Y | N | N | PY | Y | N | N | PY | N | N | Y | N | N | Y | N | N | CL |
| Khaing | 2017 | Y | Y | N | Y | N | Y | N | Y | Y | N | Y | N | N | Y | Y | N | CL |
| Kim | 2021 | Y | N | N | Y | Y | Y | N | Y | Y | N | NM | NM | Y | Y | NM | Y | CL |
| Kraft | 2020 | Y | N | N | PY | N | N | N | Y | N | N | NM | NM | N | Y | NM | NR | CL |
| Kuper | 2002 | Y | N | Y | Y | N | N | N | Y | N | N | NM | NM | N | Y | NM | NR | CL |
| Lee | 2021 | Y | N | N | PY | Y | N | N | Y | Y | N | NM | NM | N | Y | NM | Y | CL |
| Lightbody | 2017 | Y | PY | N | Y | Y | N | N | Y | Y | N | Y | N | Y | Y | Y | N | L |
| Lunde | 2018 | Y | N | N | Y | N | N | N | Y | Y | N | NM | NM | N | Y | NM | Y | CL |
| Malambo | 2016 | Y | N | N | Y | N | Y | Y | Y | Y | N | NM | NM | N | Y | NM | Y | CL |
| Mallinson | 2021 | Y | Y | N | Y | N | N | N | Y | Y | N | NM | NM | Y | Y | NM | Y | L |
| Manfique-Garcia | 2011 | Y | N | N | Y | N | N | N | Y | N | N | Y | N | N | Y | Y | Y | CL |
| McEniry | 2013 | Y | N | N | N | N | N | N | Y | N | N | NM | NM | N | N | NM | Y | CL |
| McHutchison | 2017 | Y | Y | N | Y | N | N | N | Y | Y | N | Y | N | Y | Y | Y | Y | L |
| Burnette | 2020 | Y | N | N | Y | N | N | N | Y | N | N | NM | NM | N | N | NM | Y | CL |
| MorettiAnfossi | 2022 | Y | Y | Y | Y | N | Y | N | Y | Y | N | NM | NM | Y | Y | NM | Y | L |
| Norman | 2012 | Y | PY | N | Y | Y | N | N | Y | Y | N | Y | Y | Y | Y | Y | Y | L |
| O'Neil | 2018 | Y | N | N | Y | Y | N | N | Y | N | N | NM | NM | N | N | NM | Y | CL |
| Oramasionwu | 2012 | Y | N | N | N | N | N | N | Y | N | N | NM | NM | N | N | NM | Y | CL |
| Panza | 2019 | Y | N | N | PY | N | Y | N | Y | Y | N | NM | NM | Y | Y | NM | Y | CL |
| Parekh | 2022 | Y | Y | N | N | N | N | N | Y | Y | N | NM | NM | Y | Y | NM | Y | CL |
| Park | 2021 | Y | N | N | PY | Y | Y | N | Y | Y | N | Y | Y | Y | Y | N | Y | CL |
| Park | 2022 | Y | N | N | Y | N | Y | N | Y | N | N | Y | N | N | N | Y | Y | CL |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pate | 2021 | Y | N | N | PY | N | N | N | Y | N | N | NM | NM | N | N | NM | Y | CL |
| Peer | 2020 | Y | N | Y | PY | Y | N | N | Y | Y | N | NM | NM | N | Y | NM | Y | CL |
| Petitte | 2015 | Y | N | N | PY | N | N | N | Y | N | N | NM | NM | N | N | NM | Y | CL |
| Petruccelli | 2019 | Y | PY | N | Y | Y | Y | N | Y | Y | N | Y | N | Y | Y | N | Y | CL |
| Pool | 2021 | Y | N | N | N | N | N | N | Y | N | N | NM | NM | N | Y | NM | Y | CL |
| Potter | 2019 | Y | N | N | Y | N | Y | N | Y | Y | N | Y | Y | Y | Y | N | Y | CL |
| Rodgers | 2019 | Y | PY | N | Y | Y | N | N | Y | N | N | NM | NM | N | N | NM | Y | CL |
| Zaman | 2013 | Y | PY | N | Y | Y | Y | N | Y | N | N | Y | N | N | Y | N | Y | CL |
| Saif-Ur-Rahman | 2021 | Y | Y | N | Y | Y | Y | N | Y | Y | N | NM | NM | Y | Y | NM | Y | L |
| Salgado-Barreira | 2014 | Y | N | N | Y | Y | N | N | PY | N | N | NM | NM | N | Y | NM | N | CL |
| Sanchez-Santos | 2013 | Y | N | N | N | N | N | N | Y | N | N | Y | N | N | N | N | Y | CL |
| Sebastianski | 2014 | Y | N | N | Y | N | Y | N | Y | Y | N | Y | N | N | Y | N | Y | CL |
| Smaardijk | 2019 | Y | Y | N | Y | Y | N | N | Y | N | N | Y | N | N | Y | Y | Y | CL |
| Suglia | 2015 | Y | N | N | Y | N | N | N | Y | Y | N | NM | NM | N | Y | NM | Y | CL |
| Tang | 2016 | Y | PY | N | Y | Y | N | N | Y | Y | N | Y | Y | Y | Y | Y | Y | L |
| Theorell | 2016 | Y | N | N | Y | N | N | N | Y | Y | N | NM | NM | Y | Y | NM | Y | CL |
| Tibirica | 2022 | Y | N | N | PY | N | N | N | Y | Y | N | NM | NM | Y | Y | NM | Y | L |
| Valtorta | 2016 | Y | Y | N | Y | N | N | N | Y | Y | N | Y | Y | Y | Y | Y | Y | L |
| Vathesatogkit | 2014 | Y | N | N | Y | N | N | N | Y | N | N | Y | Y | N | Y | Y | Y | CL |
| Virtanen | 2013 | Y | N | N | Y | Y | N | Y | Y | N | N | Y | N | N | Y | N | Y | CL |
| Wang | 2020 | Y | N | N | PY | Y | N | N | Y | Y | N | Y | N | N | Y | Y | Y | CL |
| Wegman | 2009 | Y | N | N | Y | N | N | N | Y | N | N | Y | N | N | Y | Y | Y | CL |
| Williams | 2018 | Y | Y | N | Y | Y | N | N | Y | Y | N | NM | NM | Y | Y | NM | Y | L |

In the top row Dark orange highlights indicate critical and light green indicate non-critical domains.

**Abbreviations**: CL, critically low; H, high; L, low; M, Medium; N, No; NM, No Meta-analysis; PY, Partial Yes; Y, Yes.

**Figure S1. Heatmap of findings from systematic reviews without meta-analysis assessing the association between social determinants of health and cardiovascular disease outcomes (n=40).**

| Social; determinants of health characteristics | Cardiovascular disease outcome | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cardiovascular disease | Cardiovascular disease mortality | Stroke | Coronary artery/heart disease | Heart Failure | Heart disease | Myocardial infarction | Ischemic Heart disease | Angina | Atrial fibrillation | Cardiomyopathy |
| **Economic stability theme** | | | | | | | | | | | |
| Composite SES | Lee 2021 (n=4) | Williams 2018 (n=2) | Williams 2018 (n=1) | Williams 2018 (n=1) | Hawkins 2012 (n=8) | Salgado-Barreira 2014 (n=8) | Williams 2018 (Acute, n=1) | | | Allan 2017 (n=6) | Agisilaou 2020 (n=2) |
| Education | Birhanu 2022 (n=4) | | | | | | | Gonzalez 1998 (n=14) and Lee 2021 (n=1) | | Lunde 2020 (n=9) | |
| Income | | Lee 2021 (n=2) | | | | | Lee 2021 (n=1) | | | Lunde 2020 (n=5) | Agisilaou 2020 (n=3) |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Occupation | Lee 2021 (n=3) & Saif-Ur-Rahman 2021 (n=1)<br>Birhanu 2022 (n=2) | Lee 2021 (n=3) and Saif-Ur-Rahman 2021 (n=1) | Lee 2021 (n=3) & Saif-Ur-Rahman 2021 (n=1) | | | | Lee 2021 (n=3) | Gonzalez 1998 (n=23) & Saif-Ur-Rahman 2021 (n=1) | Lee 2021 (n=3) | Lunde 2018 (n=3) | |
| Job insecurity | | | | Theorell 2016 (CHD, n=15) | | | | MorettiAnfossi 2022 (n=7)<br>Eller 2019 (n=5) | | | |
| Homelessness | Parekh 2022 (1) | Parekh 2022 (n=2) | Parekh 2022 (n=3) | | | Parekh 2022 (n=1) | | Parekh 2022 (mortality, n=1) | | | Parekh 2022 (mortality, n=1) |
| Food insecurity | Parekh 2022 (n=5) | Parekh 2022 (n=2) | | Parekh 2022 (CHD, n=2) | Parekh 2022 (CHF, n=2) | | Parekh 2022 (n=1) | | | | |
| **Social and community context theme** | | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Lack of/poor social support | | | | Kuper 2002 (n=12) | | | Barth 2010 (n=5) | Eller 2019 (n=7) and Theorell 2016 (n=11) | | | |
| Loneliness and social isolation | | | Petitte 2015 (n=1) and Tibirica 2022 (n=1) | Petitte 2015 (n=1) | | Tibirica 2022 (n=1) | | Petitte 2015 (mortality, n=1) | | | |
| Social capital index | | Choi 2014 (n=6) and Rodgers 2019 (n=6) | Rodgers 2019 (n=1) | Rodgers 2019 (mortality, n=1) | | | Rodgers 2019 (acute, mortality, n=1) | | | | |
| Social capital (Fewer social roles) | Chin 2020 (n= 12) | Chin 2020 (n= 7) | | | | | | | | | |
| Discrimination | Panza 2019 (n=1) | Panza 2019 (n=1) | Panza 2019 (n=1) | | | | Panza 2019 (n=1) | | Panza 2019 (n=1) | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Ethnicity (Black vs White) | Oramasionwu 2012 (n=2) | | Oramasionwu 2012 (n=1) | Oramasionwu 2012 (n=1) | | Oramasionwu 2012 (n=1) | Oramasionwu 2012 (n=2) | Oramasionwu 2012 (n=2) | | | |
| Ethnicity (African-American, Asian, Chinese, Hispanic, and Non-Hispanic Black vs White) | | | | | | | | | | Allan 2017 (n=5) | |
| Ethnicity (Afro-Caribbean vs Caucasian) | | | | | | | | Francis 2015 (mortality, n=1) | | | |
| Ethnicity (African-American and Hispanic and white women) | | | | | | | | | | | Agisilaou 2020 (n=5) |
| **Early childhood development theme** | | | | | | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Childhood socioeconomic status | Galobarde 2006 (n=40) and Pool 2021 (n=7) | Galobardes 2004 (n=9) | Bijker 2016 (n=1) and Pool 2021 (n=2)<br>Galobardes 2004 (mortality n=6) | Galobardes 2004 (mortality, n=10) and Pool 2021 (n=2)<br>Mallinson 2021 (n=3) | Bijker 2016 (n=1) | McEniry 2013 (n=3) | | | | | |
| Adverse childhood events* | Pool 2021 (n=5) and Suglia 2015 (n=8) | | Pool 2021 (n=3) | Pool 2021 (n=1) | Pool 2021 (n=1) | | | Suglia 2015 (n=8) and Kalmakis 2014 (n=1) | | | |
| **Neighborhood and built environment** | | | | | | | | | | | |
| Violence | Burnette 2020 (n=1), O'Neil 2018 (n=1), and Pate 2021 (n=1) | | Suglia 2015 (n=3)<br>Peer 2020 (n=1) | Suglia 2015 (n=4) | Suglia 2015 (CHF, n=2) | | Suglia 2015 (n=3)<br>Peer 2020 (n=1) | | | | |
| Conflict | | | Jawad 2019 (n=5) | | | Jawad 2019 (n=5) | Jawad 2019 (acute, n=7) | Jawad 2019 (chronic, n=4)<br>Jawad 2019 (mortality, chronic, n=3) | Jawad 2019 (n=5) | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Jawad 2019 (mortality, n=4) | | | Jawad 2019 (mortality, n=5) | | | | | |
| Environmental attributes[#] | | | Malambo 2016 (n=2) and Kraft 2020 (n=1) | Malambo 2016 (n=2)<br>Kraft 2020 (n=1) | Malambo 2016 (CHF, n=1) | | Malambo 2016 (n=1) | | Malambo 2016 (n=1) | | |
| Neighborhood socioeconomic disadvantage | | | | | | | | | | | Kim 2021 (n=8) |

[#]Includes inaccessibility of healthcare facilities, environmental noise, proximity to a major road/ high traffic density, high crime rate, reduced access to food stores, parks/recreation, and increased access to fast food restaurants.

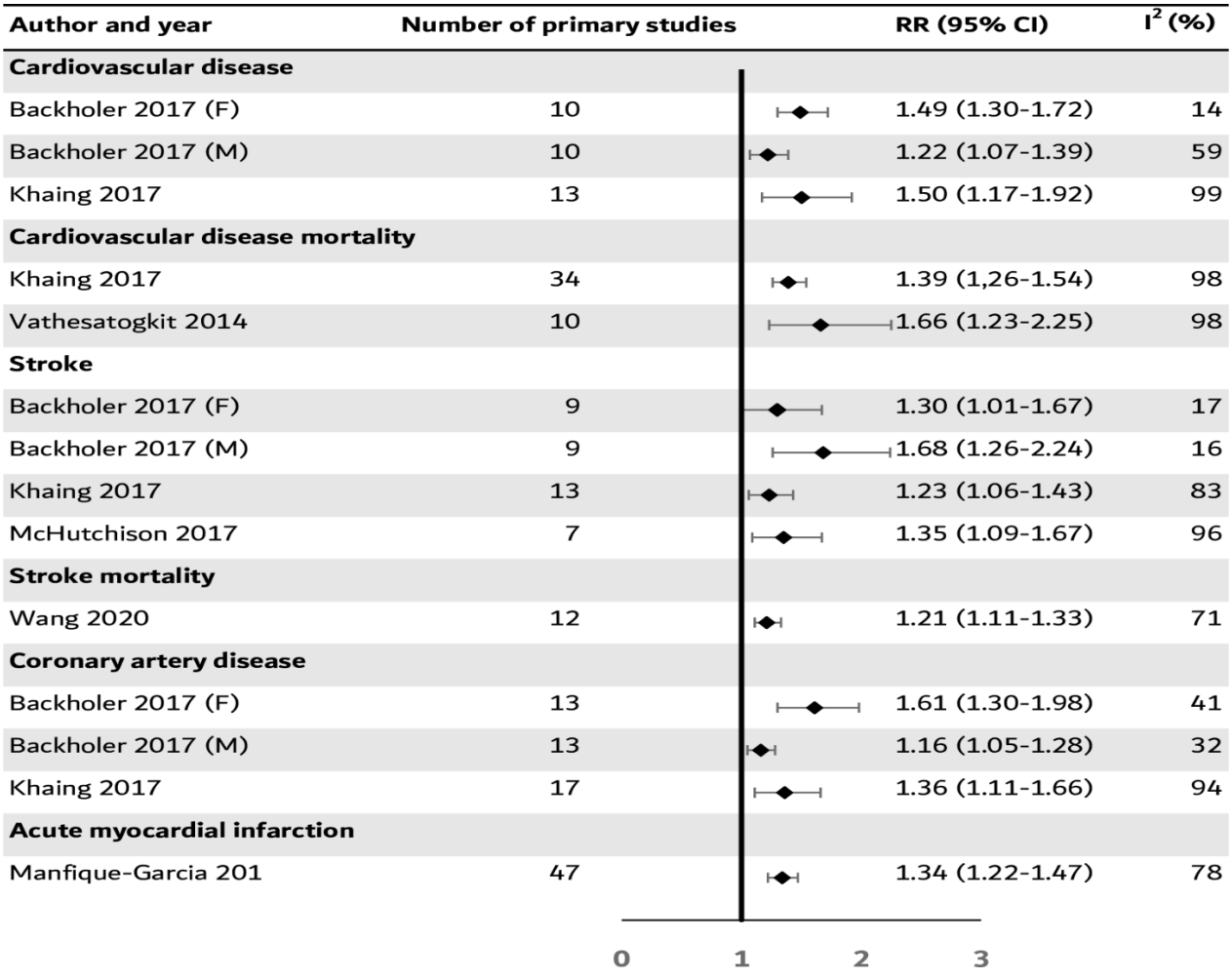
*Childhood adverse events such as lower childhood cumulative adverse events and adverse events specific to abuse, neglect, and violence.

Available systematic reviews are presented as first author, year of publication, and the number of studies (represented by n) contributing to the finding.

Red highlighting indicates that worse/poor SDoH factor is associated with a higher CVD risk. Orange highlighting indicates an inconsistent relationship. Yellow highlighting indicates a null relationship and those without highlighting indicate there were no reviews (without meta-analysis) that assessed the exposure and the specified CVD and CVD subtype. No reviews (without meta-analysis) reported a protective effect of poor SDoH on CVD.

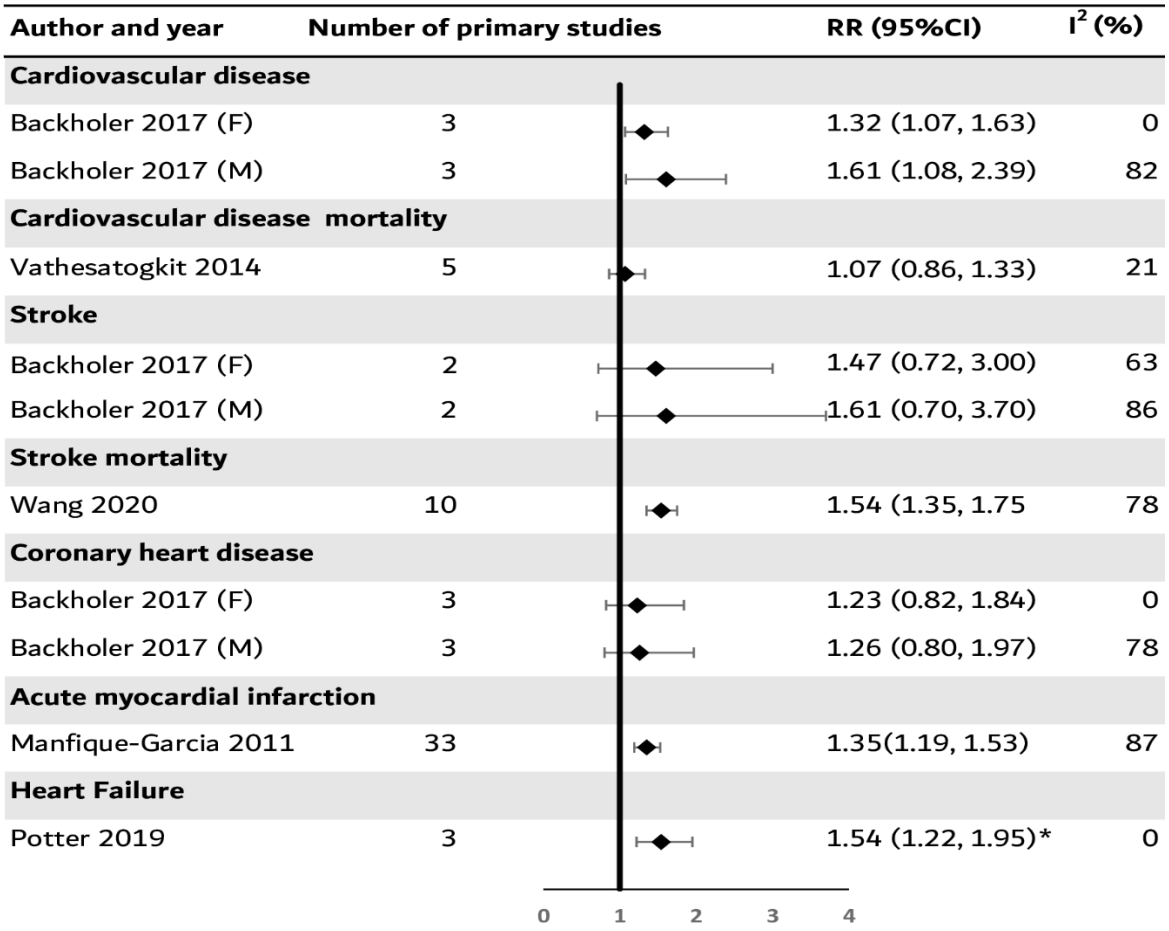
**Abbreviations:** CHD, Coronary Heart Disease; CHF, Congestive Heart Failure

**Figure S2. Forest plot of outcomes from systematic reviews with meta-analytic analyses assessing the association between education (lower vs higher level of education; reference: lower level of education) and CVD.**




**Abbreviations:** CI, confidence interval; F, Female; $I^2$, Heterogeneity; M, Male; RR, Relative Risk.

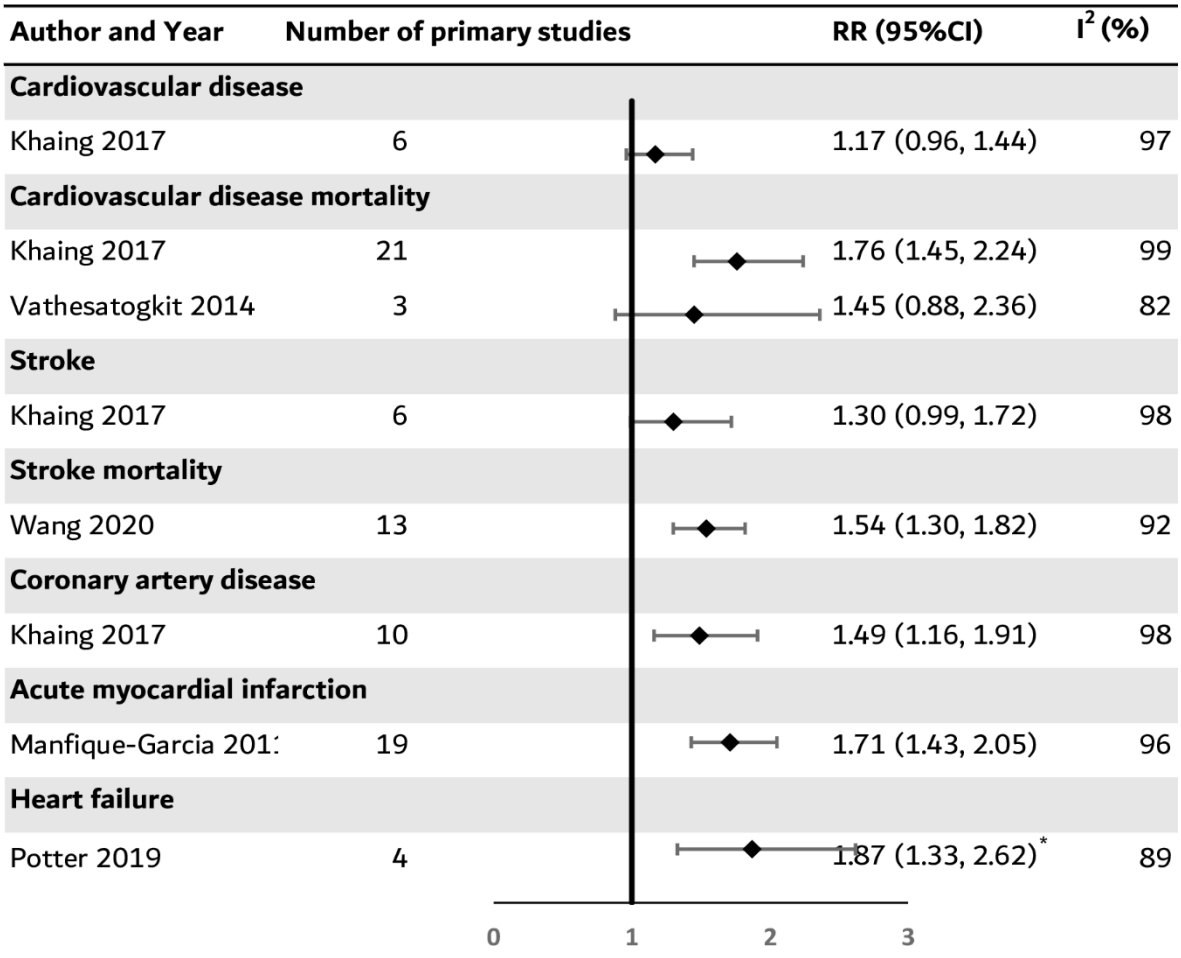
**Figure S3. Forest plot of outcomes from systematic reviews with meta-analytic analyses assessing the association between occupation (lower vs higher occupation level; reference: lower occupational level) and CVD.**




* Hazard ratio

**Abbreviations**: CI, confidence interval; F, Female; $I^2$, Heterogeneity; M, Male; RR, Relative Risk.

**Figure S4. Forest plot of outcomes from systematic reviews with meta-analytic analyses assessing the association between income (lower vs higher level of income; reference: lower level of income) and CVD.**

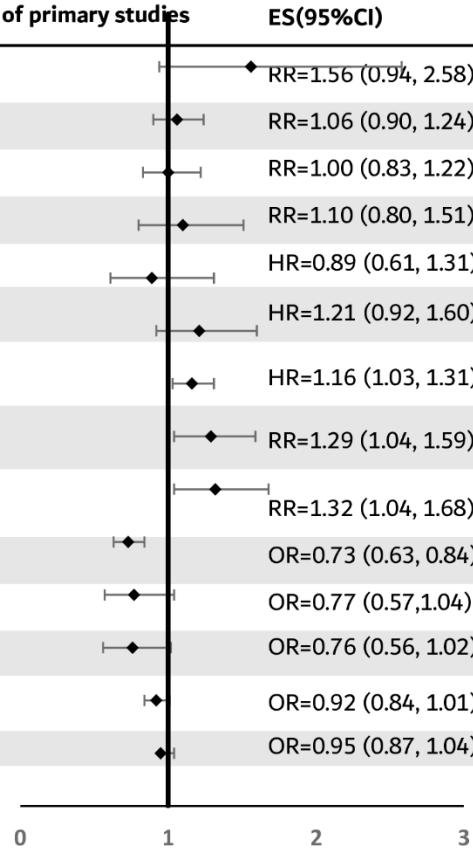



*Hazard ratio

**Abbreviations**: CI, confidence interval; F, Female; $I^2$, Heterogeneity; M, Male; RR, Relative Risk.

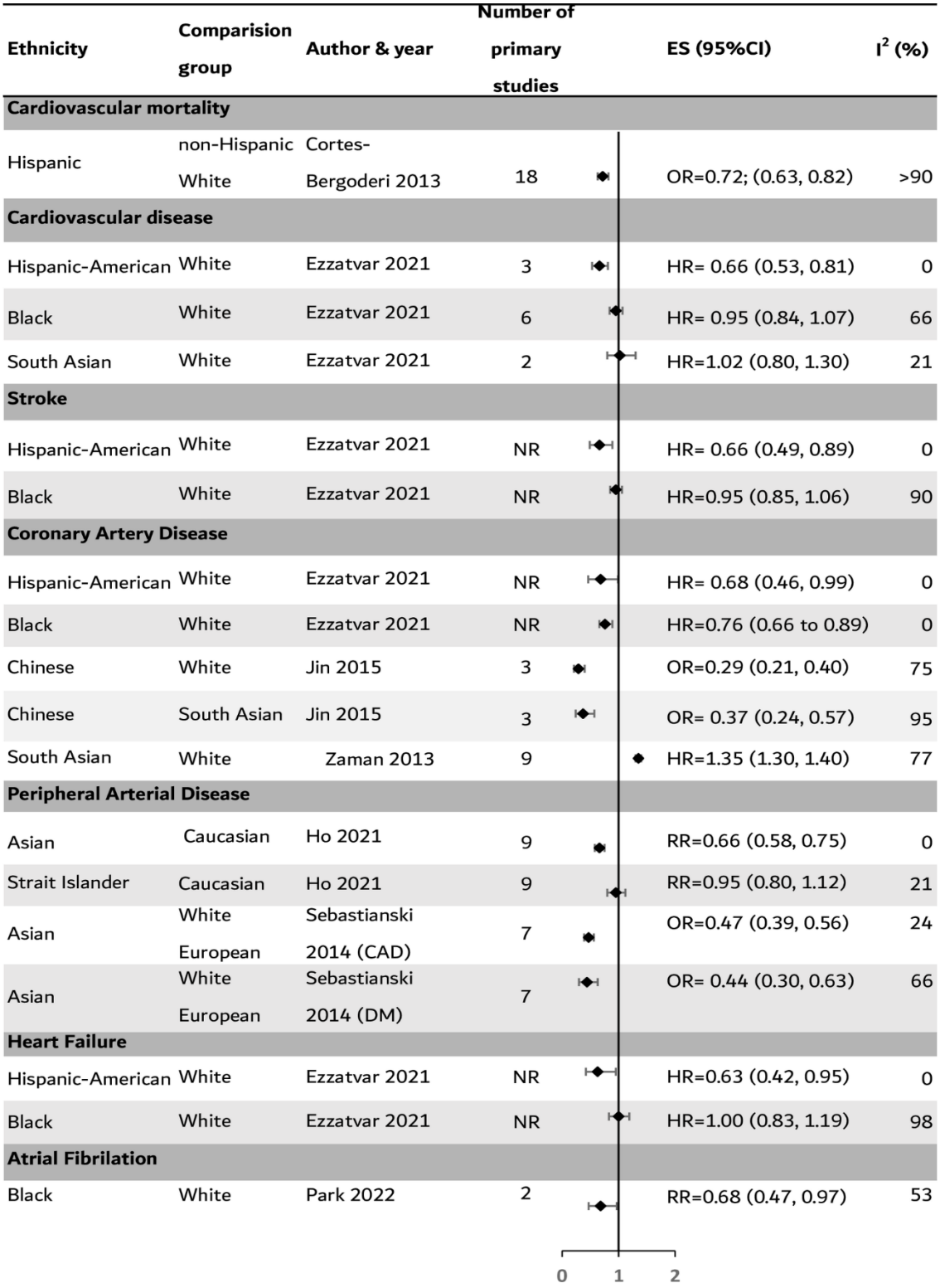
**Figure S5. Forest plot of outcomes from systematic reviews with meta-analytic analyses assessing the association between social health and CVD.**

| Exposure | Author and Year | Outcome | Number of primary studies | ES(95%CI) | $I^2$ (%) |
|---|---|---|---|---|---|
| Poor social support | Barth 2010 | CVD mortality | 5 | RR=1.56 (0.94, 2.58) | 84 |
| | Freak-poli 2022 | CVD | 4 | RR=1.06 (0.90, 1.24) | 55 |
| | Freak-poli 2022 | Stroke | 2 | RR=1.00 (0.83, 1.22) | 0 |
| | Freak-poli 2022 | CHD | 2 | RR=1.10 (0.80, 1.51) | 84 |
| | Smaardijk 2019 (F) | IHD | 3 | HR=0.89 (0.61, 1.31) | 44 |
| | Smaardijk 2019 (M) | IHD | 3 | HR=1.21 (0.92, 1.60) | 42 |
| | Lightbody 2017 | Stroke | 10 | HR=1.16 (1.03, 1.31) | 74 |
| Social isolation & loneliness | Valtorta[SI&L] 2016 | CHD | 11 | RR=1.29 (1.04, 1.59) | 66 |
| | Valtorta[SI] 2016 | Stroke | 8 | RR=1.32 (1.04, 1.68) | 53 |
| High social network | Park 2021 | CVD mortality | 2 | OR=0.73 (0.63, 0.84) | 0 |
| | Park 2021 | Stroke | 3 | OR=0.77 (0.57,1.04) | 21 |
| | Park 2021 | CHD | 2 | OR=0.76 (0.56, 1.02) | 0 |
| High social cohesion | Park 2021 | Stroke | 2 | OR=0.92 (0.84, 1.01) | 11 |
| | Park 2021 | CHD | 2 | OR=0.95 (0.87, 1.04) | 0 |




**Abbreviations:** CHD, Coronary Heart Disease; CI, confidence interval; E, Effect size; F, Female; HR, Hazard Ratio; $I^2$, Heterogeneity; IHD, Ischemic Heart Disease; M, Male, OR, Odds Ratio; RR, Relative Risk; SI, Social isolation; SI&L, Social Isolation and Loneliness.

**Figure S6. Forest plot of outcomes from systematic reviews with meta-analytic analyses assessing the association between Ethnicity and CVD.**




**Abbreviations**: CAD, among patients with Coronary Artery Disease; CI, confidence interval; DM, among patients with Diabetes Mellitus, ES, Effect size; HR, Hazard Ratio; $I^2$, Heterogeneity; NR, Not Reported; OR, Odds Ratio; RR, Relative Risk.

**Figure S7. Forest plot of outcomes from systematic reviews with meta-analytic analyses assessing the association between early childhood events and adulthood CVD.**

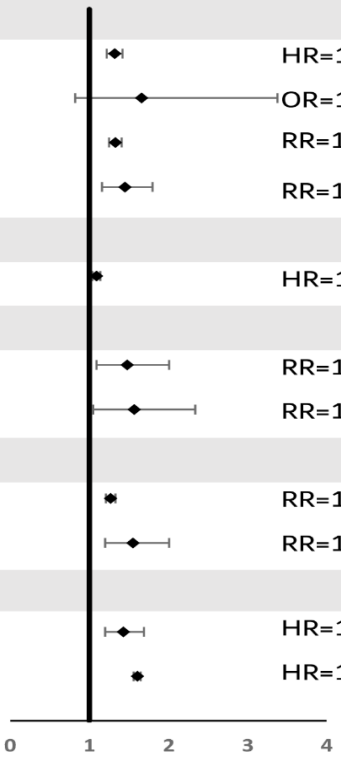
| Childhood event | Author and year | Outcome | number of primary studies | OR (95%CI) | $I^2$ (%) |
|---|---|---|---|---|---|
| Adverse childhood events[$] | Hughes 2017 | CVD | 8 | 2.07 (1.66, 2.59) | 24 |
| | Jacquet-Smailovic 2021 | MI | 3 | 1.78 (1.24, 2.57) | 76 |
| | Petruccelli 2019 | IHD | 4 | 6.62 (5.26, 8.34) | NR |
| Childhood abuse | Norman 2012 | CVD | 4 | 1.57 (1.21, 2.22) | 56 |
| | Norman 2012 | Stroke | 3 | 1.76 (0.56, 5.51) | 0 |
| | Wegman 2009 | CVD | 7 | 0.66 (0.63, 0.70)[#] | NR |
| Childhood neglect | Norman 2012 | Stroke | 2 | 3.0 (0.99, 9.10) | 0 |
| | Norman 2012 | IHD | 2 | 1.35 (1.17, 1.55) | 0 |
| Low Childhood SES | McHutchison 2017[^] | Stroke | 3 | 1.31(1.03, 1.68)* | 88 |
| | | Stroke | 6 | 1.28 (1.12, 1.46) | 56 |


[$]Cumulative adverse childhood events, [#]Mean difference; ^ the author reports two effect sizes; * Hazard Ratio;

**Abbreviations:** CI, confidence interval; $I^2$, Heterogeneity; IHD, Ischemic Heart Disease; MI, Myocardial Infarction; NR, Not Reported; OR, Odds Ratio.

**Figure S8. Forest plot of outcomes from systematic reviews with meta-analytic analyses assessing the association between the neighborhood and build environment and adulthood CVD.**

| Exposure | Author & year | Number of primary studies | ES (95%CI) | $I^2$ (%) |
|---|---|---|---|---|
| Having history of sexual violence | **Cardiovascular disease** | | | |
| | Jakubowski 2021 | 33[es] | HR=1.32 (1.22, 1.42) | 53 |
| | Jakubowski 2021 | 3[es] | OR=1.66 (0.82, 3.38) | 90 |
| Lower Neighborhood Socioeconomic status/area-level deprivation | Backholer 2016 (M) | 3 | RR=1.33 (1.25, 1.41) | 25 |
| | Backholer 2016 (F) | 3 | RR=1.45 (1.16, 1.80) | 85 |
| | **Cardiovascular disease mortality** | | | |
| | Sanchez-Santos 2013 | 8 | HR=1.09 (1.04, 1.14) | 80 |
| | **Stroke** | | | |
| | Backholer 2016 (M) | 3 | RR=1.48 (1.09, 2.01) | 77 |
| | Backholer 2016 (F) | 3 | RR=1.57 (1.05, 2.34) | 84 |
| | **Coronary heart disease** | | | |
| | Backholer 2016 (M) | 2 | RR=1.27 (1.21, 1.33) | 0 |
| | Backholer 2016 (F) | 2 | RR=1.55 (1.20, 2.01) | 82 |
| | **Heart failure** | | | |
| | Potter 2019 ($CI_x$) | 2 | HR=1.43 (1.2, 1.69) | 0 |
| | Potter 2019 (IMD) | 2 | HR=1.61 (1.56, 1.65 ) | 0 |




[es] number of effect sizes

**Abbreviations**: CI, confidence interval; $CI_x$, Carstairs index; E, Effect size; F, Female; HR, Hazard Ratio; $I^2$, Heterogeneity; IMD, Index of Multiple Deprivation; M, Male; OR, Odds Ratio; RR, Relative risk.