Institute for Health Metrics and Evaluation

Evaluation frameworks for the social determinants of cardiovascular disease: A Landscape Review of Existing Approaches

Louisa Johnson MA
Kate LeGrand MPH
Feras Wahab MPH
Emmanuela Gakidou PhD
Bernardo Hernandez Prado DSc
Gregory Roth M.D.

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Acronyms

AHA   American Heart Association

CVD   Cardiovascular disease

IHME   Institute for Health Metrics and Evaluation

SDH   Social determinants of health

SES   Socioeconomic status

SIF   Social Impact Fund

WHO   World Health Organization

Executive Summary

There are strong associations between Social Determinants of Health (SDH) and health outcomes, specifically for cardiovascular disease (CVD) and in order to understand the psychosocial, biological, and environmental pathways in which SDH affect health outcomes, institutions have developed frameworks for defining and measuring SDH.

This report provides an overview of SDH frameworks and metrics that exist in the form of academic literature and institutional reports. We sought to identify frameworks and sources through a combination of a systematic literature review and an institutional review.

We provide an overview of some key SDH frameworks developed by major global health institutions including the World Health Organization and the US Department of Health and Human Services. Our analysis included 26 sources identified in the literature review and 36 in the institutional review, for a total of 62 sources of information.

Figure I Frequency of SDH categories
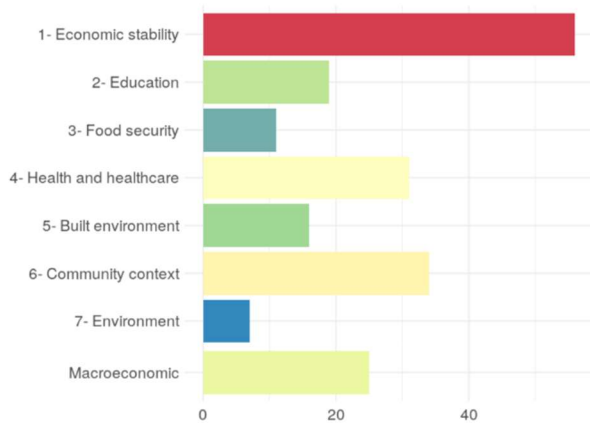
From each institutional framework, we identified and extracted the domains and metrics and categorized them into nine categories: **Economic stability, Education, Food security, Health and healthcare, Built environment, Community context, Environment,** and **Macroeconomic.** Overall results from this analysis can be seen in Figure I.[1]

Through defining, categorizing, and quantifying determinants and domains, we saw that many SDH frameworks incorporate similar overall determinants and domains, but few contain overlapping metrics.

The review identified as the most cited determinants economic stability (including important variables that are strongly related to CVD, such as income, occupation, housing, and socioeconomic status), and education. Other determinants, like food security, health and healthcare and community context are also mentioned in their relation to SDH. The literature review also allowed to identify research about SDH and CVD, specifically environment as SDH, which is typically included in SDH frameworks.

The literature review described in this report will be used at later stages of this project to provide a structure able to capture SDH addressed in projects included in the American Heart Association´s Social Impact Fund (SIF) portfolio. The analysis of variables and metrics used in existing studies will be also useful to develop this structure and capture information about SDH in a systematic way.

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[1] Social Determinant of Health (SDH) categories: **Economic stability** measures include income, occupation, and housing. **Education** includes variables related to education level and schooling. **Food security** measures access to and quality of food as well as diet and nutrition. **Health and healthcare** measures access to and quality of healthcare. **Built environment** includes physical structures that individuals interact with. **Community context** includes social support and cultural aspects. The **Environment** category measures the effects of environmental factors such as air pollution and climate change. The **Macroeconomic** category includes measures related to policy and governance.

Introduction

The political, macroeconomic, structural, and societal factors affecting health are critical in understanding and preventing cardiovascular disease (CVD). The conditions into which we are born, grow, learn, play, work and age have a strong impact on our life-long physical and mental health and well-being. These social determinants of health (SDH) represent the everyday factors to which we are exposed.

Numerous studies have shown strong associations of inequalities in SDH related to education, environment, working conditions and income with increased risk for diseases and poor health, as well as worse prognosis and outcomes for affected individuals (Kreatsoulas & Anand, 2010). These inequalities suggest the importance of SDH for the prevention of CVD and the need to measure them in robust and reproducible ways (Mannoh et al., 2021; Roger, 2020).

Programs, policies, and interventions such as those funded by American Heart Association's Social Impact Fund (SIF) can target inequities caused by SDH and are likely to have positive impact in the prevention of disease, adherence to treatment, improved care and ultimately more favorable outcomes for CVD and other diseases and conditions. Several organizations have highlighted the importance of considering SDH across the course of clinical care, including the American Heart Association (AHA) (White-Williams et al., 2020). Because SDH are foundational, addressing them should have positive effects on a broad range of human health and well-being. Having evidence-based tools for the measurement of social determinants of health takes on increasing importance in this context.

Project overview: Measuring social determinants of health to help evaluate interventions

The overarching goal of this project is twofold: 1) to develop an approach for measuring the effect of social, environmental, and structural determinants of health across a broad portfolio of programs supported by AHA, and 2) to establish standards for social determinants of health SDH measurement and impact evaluation for CVD and related outcomes. The project's first phase is to review and compile existing SDH measurement models in the literature, as related to CVD. Subsequent phases of the project will involve development of an evidence-based theoretical model and theory of change for impact evaluation of programs targeting SDH and CVD and creating an SDH evaluation framework for the SIF programs grounded in an evidence-based theoretical model.

Objectives of this report: What are the existing approaches to SDH evaluation

This report provides a landscape review of existing frameworks for the analysis of SDH and their relationship with CVD in order to support this project's first objective. This report is not intended to be an exhaustive review of this large field, but rather **a description of the major frameworks proposed by major organizations and leading research groups**. We present existing evidence in support of the development of an evaluation framework for interventions designed to improve CVD by addressing SDH. We also report a **review of the published literature describing existing approaches** for the measurement of SDH as it relates to overall health and CVD in particular. We categorize existing methods by domains of SDH. Domains serve as an organizing principle for this review and are described in more detail throughout the report.

Theoretical frameworks for social determinants of health: Why models matter

Improvements in population health often result from health promotion and health education activities that change behaviors. Developing successful health interventions, programs and policies requires an understanding of the social, environmental, and cognitive circumstances that lead to healthy behaviors. Behavior theory is a core tool in health promotion practice and research because it seeks to explain the observed relationships between healthy behaviors and population health (Simons-Morton, 2013). Theories and theoretical frameworks serve a similarly important role in public health evaluation because they describe the concepts, context and mechanisms that lead to specific health outcomes. The development of **theoretical frameworks can guide the design of evidence-based evaluation methods** based on determinants of health-related behavior and their causal relationship with health outcomes.

In this section we review key theoretical frameworks that are intended to explain the pathways by which SDH may affect health, and specifically CVD.

Socio-ecological model of health

Understanding the intersection between individual, relationship, community, and societal factors is critical in modeling the effects of SDH on health outcomes. The socio-ecological model, illustrated in *Figure 1*, was introduced in the 1980s by Urie Bronfenbrenner as a theory for understanding external influences on human health and development (Kilanowski, 2017). This theory places the individual in the center of nesting circles representing various systems. The system, or circle, closest to the individual contains the strongest influences and encompasses the interactions and relations of the individual's immediate surroundings. The second circle includes less direct interactions such as work, school, church, and neighborhood. The third circle contains societal, religious, and cultural values. Lastly, the outer circle encompasses elements of time and historical context, and in some models contains influences of policy (Bronfenbrenner, 1986).

Figure 1: Socio-Ecological Model Source: (Centers for Disease Control and Prevention, n.d.;)

This model shifted the lens from individual attribution and responsibility to societal organization and the institutions, structures, inequalities, and ideologies driving health behaviors, leading to further developments in the study of SDH.

CVD risk factors and the biology of adversity

The pathways in which SDH affect health outcomes, specifically for CVD, involves psychosocial, environmental, and biological factors. The Global Burden of Disease (GBD) study estimates the population-level burden of CVD and its risk factors. The modifiable risk factors found to increase risk of CVD include **high systolic blood pressure, high fasting plasma glucose, high low-density lipoprotein (LDL) cholesterol, high body mass index (BMI), impaired kidney function, ambient and household air pollution, tobacco including second-hand smoke, dietary risks, lead exposure, non-optimal ambient temperature** and **low physical activity** (Roth et al., 2020).

One model used to understand the role of these factors is called the biology of adversity (*Figure 2*). The biology of adversity explains that personal experiences and environmental exposures are embedded biologically, and all of these factors should be considered to understand the effect of SDH on CVD (Shonkoff, 2012).

Figure 2. The social determinants of health and biology of adversity Source: (Powell-Wiley et al., 2022)
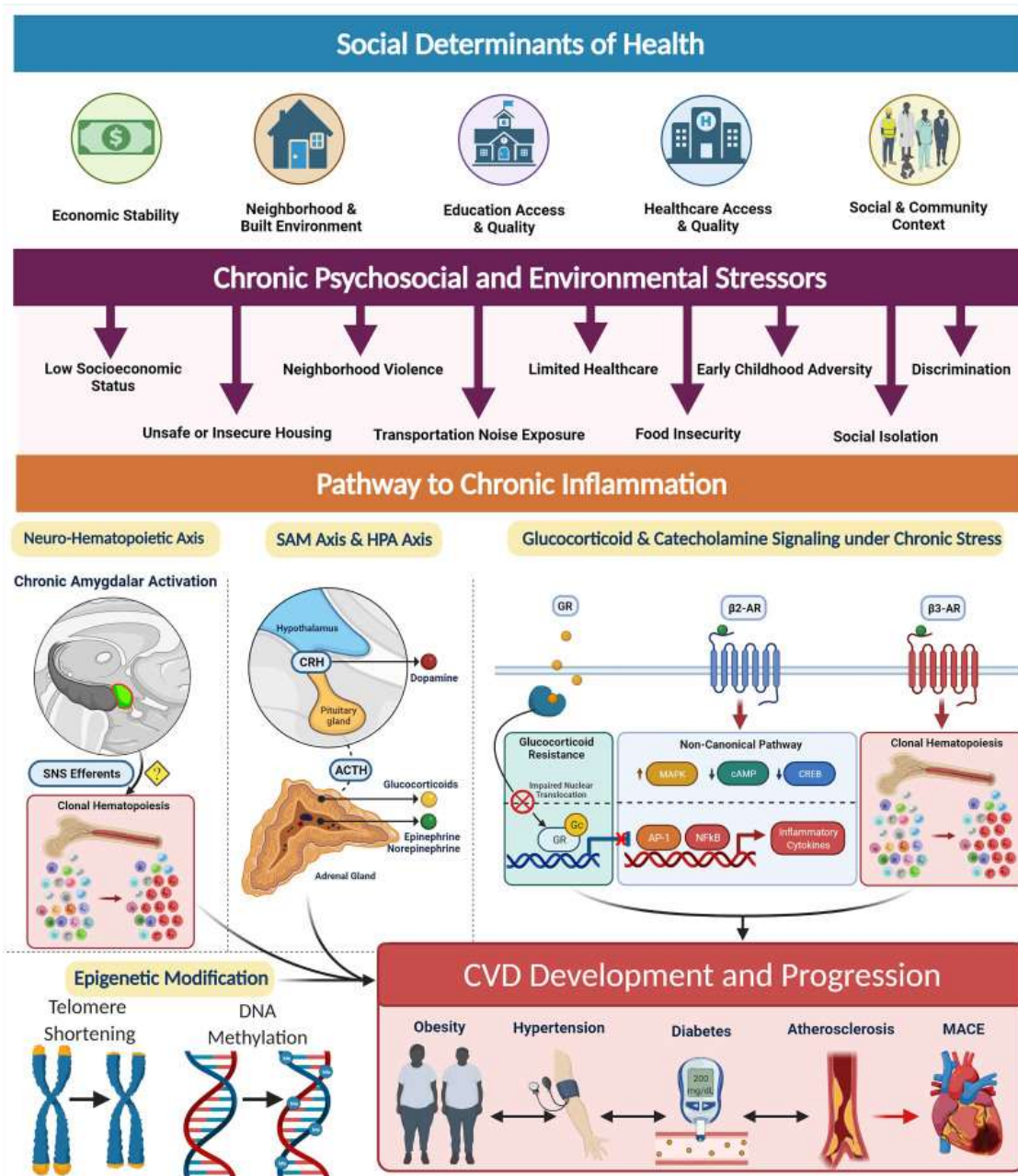
The mechanisms by which SDH influence biological pathways associated with CVD development highlight the trickle-down effects of the sociopolitical and economic impacts. Individuals suffering from **low socioeconomic status, unsafe housing, neighborhood violence, discrimination**, and other determinants can suffer from chronic inflammation through the biological pathways shown in *Figure 2*.

SDH Frameworks from Major Institutions

The concept that social conditions can affect health first developed in the mid-19th century. German physician Rudolf Virchow, dubbed the "Father of Modern Pathology," believed that diseases of the populace were due to problems found in society (Jha, 2016). When sent to investigate a typhus epidemic and famine in Eastern Europe in 1848, Virchow famously prescribed "full and unlimited democracy" as the solution (Klag, 2014). Exactly a century later in 1948, the newly formed World Health Organization (WHO) included social well-being in its definition of health.

Since then, institutions around the world have started incorporating SDH into their own conceptual frameworks for achieving health equity. The following section provides an overview of some key SDH models developed by major global health institutions.

World Health Organization

The term Social Determinants of Health (SDH) started appearing in published health literature in the United States following government public health research initiatives aimed to evaluate how communities might solve current health problems (Macgregor, 1961). The WHO established the Commission on Social Determinants of Health in 2005 to gather evidence and create a framework for achieving health equity. The Commission asserted that the unequal distribution of power, income, goods, and services leads to inequity in the immediate circumstances of people's lives, including their health (World Health Organization, 2010).

The conceptual framework proposed by the Commission defines several types of determinants that impact health equity and differentiates between structural and intermediary determinants. Structural determinants, or social determinants of health inequities, includes macroeconomic and political factors (**governance, macroeconomic policies, social policies, public policies,** and **culture and societal values**) and socioeconomic position (**social class, gender, ethnicity, education, occupation, and income**). Intermediary determinants, or social determinants of health, include material circumstances (**living and working conditions, food availability**), behavioral and biological factors, and psychosocial factors. **Social cohesion** and **social capital** are defined as both structural determinants within socioeconomic position and intermediary determinants.

The framework proposed in the WHO report classified SDH in different types and **domains**, as listed in *Figure 3*. In the Commission report, **the WHO defined a domain as a subcategory of a given determinant** (I.e. Healthcare access). Each domain, in turn, includes one or more individual metrics that provide a measure of that domain.
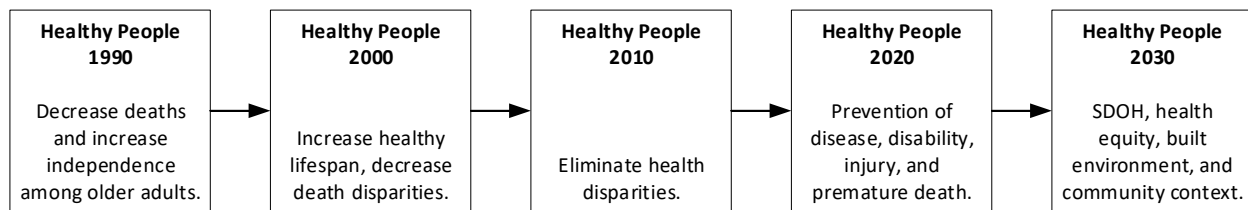
Figure 3. World Health Organization Conceptual Framework on the Social Determinants of Health
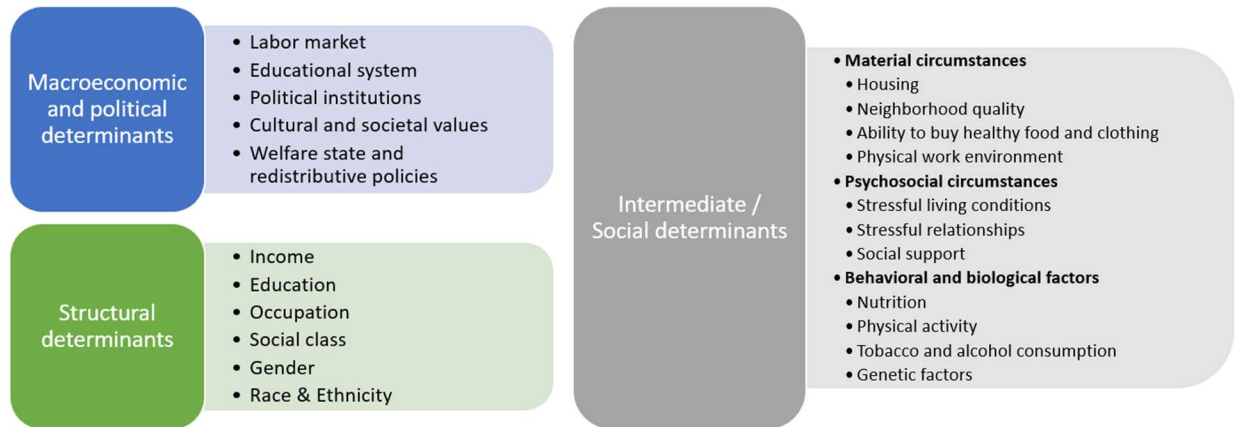
In the WHO framework, the <u>Macroeconomic and Political Determinants</u> include several domains, including the **labor market, educational system, political institutions, cultural and societal values**, and the **welfare state's redistributive policies**. These domains are not easily changed by individual effort, but top-down policies can have large impacts on the population. <u>Structural Determinants</u> include domains that encompass one's socioeconomic position: **income, education, occupation, social class, gender**, and **race and ethnicity**. Domains included in the Structural Determinants can be more challenging to change at the individual level over short periods of time. <u>Intermediate, or Social Determinants</u> include domains at the local or individual level and are often targeted for improvement with interventions. These domains include material circumstances such as **housing, neighborhood,** ability to buy **food and clothing**, and **work environment**. Psychosocial circumstance domains include stressful **living conditions and stressful relationships** as well as levels of **social support**. Behavioral and biological domains include **nutrition**, **physical activity**, **tobacco and alcohol consumption**, and **genetic factors**.

Healthy People Initiative: US Department of Health and Human Services (US DHHS)

The Healthy People Initiative began in 1979 when Surgeon General Julius Richmond presented a landmark report titled "Healthy People: The Surgeon General's Report on Health Promotion and Disease Prevention" (US DHHS, 2022). This report introduced key concepts in health promotion and disease prevention across the lifespan (Institute of Medicine, 1979). In a chapter dedicated to the prevention of cardiovascular diseases, Dr. Oglesby Paul summarized the importance of curtailing cigarette smoking and "excessive" alcohol use, preventing infections that contribute to CVD (i.e. rheumatic fever), and influences of nutrition and physical activity, on cardiovascular health. However, discussions about SDH, such as **economic stability, access to healthcare, the built environment,** and **social structures**, are largely absent.

Figure 4. Priority areas for Healthy People Initiative 1990-2030

Healthy People 1990	Healthy People 2000	Healthy People 2010	Healthy People 2020	Healthy People 2030
Decrease deaths and increase independence among older adults.	Increase healthy lifespan, decrease death disparities.	Eliminate health disparities.	Prevention of disease, disability, injury, and premature death.	SDOH, health equity, built environment, and community context.

This landmark report laid the foundation for the 1980 launch of Healthy People 1990, the first ever set of measurable 10-year objectives for improving population health. This inaugural initiative prioritized decreasing deaths throughout the lifespan and increasing independence among older adults (US DHHS, 2022). Healthy People 1990 has been followed by decennial iterations, each building on the previous goals and objectives as illustrated in *Figure 4*. In Healthy People 2000, the focus was on increasing healthy lifespan, decreasing health disparities, and achieving access to preventative services for all (US DHHS, n.d.). Healthy People 2010 called for the elimination of health disparities, not just reducing them. The next iteration, Health People 2020, prioritized prevention of disease, disability, injury and premature death health equity and disparities and promotion of good health through social and built environments and healthy behaviors. Healthy People 2030 is the fifth and current iteration of the initiative and builds on knowledge gained and lessons learned to address the latest public health priorities (US DHHS, 2022). This is the first initiative to emphasize SDH alongside health equity, health literacy, and well-being. The Healthy People 2030 national framework includes five main SDH domains: **economic stability, education, health and healthcare, neighborhood and built environment,** and **social and community context**. While there have been tremendous improvements in health nationwide, the US still faces health challenges that are exacerbated by SDH, making it a critical component of health research.

American Heart Association

Founded in 1924, the AHA is the nation's oldest and largest voluntary organization committed to combating stroke and cardiovascular diseases. To date, the AHA has invested over 5 billion USD into research funding, and today comprises over 30 million volunteers and supporters dedicated to improving cardiovascular disease outcomes and health (American Heart Association, n.d.). The AHA conducts a multitude of programs aimed at educating the public, including campaigns concerning healthy eating, stroke prevention in women, smoking cessation, and guides to carrying out hands-only CPR (American Heart Association News, n.d.; CBS News/AP, 2014).

In a 2015 report describing SDH as they relate to CVD, the AHA built upon the WHO framework and explored determinants and their associations with CVD (Havranek et al., 2015). The report called for several future directions for research including the creation of standardized measures of social group categories, the development of nontraditional measures of social determinants, and prioritize research that investigates the intergenerational transmission of social disadvantage.

One key AHA program is Get With the Guidelines (GWTG), a hospital-focused quality improvement initiative created in collaboration with the American Stroke Association (ASA) to improve standards of care for patients with CVD and stroke. GWTG promotes consistent hospital adherence to modern

treatment guidelines and covers millions of patient records across over 2,000 hospitals across the world (American Heart Association, 2022).

In addition to clinical outcomes, GWTG collects SDH data from several registries including resuscitation, stroke, heart failure, and CAD registries. Data points include whether the patient had an unmet social need in the following areas: **education, employment, financial strain, food, living situation or housing, mental health, personal safety, substance abuse, transportation barriers,** or **utilities**.

AHA's SIF invests in community solutions to shift health inequities through social determinants of health challenges. The three main pillars included in SIF's framework are health and healthcare, food security, economic resiliency and poverty reduction. Programs funded by SIF address one of the following determinants: **employment and income, housing, education, food security, healthcare access, mental health, social cohesion, early childhood, built environment,** or **transportation**. Through investments, AHA hopes to improve community capacity to address SDH in order to reduce social and economic barriers to health and improve quality of life and life expectancy.

Other Institutions
Several other governmental or international institutions have developed different frameworks to guide their work on SDH and CVD. In this section we summarize some of them highlighting their key characteristics.

Australian Institute of Health and Welfare
The Australian Government currently measures socioeconomic inequalities in the prevalence of CVD, with a strong emphasis on Indigenous determinants of health (Australian Institute of Health and Welfare, 2019, 2022). In July 2020, the National Agreement on Closing the Gap was signed by the Australian government and the Coalition of Aboriginal and Torres Strait Islander Peak Organizations. The agreement provided a framework to address entrenched inequalities faced by the Indigenous groups so that their life outcomes are equal to all Australians. The Agreement includes a range of health outcome measures related to **education, employment, health and wellbeing, justice, safety, housing, land and waters,** and **languages** (Government of Australia, 2020). The main determinants included in this framework include **cultural and historical factors and the effects of colonialism, education, employment, income, housing, child protection system,** and **justice systems**.

Government of Canada
The Government of Canada acknowledges twelve main determinants of health (Government of Canada, n.d.): 1. **income and social status**, 2. **employment and working conditions**, 3. **education and literacy**, 4. **childhood experiences**, 5. **physical environments**, 6. **social support and coping skills**, 7. **healthy behaviors**, 8. **access to health services,** 9. **biology and genetic endowment**, 10. **Gender**, 11. **Culture**, and 12. **Race and racism**. This framework emphasizes the experiences of **discrimination**, **racism**, and h**istorical trauma** as important determinants for certain groups.

SDH DATA REPOSITORIES

This section provides brief descriptions of data repositories and sources for data on SDH. These sources only reflect US-based data.

Compendium of Federal Datasets Addressing Health Disparities
The Compendium is an initiative of the Interdepartmental Health Equity Collaborative (IHEC) and the HHS Office of Minority Health to encourage intersectoral collaboration across federal agencies to better address health disparities. The data within the Compendium serves as a resource to identify the relationship between socioeconomic factors, social determinants of health, and health equity. This new Compendium includes: descriptions of over 250 databases from HHS and 9 other Departments/federal partners; information on data sources relevant to opioid use/research; and information on datasets with more controlled access (e.g. those available from biorepositories).
URL: https://www.minorityhealth.hhs.gov/omh/browse.aspx?lvl=1&lvlid=4

PhenX Toolkit
In 2018, the National Institute on Minority Health and Health Disparities (NIMHD) funded an administrative supplement to the PhenX project to select high-quality standard measures related to social determinants of health (SDH) for inclusion in the Toolkit. The goal of the PhenX Measures for SDH project is to establish a common currency of measurement protocols that will help inform effective interventions to reduce health disparities. In addition, consistent use of standard measurement protocols will improve the quality and consistency of data collection and facilitate collaboration. The ability to easily share and combine data from multiple studies has the potential to increase the scientific impact of individual studies.
URL: https://www.phenxtoolkit.org/sub-collections/view/30

Social Determinants of Health Database
The Agency for Health Research and Quality (AHRQ) database on Social Determinants of Health (SDH) was created under a project funded by the Patient Centered Outcomes Research (PCOR) Trust Fund. The purpose of this project is to create easy to use, easily linkable SDH-focused data to use in PCOR research, inform approaches to address emerging health issues, and ultimately contribute to improved health outcomes. Variables in the files correspond to five key SDOH domains: social context (e.g., age, race/ethnicity, veteran status), economic context (e.g., income, unemployment rate), education, physical infrastructure (e.g, housing, crime, transportation), and healthcare context (e.g., health insurance). The files can be linked to other data by geography (county, ZIP Code, and census tract).
URL: https://www.ahrq.gov/sdoh/data-analytics/sdoh-data.html

Results

Our aim in this landscape review was to identify SDH evaluation frameworks and sources through a combination of a systematic literature review and a review of the positions of major institutions. We conducted this review to document information available regarding SDH and CVD, identifying areas with more information and gaps in knowledge, as well as SDH frameworks and metrics that have been used and which will be useful for further stages of this project. The methodology for this review is presented in *Appendix I*.

Literature review results

The systematic review yielded 146 sources across the five databases analyzed, from 1980 to 2022. *Figure 5* presents the results from the five databases as well as an expert-guided institutional review. There were 8 total results for Cumulative Index of Nursing and Health Literature (CINAHL) with 4 (50%) that met the inclusion criteria. Web of Science had 52 total results with 16 (31%) accepted. Embase had the most sources identified at 65, but only 6 (9%) were accepted. We accepted 6 (43%) from a total of 14 sources from PubMed, and only 2 (29%) out of 7 sources from Global Index Medicus. Since one unique source can appear across multiple databases, we had to de-duplicate the sources, arriving at 26 unique sources.

Figure 5. Literature and institutional review results[1]
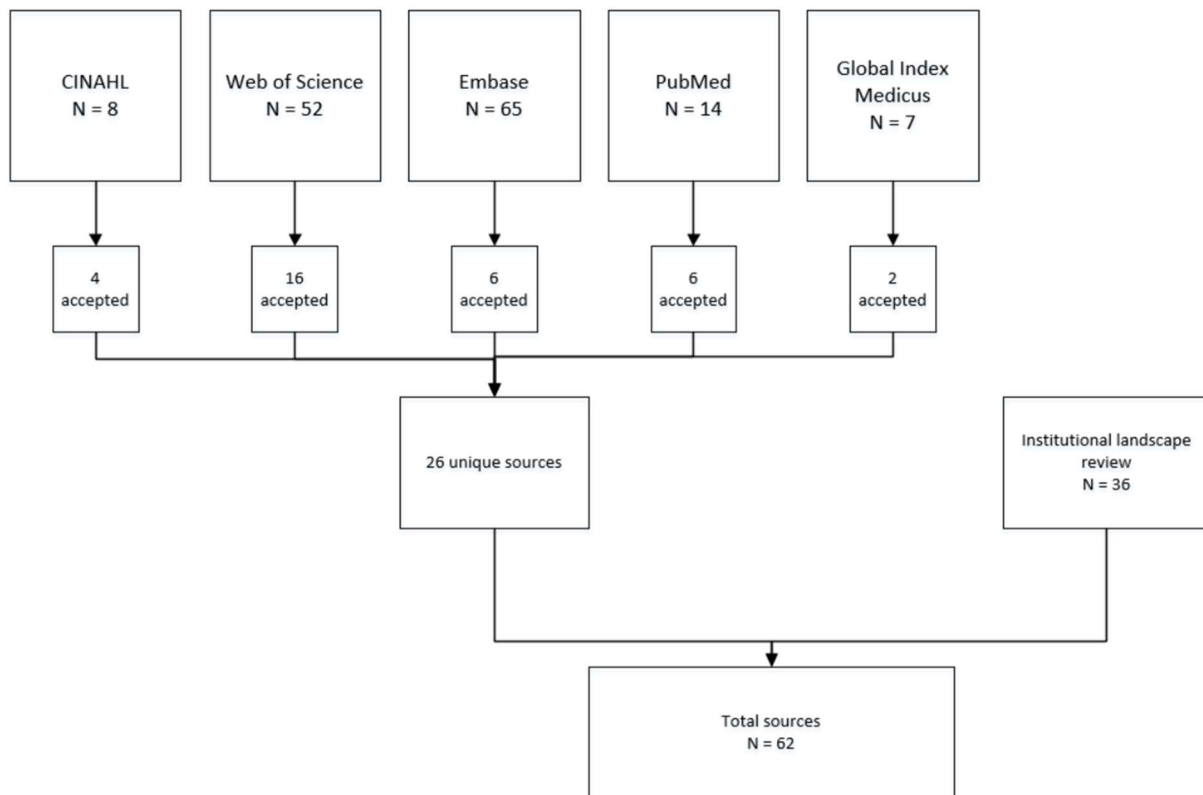
[1]Some sources are duplicated across databases, resulting in accepted sources not adding up to the total number of unique sources.

Institutional review results

In addition to the sources identified in the systematic literature search, we also identified 36 additional sources through expert-guided input that we included in our review of SDH frameworks. Ten sources included frameworks for CVD-specific outcomes and the remaining 26 sources were for more general health outcomes. Twenty-two sources were from the United States, three from the United Kingdom, two from Latin America, two from Australia, two from Canada, one from France, one from India, and one international organization.

Our analysis included 26 sources identified in the literature review and 36 in the institutional review, for a total of 62 sources of information.

Domain categorization

In order to quantify the determinants and domains found within the sources, we chose to categorize determinants closely based on the Healthy People framework due to its close alignment with the original WHO conceptual framework and its wide usage in public health. In addition to the six main determinant categories defined in the Healthy People framework **(Economic stability, Education, Food security, Health and healthcare, Built environment,** and **Community context),** we also included three additional categories: **Environment, Macroeconomic,** and an **Other** category.

For each source of information, we extracted SDH domains verbatim according to the institution producing it (i.e. **Socioeconomic position**) and then categorized them into the nine broader SDH categories (i.e. **Economic stability**). Some institutions included several domains that were categorized into the same category (i.e. **Income** and **Housing**). *Figure 6* presents the results of this categorization.

Overlapping Domains

It is quite clear that there is **substantial overlap across some of the domains**. For the purpose of this review, we separately report domains that may appear quite similar. Because language can often be used by organizations in general ways and specific glossaries or case definitions are not usually provided, and because the overarching purpose of this project is the development of specific evaluation criteria, we have chosen to report results as described by the original sources. Therefore we count domains as distinct when the terms differ. For example, we report "food security" and "food insecurity", or "education" and "educational attainment" separately.

Figure 6. Frequency of social determinant of health categories[1] appearing in institutional frameworks
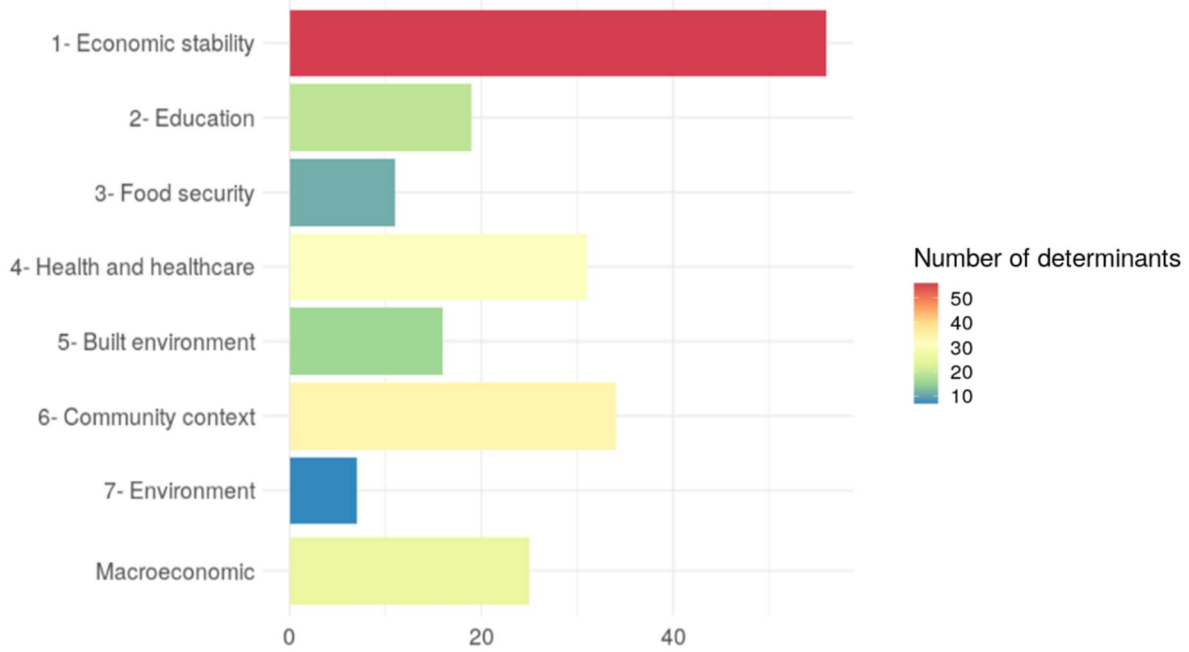
[1] **Economic stability** measures include income, occupation, and housing. **Education** includes variables related to education level and schooling. **Food security** measures access to and quality of food as well as diet and nutrition. **Health and healthcare** measures access to and quality of healthcare. **Built environment** includes physical structures that interact with the community such as utilities, streets, parks, and safety. **Community context** includes social support and cultural aspects. The **Environment** category measures the effects of environmental factors such as air pollution and climate change. The **Macroeconomic** category includes measures related to policy and governance.

Variables under the **economic stability** category appeared 56 (23.7%) times. The next largest category was **community context**, which had 34 (14.4%) of variables appear in frameworks. **Health and healthcare** included 31 (13.1%) of results, **macroeconomic** variables appeared 27 (11.4%) times, and **education** appeared 19 (8.1%) times. Of the remaining four categories, **built environment** variables were included 14 (5.9%) times, **food security** had 11 (4.7%) variables, and **environment** had 7 (2.9%).

Description of variables used in each domain

Economic stability

Economic stability variables accounted for almost one-fourth of all variables appearing in the institutional sources due to its strong association with CVD. The WHO's conceptual framework on SDH measures economic stability as the "ownership of higher quality resources such as food and shelter, having access to services, and being able to participate in society (World Health Organization, 2010).

Figure 7 illustrates the number of times each domain appeared in frameworks, as defined by each institution.

Figure 7. Economic stability domains
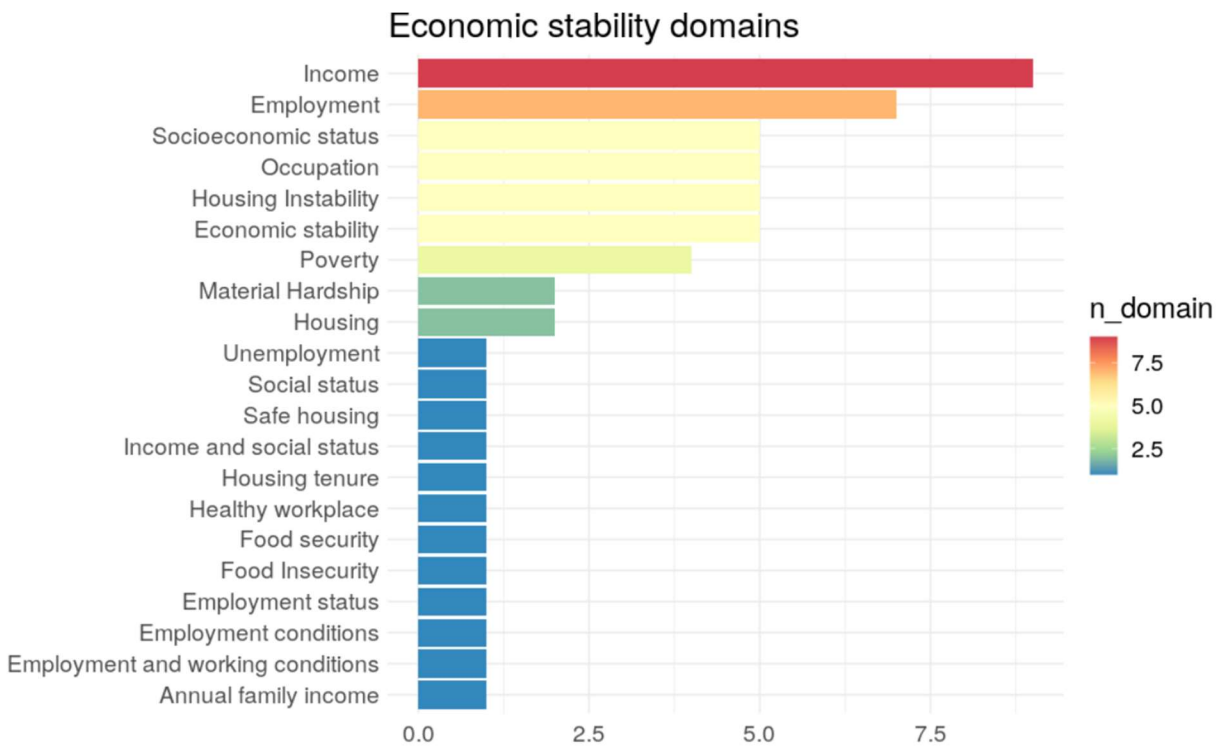
Income, employment/occupation, and **housing** were the most used domains. *Table 2* lists specific variables and metrics used for each domain.

Table 2. Economic stability domains and variables

Domain	Variables
Income	• Individual or household income (Agency for Healthcare Research and Quality, 2020; DeMilto & Nakashian, 2016) • Annual family income (Hamilton et al., 2011)

	• Median household income (Economic Innovation Group, n.d.) • GINI index of income inequality (Mathematica, n.d.) • Proportion of people living in poverty (Mathematica, n.d.) • Percent population less than 100% FPL (population under 0.99 /total population) (Butler et al., 2013) • Inflation (Pan-American Health Organization, n.d.)
Employment	• Proportion of adolescents and young adults who aren't in school or working (US DHHS, 2022) • Proportion of employment among working-age people (US DHHS, 2022) • Proportion of children living with at least one parent who works full-time (US DHHS, 2022) • Proportion of adults whose arthritis limits their work (US DHHS, 2022) • Percent Non-employed (not in labor force + unemployed) / (civilian + not in the labor force) for the population 16-64 years (Butler et al., 2013) • Change of job [EIG]
Housing	• Proportion of households that spend more than 30 percent of income on housing (US DHHS, 2022) • US population living in households spending 50% or more of household income on housing [RWJF] • Share of housing units that are vacant (Economic Innovation Group, n.d.) • Housing tenure/moving frequency (Perry et al., 2021) • Multi-generational housing (Perry et al., 2021) • Housing status (rent, own, none) (Australian Institute of Health and Welfare, 2019) • Eviction and foreclosure rates (Perry et al., 2021) • Percent population living in renter-occupied housing units (Renter occupied housing units/ (Owner-occupied housing units + Renter occupied housing units)) (Butler et al., 2013) • Percent population living in crowded housing units (Tenure by Occupants Per Room – a population with ≥ 1.01 occupants per room in Owner-occupied housing units and Renter occupied housing units) / total population (Butler et al., 2013)

The domain encapsulates many subcategories related to one's finances such as **income**, **occupation**, and **employment**, and material resources such as **food** and **housing**. Often, variables in this domain will be measured as a **socioeconomic status** (SES) index made up of several variables. A 2015 meta-analysis of 51 studies on the relationship between socioeconomic status and hypertension found that low socioeconomic status is associated with higher blood pressure (Leng et al., 2015).

Socioeconomic status indices
One example of an SES index is the Social Vulnerability Index (SVI) developed by the US CDC and Agency for Toxic Substances and Disease Registry (ATSDR) (Agency for Toxic Substances and Disease Registry, 2022). This index uses 15 US census variables to measure the potential negative effects on the health of communities caused by external stresses. The four themes and their social factors are 1) **socioeconomic status** (below poverty, unemployed, income, no high school diploma), 2) **household composition and disability** (aged 65 or older, aged 17 or younger, older than age 5 with a disability, single-parent

households), 3) **minority status and language** (minority, English proficiency), and 4) **housing type and transportation** (multi-unit structures, mobile homes, crowding, no vehicle, group quarters).

Another SES index is the Social Deprivation Index (SDI) developed by the Robert Graham Center which uses seven demographic variables collected in the American Community Survey to create a composite measure of area level deprivation that is used to quantify the socioeconomic variation in health outcomes (Robert Graham Center, n.d.). The seven variables (percent living in **poverty**, percent with less than 12 years of **education**, percent **single-parent household**, percent living in the **rented housing** unit, percent living in the **overcrowded housing** unit, percent of **households without a car**, and percent **non-employed adults** under 65 years of age) are calculated at the county, census tract, zip code, and Primary Care Service Area and then used in a factor analysis to create the SDI.

At a community level, the Economic Innovation Group developed the Distressed Communities Index (DCI) which combines seven metrics **(no high school diploma, poverty rate, adults not working, housing vacancy rate, median household income, change in employment,** and **change in establishments**) into a single score that depicts how economic well-being in a community compares to its peers (Economic Innovation Group, n.d.).

Education

Education as an individual determinant of health appeared in 19 frameworks examined. Of the remaining 17 studies that did not include an explicit education determinant and four were exclusively macroeconomic. The frameworks that did not include education or socioeconomic status as an explicit determinant either focused on race or ethnicity (i.e. Aboriginal and Torres Straight Islander Social Justice, Brookings, Indian Health Service) or were based outside the United States and focused on occupation and income (i.e. Public Health of India, Inter-American Development Bank, Federal University of Toulouse).

Figure 8. Education domains
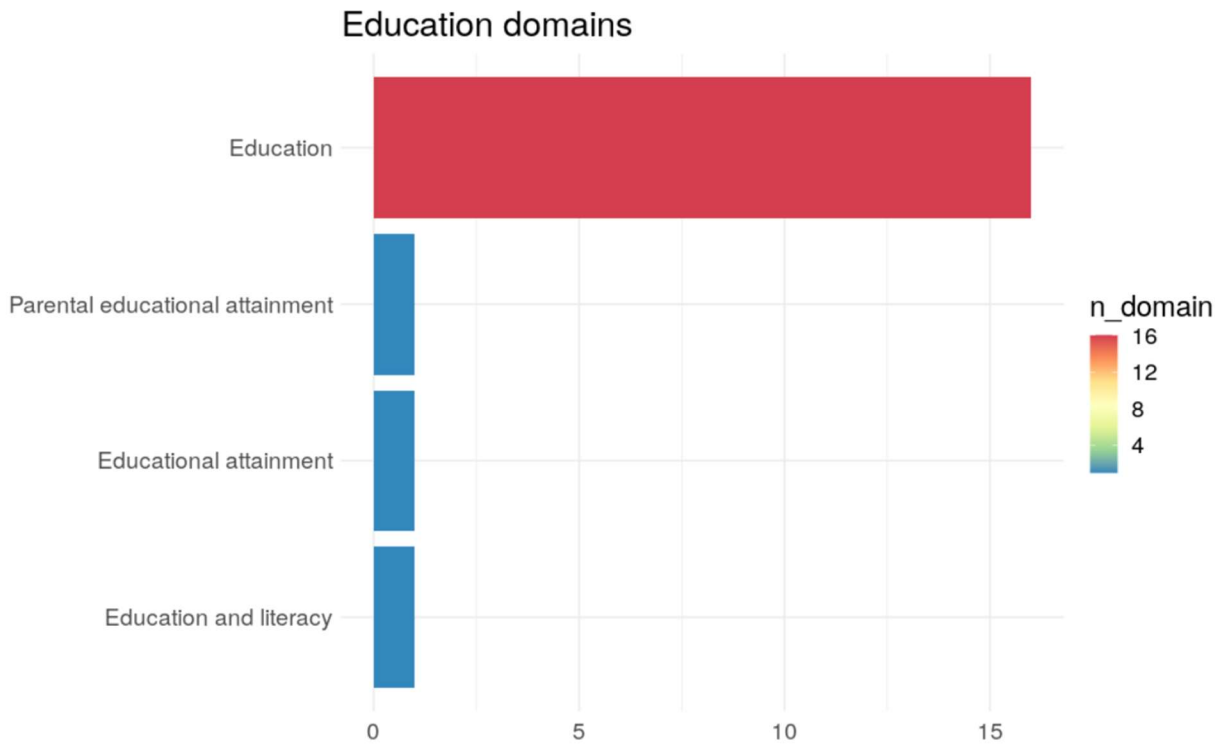
Most sources identified dealing with education refer to it as a general category, as seen in *Figure* 8, with only a few studies referring specifically to **parental education, educational attainment,** or **education** and **literacy**. Education-based domains are most often measured in the literature by individual educational attainment such as the number of years of education an individual has completed, or the highest level of schooling completed (primary, secondary, college). In SDH frameworks where there is a **SES** measure, education will be combined with other variables like income and occupation. However, there are many other variables that have been used to measure educational access and quality as described in *Table 3*.

Table 3. Education domains and variables

Domain	Variables
Educational attainment	• Individual educational attainment • Proportion of high school students graduating in 4 years (US DHHS, 2022)

	• High school graduation rates (Agency for Healthcare Research and Quality, 2020) • Percent population 25 years or more with less than 12 years of education (population with less than high school diploma or 12 years of education/total population) (Butler et al., 2013) • Proportion of adults with more than high school education (Mathematica, n.d.)
Access to education	• Percent of 3- and 4-year-olds enrolled in state pre-kindergarten (Robert Wood Johnson Foundation, 2016) • Proportion of high school graduates in college (US DHHS, 2022) • School absenteeism rate (Robert Wood Johnson Foundation, 2016)
Quality of education	• Quality of day care, schools, and adult education (Agency for Healthcare Research and Quality, 2020) • State pre-K quality score [RWJF] • 4th grade reading and math proficiency (US DHHS, 2022) • 8th grade reading and math proficiency (US DHHS, 2022) • Literacy rates (Agency for Healthcare Research and Quality, 2020)
Education for children with developmental delays	• Proportion of children developmentally ready for school (US DHHS, 2022) • Intervention services for children with developmental delays by age 4 (US DHHS, 2022) • Proportion of students with disabilities in regular education programs (US DHHS, 2022)

Food Security

Food security was named explicitly as a determinant in 11 frameworks and had two main domains: **food access** and **nutrition** as illustrated in *Figure 9*. *Table 4* lists the metrics used to measure food access included the price of food as well as child tax credit expenditure and Supplemental Nutrition Assistance Program (SNAP) recipients.

Though food security may not have been a determinant for two-thirds of the frameworks examined in this review, metrics involving access to food and nutrition may sometimes be included in variables for economic stability or built environment.

Figure 9. Food security domains
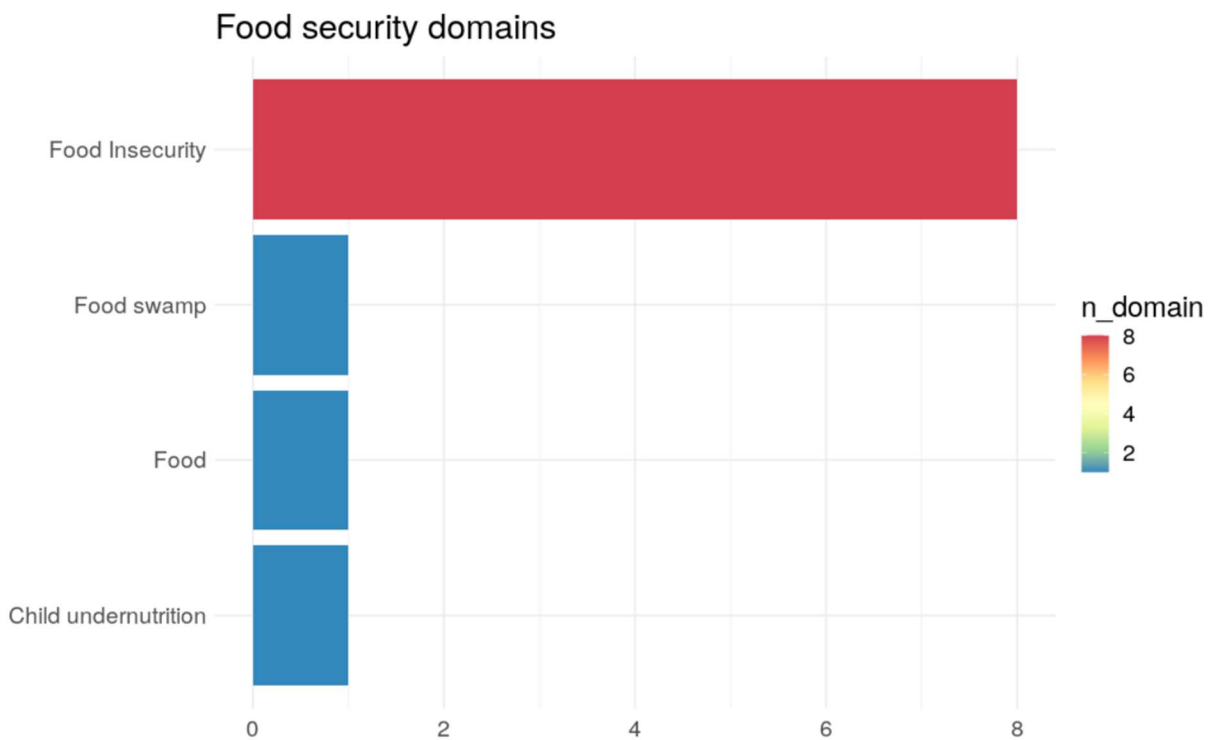
Table 4. Food security domains and variables

Domain	Variables
Food access	• Food prices (Pan-American Health Organization, n.d., p.) • SNAP recipients (Perry et al., 2021) • Child tax credit expenditure (Perry et al., 2021)
Nutrition	• Access to healthy food (Artiga & Hinton, 2018; Mathematica, n.d.) • Undernutrition rates (Cowling et al., 2014; Pan-American Health Organization, n.d.) • Food swamp (Hamilton et al., 2011)

Health and healthcare

Since healthcare is a strong and well-established determinant of health, domains and metrics within this determinant are abundant and appeared 31 times in the frameworks reviewed. In most frameworks, domains focus on **healthcare access and quality**, with strong focuses on **health insurance coverage, preventive services,** and **mental health** as shown in *Figure 10*.

Figure 10. Health and healthcare domains
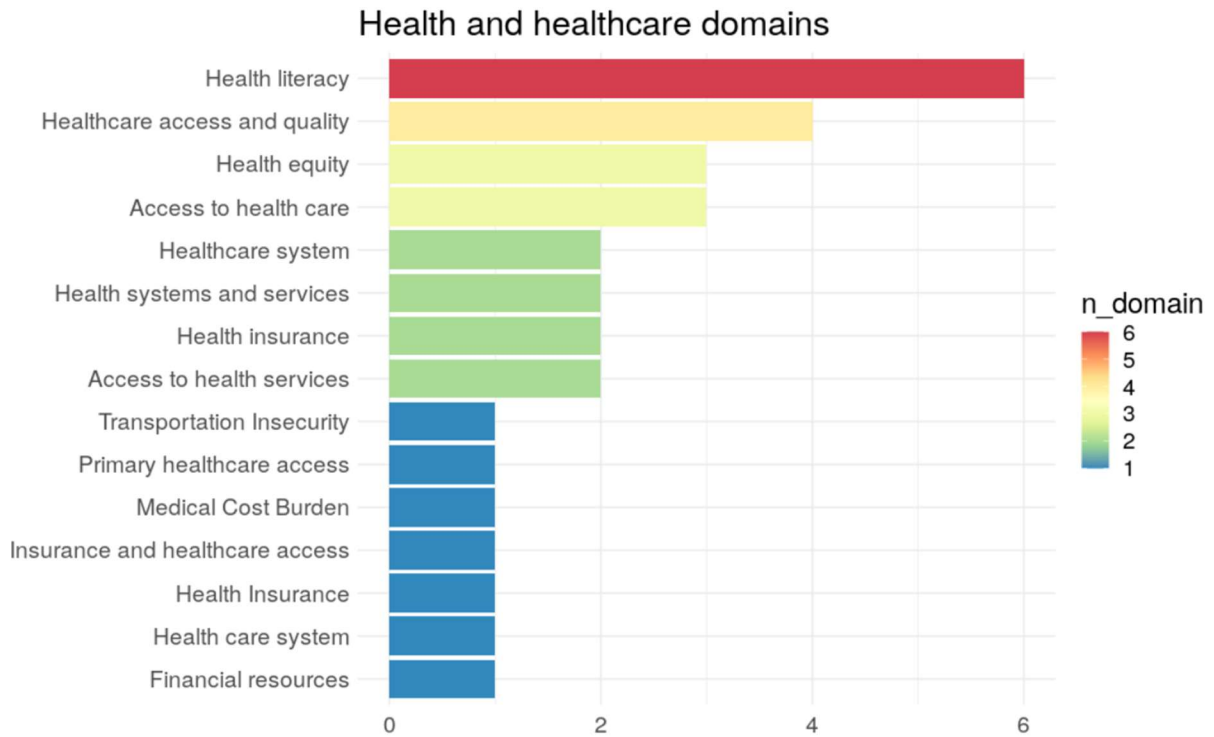
Selected variables and metrics from each health and healthcare domain appear in *Table 5.*

Table 5. Health and healthcare domains and variables

Domain	Variables
Healthcare access	• Health literacy and numeracy (Hamilton et al., 2011) • Hospitals per 100,000 people (Mathematica, n.d.) • Number of community organizations providing preventive services (US DHHS, 2022) • Proportion of adults using IT to track health care or communicate with providers (US DHHS, 2022) • Access to electronic health information and technology (Hamilton et al., 2011) • Access to primary care practitioner (Perry et al., 2021) • Approachability (Havranek et al., 2015) • Availability and accommodation (Havranek et al., 2015) • Affordability (Havranek et al., 2015) • Access to clinical trials [Essien]

	• Limited medication adherence and health-care utilization (Essien et al., 2021) • Access to publicly funded family planning services, dental care, vision care, hearing care, prescription medication, behavioral health services, prenatal and newborn care (US DHHS, 2022) • Knowledge of HIV status, HIV infections, and diagnoses (US DHHS, 2022) • Percent of population who had any dental care in the previous year (Robert Wood Johnson Foundation et al., 2015) • Treatment for substance use disorders (US DHHS, 2022)
Mental and behavioral health	• US adults receiving treatment for reported mental health or substance use problem (Robert Wood Johnson Foundation et al., 2015) • Number of mentally unhealthy days per month (Mathematica, n.d.)
Preventive care	• Proportion of adolescents and adults with preventive care visit in past year (US DHHS, 2022) • Number of cancer screenings (US DHHS, 2022) • Access to dental, vision, and hearing screening (US DHHS, 2022)
Healthcare quality	• Access to culturally and linguistically appropriate care (Agency for Healthcare Research and Quality, 2020; Artiga & Hinton, 2018) • Proportion of adolescents and adults recommended preventive health care (US DHHS, 2022) • Emergency visit wait times (US DHHS, 2022)
Healthcare system	• US population served by a comprehensive public health system (Robert Wood Johnson Foundation et al., 2015) • Health system funding (Robert Wood Johnson Foundation et al., 2015) • Universal healthcare access (Pan-American Health Organization, n.d., p.) • High rates of chronic risk factors (Essien et al., 2021) • Federal, state, and/or local budget for health equity (Mathematica, n.d.) • Federal, state, and/or local budget for public health planning (Mathematica, n.d.) • Federal, state, and/or local budget for health prevention services (Mathematica, n.d.)
Insurance	• Dental insurance coverage (US DHHS, 2022) • Prescription drug insurance coverage (US DHHS, 2022) • Proportion of over 65 insurance coverage (US DHHS, 2022) • Employer-sponsored health insurance (Perry et al., 2021)

Community Context

Community impacts health through social capital, support, and childhood experiences. The community context determinant covers domains having to do with **social support and networks**, **child and adolescent development**, and **cultural aspects**. Domains within the community context determinant appeared in 25 frameworks, part of this high number is due to the wide categories that this determinant encapsulates. **English proficiency** (for US-based frameworks), **immigration status**, and **childhood experiences** were some of the main themes as shown in *Figure 11*.

Figure 11. Community context domains
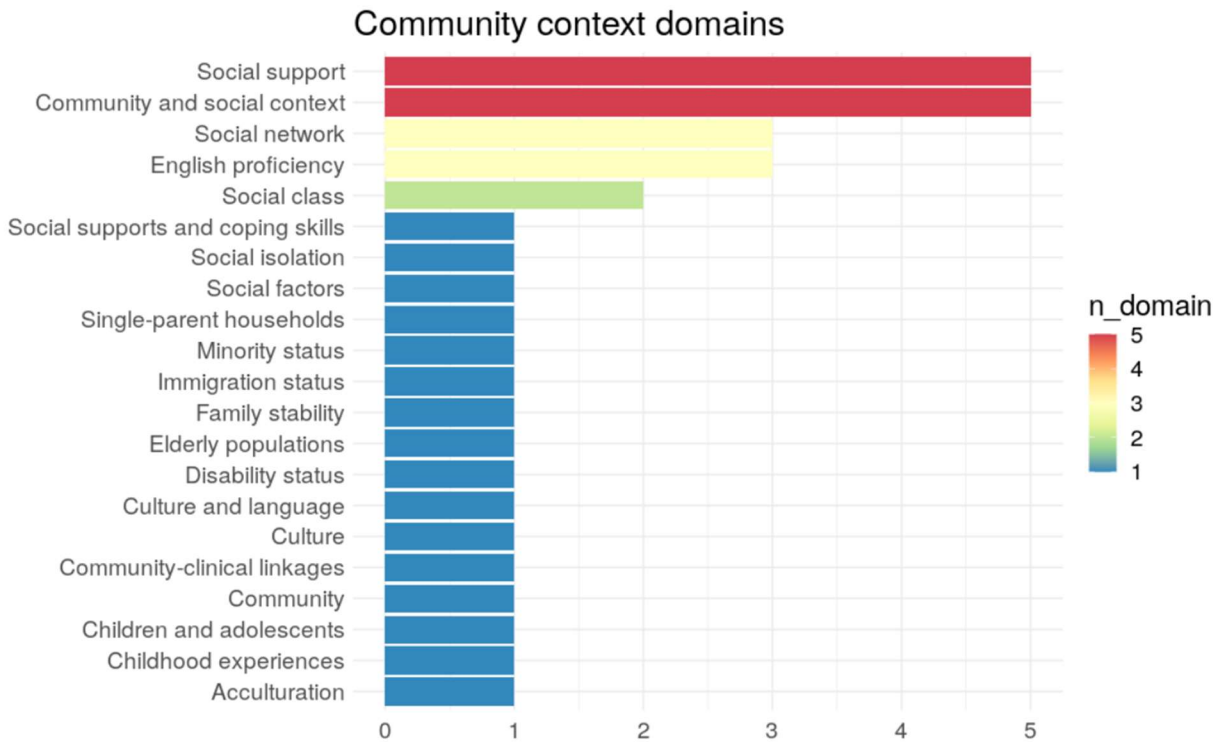
Selected variables from the **community conte**xt category appear in *Table 6*.

Table 6. Community context domains and variables

Domain	Variables
Social support	• Anxiety and depression among caregivers of people with disabilities (US DHHS, 2022) • Proportion of voting-age people who vote (US DHHS, 2022) • Proportion of adults who talk to friends or family about health (US DHHS, 2022) • Proportion of people with intellectual and developmental disabilities who live in institutional settings with 7 or more people (US DHHS, 2022) • Social club members per 10,000 people (Mathematica, n.d.)

	• Percent high needs population – (population under 5 years of age + women between the ages of 15-44 years + everyone 65 years and over)/total population (Butler et al., 2013) • Incarceration (Havranek et al., 2015) • Number of sentenced prisoners in the US (Robert Wood Johnson Foundation et al., 2015) • Number of jail inmates in the US (Robert Wood Johnson Foundation et al., 2015) • Skill development (Ackerman-Barger, 2018) • Access to quality programs for people in vulnerable situations (Inter-American Development Bank, n.d.)
Children and adolescents	• Proportion of children with a parent or guardian who has served time in jail (US DHHS, 2022) • Proportion of adolescents who have adult they can talk to (US DHHS, 2022) • Proportion of adolescents in foster care who show signs of being ready for adulthood (US DHHS, 2022) • Proportion of children and adolescents who communicate positively with parents (US DHHS, 2022) • Proportion of children whose family read to them at least 4 days/week (US DHHS, 2022) • proportion of children and adolescents who show resilience to challenge and stress (US DHHS, 2022) • bullying of transgender students (US DHHS, 2022) • Children living in household headed by single parent • Percent of children who have had one or more adverse childhood experiences (ACES) (Robert Wood Johnson Foundation, 2016) • Adverse childhood experiences (ACES) (Ackerman-Barger, 2018) • Percent single-parent households with dependents < 18 years (total single-parent households (male and female) with dependents <18 years)/total population) (Butler et al., 2013)
Social class	• Social cohesion (Agency for Healthcare Research and Quality, 2020) • Racial, ethnic, religious, and gender discrimination (Artiga & Hinton, 2018; Essien et al., 2021) • Control over resources (physical, financial, organizational) (World Health Organization, 2010)
Culture	• English proficiency (Agency for Healthcare Research and Quality, 2020; Agency for Toxic Substances and Disease Registry, 2022; Min et al., 2022) • Years in US (Min et al., 2022) • Nativity/birthplace (Min et al., 2022) • Immigration status (Min et al., 2022)

Built Environment

The built environment category appeared in 14 frameworks and represents domains such as our **neighborhood**, **home and work environments**, and **physical infrastructure** (i.e. Internet, roads). These structures influence decisions related to individual and community health outcomes such as physical activity, social capital, and depression (Renalds et al., 2010). Domains under the built environment category can be seen in *Figure 12.*

Figure 12. Built environment domains
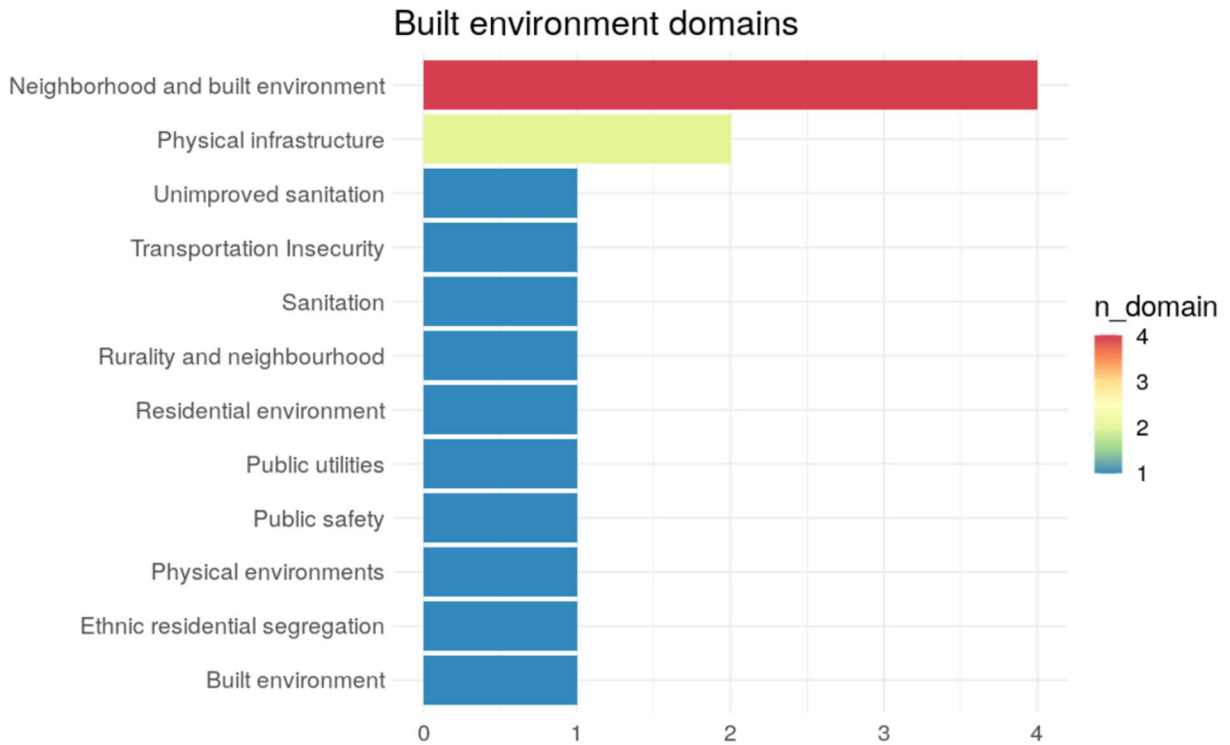
Selected variables measuring each domain are listed in *Table 6.*

Table 6. Built environment domains and variables

Domain	Variables
Neighborhood	• Rate of minors and young adults committing violent crimes (US DHHS, 2022) • Youth who report feeling unsafe going to and from school (Robert Wood Johnson Foundation, 2016) • Proportion of schools with policies that promote health and safety (US DHHS, 2022) • Proportion of adults with internet (US DHHS, 2022) • Proportion of homes that have an entrance without steps (US DHHS, 2022) • Proportion of adults and adolescents who walk or bike to get places (US DHHS, 2022) • Proportion of adults with hearing loss due to noise exposure (US DHHS, 2022)

	• Number of states with smoke-free worksites, restaurants, and bars (US DHHS, 2022) • Internet access (Robert Wood Johnson Foundation, 2016) • Police prevention and justice system improvements (Inter-American Development Bank, n.d.) • Access to parks, playgrounds, and other recreational facilities (Agency for Healthcare Research and Quality, 2020; Artiga & Hinton, 2018) • Walkability (Artiga & Hinton, 2018; Robert Wood Johnson Foundation, 2016)
Residential environment	• Proportion of non-smokers exposed to secondhand smoke (US DHHS, 2022) • Proportion of smoke-free homes (US DHHS, 2022) • Number of states with smoke-free multiunit housing (US DHHS, 2022) • Ethnic residential segregation (Hamilton et al., 2011) • Average racial/ethnic composition of neighborhoods (Robert Wood Johnson Foundation et al., 2015)
Work environment	• Proportion of smoke-free worksites (US DHHS, 2022) • Percent of employees working very long hours (Harvard University T.H. Chan School of Public Health, 2016) • Benefits, vacation, and sick leave (Harvard University T.H. Chan School of Public Health, 2016) • Percent unionized for non-agricultural labor force (Hamilton et al., 2011) • Exposure to occupational noise, dust, toxic agents or air contaminants
Physical infrastructure	• Access to improved sanitation (Dick, 2007) • Average number of US Public Libraries per 100,000 people (Robert Wood Johnson Foundation et al., 2015) • Percent population with no car (population with no vehicle available/total population) (Butler et al., 2013) • Workplace safety (Agency for Healthcare Research and Quality, 2020) • Public utilities (Naik et al., 2019) • deaths from motor vehicle crashes (US DHHS, 2022) • Proportion of people whose water systems have the recommended amount of fluoride (US DHHS, 2022) • blood lead levels in children aged 1-5 years (US DHHS, 2022) • trips to work made by mass transit (US DHHS, 2022)

Environment

A healthy environment is vital to ensuring healthy lives and promoting well-being for all at all ages (Pan-American Health Organization, 2022, p.). The WHO's third Sustainable Development Goal (SDG) is "Good health and well-being," which is affected by five additional SDGs, referred to as the environmental determinants of health: 6) clean water and sanitation, 7) affordable and clean energy, 12) responsible consumption and production, and 13) climate action. The WHO estimates that 21.2% of global deaths are attributed to environmental factors including air pollution, drinking water, occupational exposure to hazardous materials, and lead exposure (Gibson, 2018).

Environmental factors appeared in seven frameworks with a large focus on **air quality**. Domains within the environment category appear in *Figure 13.*

Figure 13. Environment domains
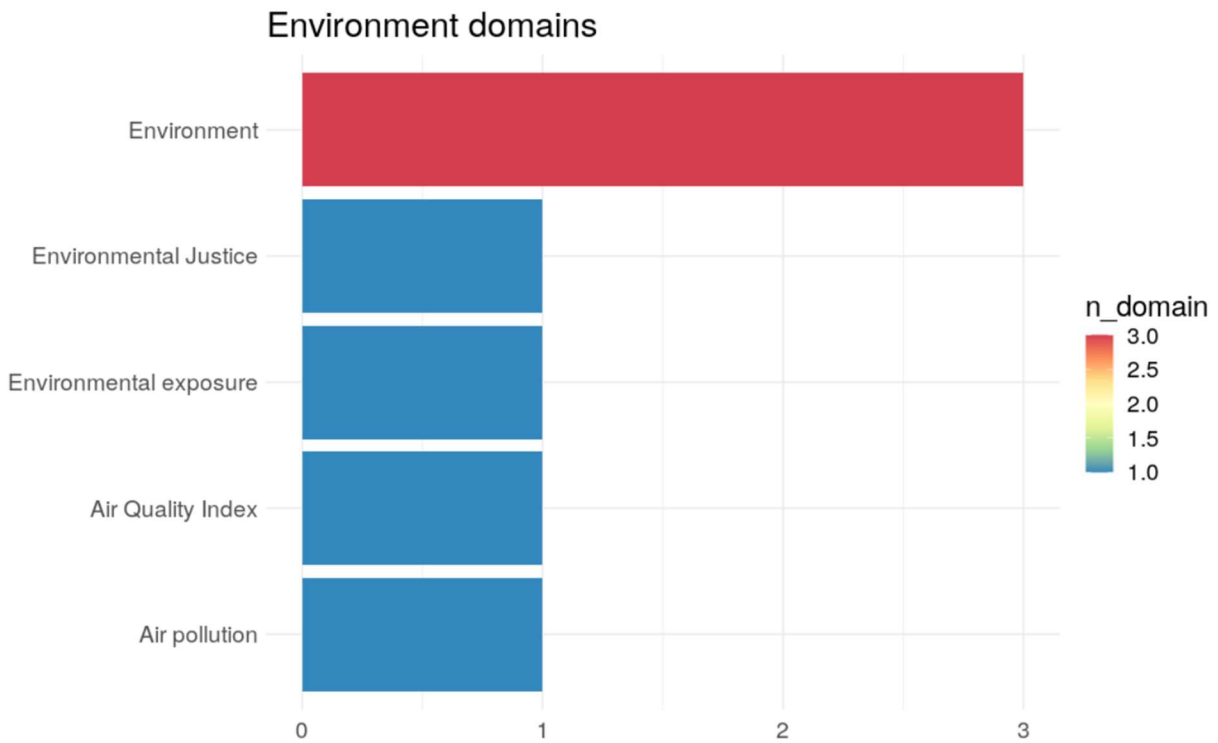
Table 7. Environment domains and variables

Domain	Variables
Air quality	• Number of venues covered by air quality laws (Gibson, 2018) • States with smoke-free air laws across all venues (Gibson, 2018) • States with climate change action plans (Gibson, 2018) • Days people are exposed to unhealthy air (US DHHS, 2022) • Asthma deaths (US DHHS, 2022) • Hospitalizations for asthma in children under-5 (US DHHS, 2022)

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	• Emergency department visits for children under-5 with asthma (US DHHS, 2022)
Water quality	• Proportion of people whose water supply meets Safe Drinking Water Act regulations (US DHHS, 2022)
Hazardous materials	• Urban high environmental pollution (Essien et al., 2021) • Amount of toxic pollutants released into environment (Gibson, 2018) • Hazardous sites (Gibson, 2018)

Macroeconomic factors

Although not the focus of this review, macroeconomic and political factors are important pathways by which SDH can affect health. In the socio-ecological model of health, macroeconomic and political factors are the outermost category, affecting individuals without direct interaction. We reviewed four frameworks focused on macroeconomic and political determinants of health.

Figure 14. Macroeconomic domains
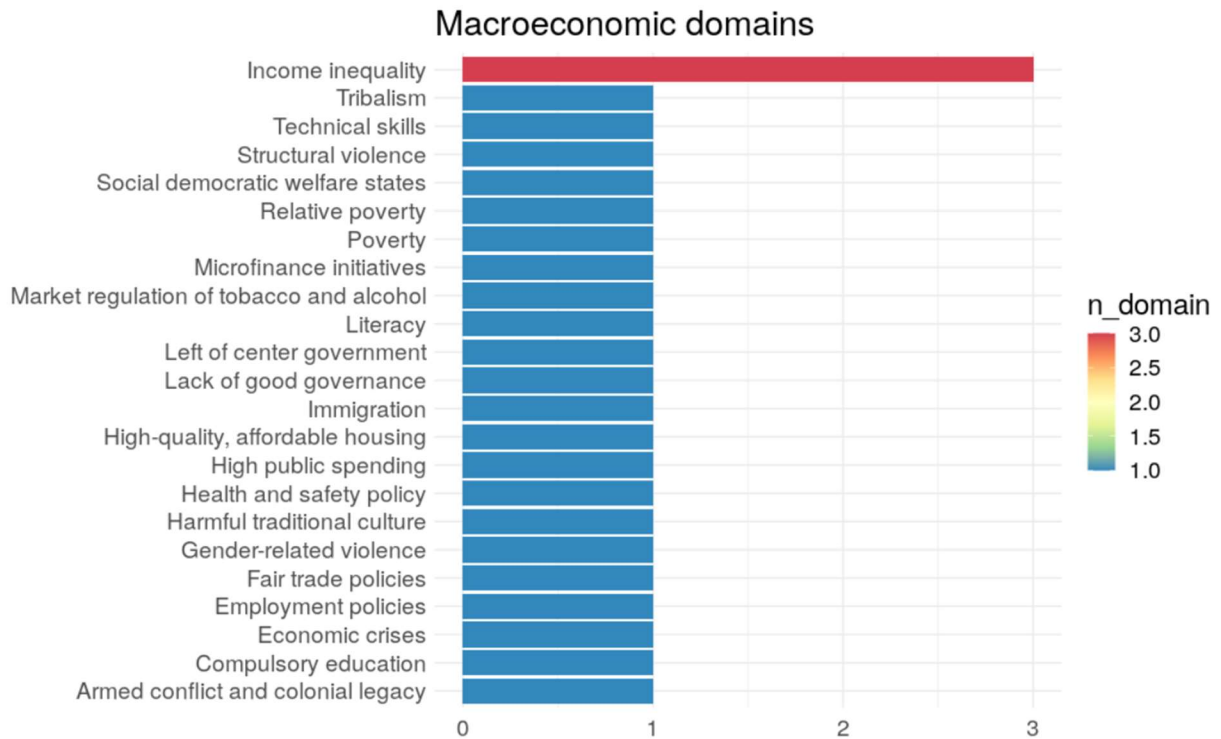
Those frameworks listed 25 different domains as can be seen in *Table 8*.

Table 8. Macroeconomic domains and variables

Domain	Variables
Policy	• Compulsory education (McCartney et al., 2019) • Universal healthcare (Inter-American Development Bank, n.d.) • Economic crises (Naik et al., 2019) • Employment policies (Naik et al., 2019) • Fair trade policies (McCartney et al., 2019) • Health and safety policy (McCartney et al., 2019) • High public spending (McCartney et al., 2019) • High-quality, affordable housing (McCartney et al., 2019) • Immigration (Eshetu & Woldesenbet, 2011) • Income inequality (McCartney et al., 2019; Naik et al., 2019; Subramanian et al., 2002) • Market regulation of tobacco and alcohol (Naik et al., 2019)

	• Microfinance initiatives (McCartney et al., 2019)
Government	• Lack of good governance (Eshetu & Woldesenbet, 2011)
	• Abuse of power (Eshetu & Woldesenbet, 2011)
	• Corruption (Eshetu & Woldesenbet, 2011)
	• Nepotism (Eshetu & Woldesenbet, 2011)
	• Left of center government (Naik et al., 2019)
	• Social democratic welfare states (McCartney et al., 2019)
Historical and cultural context	• Armed conflict (Eshetu & Woldesenbet, 2011)
	• Colonial legacy (Eshetu & Woldesenbet, 2011)
	• Gender-related violence (Eshetu & Woldesenbet, 2011)
	• Harmful traditional culture (Eshetu & Woldesenbet, 2011)
	• Structural violence (Ackerman-Barger, 2018)
	• Tribalism (Eshetu & Woldesenbet, 2011)

How to use the information in this report

The information provided in this report serves as a starting point for understanding frameworks measuring SDH in different contexts. To use this information in an evaluation, institutions and programs can learn valuable information by comparing the methods and metrics used in different frameworks.

Depending on context of evaluation, programs may be more motivated to develop a framework surrounding the data that's available vs building an evaluation framework first and then collecting data based on needed indicators.

Discussion

This report provides an overview of SDH frameworks and metrics that exist in the form of academic literature and institutional reports. Through defining, categorizing, and quantifying determinants and domains, we saw that many SDH frameworks incorporate similar overall determinants as outlined in the WHO and HHS frameworks, but few contain overlapping metrics. This is due to differing data sources and contexts in which the frameworks apply. Frameworks differ in focus and how many details are provided but combining them all together allowed us to develop lists of variables to explain the measurement of each determinant and domain. Compiling information on evaluation frameworks allowed us to review existing information that we can use for later work.

The most cited determinant, **economic stability**, encapsulates important variables that are strongly related to CVD, such as income, occupation, housing, and socioeconomic status. **Education** as a determinant has an abundance of data, metrics, and evidence correlating it with CVD. **Food security** is a determinant that is less established than others in terms of gold-standard data and metrics, but diet, nutrition, and food access have strong causal pathways with cardiovascular health. **Health and healthcare** is one of the most well-established determinants when it comes to variables and measurement as there is a lot of health data historically collected. **Community context** encapsulates social support systems and environments in which we live, and **built environment** contains the physical infrastructure that individuals interact with. **Environment** is starting to be included as a main determinant of health in many frameworks, highlighting the environmental effects on health. We also included a **macroeconomic** category to reflect community- and population-level drivers.

The Institute for Health Metrics and Evaluation (IHME) has done extensive work in the modelling of risk factors and other variables and their effects, both positive and negative, on health outcomes. Risk factors include **air pollution, alcohol consumption, child mortality, diet, maternal health, smoking** and **tobacco consumption, education, physical activity,** and exposure to **secondhand smoke** at home or at the workplace (Institute for Health Metrics and Evaluation (IHME), 2022). Building on this work, it is possible to assess to what extent the work included in this literature review overlap with key risk factors identified in the Global Burden of Disease Study.

Limitations

One of the limitations of this report is that SDH sources tend to come from high-income countries. An article examining SDH in the world's poorest countries argued that the WHO's Commission on the Social Determinants of Health does not include key determinants that play a crucial role in affecting health

outcomes in the world's poorest countries. These factors include **tribalism, lack of good governance, abuse of power, corruption, nepotism, harmful traditional culture, illiteracy, gender-related violence, armed conflict,** and **colonial legacy**. Efforts at defining and prioritizing SDH has been largely carried out in high-income, Western settings (Eshetu & Woldesenbet, 2011). For example in Indonesia, a study found that the term "social determinants of health" was not widely used, understood, or explicitly taught in schools of public health (Susilo et al., 2014). It is important to acknowledge that the factors affecting health inequality vary from country to country as well as within countries.

An additional limitation is that terms can be used in general ways such that determinants and domains may overlap across categories. One goal of this project is to identify the key measurable variables to help support the evaluation of social determinants using a highly specific, empiric foundation.

Further research

In the context of this study, the literature review described in this report allowed us to identify key SDH frameworks, especially the ones developed by WHO and HHS as well as the determinants and domains included in them. This work will be used at later stages of this project to provide a structure able to capture SDH addressed in projects included in the SIF portfolio. The analysis of variables and metrics used in existing studies will be also useful to develop this structure and capture information about SDH in a systematic way.

Appendix

Methods

We identified sources of information through a review of websites of leading global institutions, national frameworks, publicly available reports and tools, and published literature. Our review covered English language sources from any country or time period. Although we focused on materials related to cardiovascular health, our review included sources related to other aspects of health or SDH in general. Institutions and organizations identified in this phase of the review are listed in *Appendix Table 1* and *Appendix Table 2*.

To identify published literature, we performed searches in five databases including PubMed, Cumulative Index of Nursing and Health Literature (CINAHL), EMBASE, Web of Science, and Global Index Medicus. We selected these databases after consulting with a health sciences librarian, and with the intention of widening our search to diverse academic fields and geographies. Our search strings included the MeSH terms "social determinants of health," "cardiovascular disease," and either "evaluation" or "systematic review". Once sources were identified in each database, we screened them for relevance to this study. Inclusion criteria were that the source explicitly included the terms "social determinants of health" and "cardiovascular disease," and that the source included a framework for measuring SDH. Exclusion criteria included the source being about a specific CVD outcome (I.e. Diabetes) or a specific SDH domain (I.e. Effect of education on CVD).

After all sources were identified, we identified and extracted data for each source. Data that we extracted included title, authors, URL or DOI, and each SDH domain along with any specific metrics mentioned in the literature.

Appendix Table 1: Categorized social determinants of health domains by institution

Institution	CVD-specific	Economic stability	Education	Food security	Health and healthcare	Built environment	Community context	Environment	Other
American Heart Association- Havranek et. al.	Yes	SES			Healthcare access and quality	Residential environment	Culture and language, Social support		Race and ethnicity
Australian Institute of Health and Welfare	Yes	Housing tenure, Income	Education						Area-level disadvantage
Center for Outcomes Research	Yes	Economic stability	Education		Healthcare system	Neighborhood and built environment	Community and social context		
Emory University School of Medicine- Min et. al.	Yes	SES			Health literacy		Acculturation, Community and social context		Ethnicity
IFERISS- Lang et. al.	Yes	Employment			Healthcare system		Social isolation		Ethnicity, Geographical location, Traditional risk factors
Institute for Functional Medicine	Yes	SES		Food Insecurity			Social support	Environment	Race and ethnicity, Stress
Johns Hopkins University- Mannoh et. al.	Yes	SES			Access to health care, Health literacy		Social support		Adverse childhood experiences
Mayo Clinic College of Medicine	Yes	Healthy workplace, Income, Safe housing, Social status	Education		Access to health care	Built environment	Social support	Environment	
NYU School of Global Public Health- Zhao et. al.	Yes	Income, Occupation							Gender, Marital status, Race and ethnicity
University of the West of England- Ismail et. al.	Yes	SES	Education				English proficiency		
Aboriginal and Torres Straight Islander Social Justice	No	Food security, Housing			Primary healthcare access	Sanitation			
Agency for Healthcare Research and Quality	No	Economic stability	Education		Healthcare access and quality	Physical infrastructure	Community and social context		
Boston University School of Public Health- Essien et. al.	No				Financial resources, Health literacy	Rurality and neighbourhood	Social network		Race and ethnicity
Brookings	No	Employment, Housing Instability		Food Insecurity	Insurance and healthcare access			Environmental exposure	

Organization									
CDC/ATSDR	No	Income, Poverty, Unemployment	Education				Children and adolescents, Disability status, Elderly populations, English proficiency, Minority status, Single-parent households		
Centers for Disease Control	No			Food Insecurity		Neighborhood and built environment	Community-clinical linkages, Social network		Tobacco-free policy
Economic Innovation Group	No	Employment, Housing, Income, Poverty	Education			Physical infrastructure			
Government of Canada	No	Employment and working conditions, Income and social status	Education and literacy		Access to health services	Physical environments	Childhood experiences, Culture, Social support and coping skills		Biology and genetic endowment, Gender, Healthy behaviors, Race and racism
Gravity Project	No	Economic stability, Employment, Housing Instability, Housing Instability, Material Hardship	Education	Food Insecurity	Health insurance, Health literacy, Medical Cost Burden, Transportation Insecurity		Social network		Elder Abuse, Intimate Partner Violence (IPV), Stress, Veteran Status
Healthy People 2030	No	Economic stability	Education		Healthcare access and quality	Neighborhood and built environment	Community and social context		
Indian Health Service	No	Food Insecurity, Poverty			Health equity			Environment	Adverse childhood experiences, Discrimination and Stress, Trauma
Inter-American Development Bank	No	Employment				Public safety	Social support		Gender and diversity
Kaiser Family Foundation	No	Economic stability	Education	Food Insecurity	Health systems and services	Neighborhood and built environment	Community and social context		
Mathematica	No		Education	Food	Health care system		Community		
Pan-American Health Organization	No	Income, Occupation	Education	Food Insecurity	Health systems and services		Social class		Gender, Race and ethnicity

PhenX Toolkit	No	Annual family income, Employment status, Occupation	Educational attainment	Food Insecurity, Food swamp	Access to health services, Health insurance, Health literacy	Ethnic residential segregation	English proficiency	Air Quality Index, Environmental Justice	Age, Biological sex assigned at birth, Birthplace, Current address, Gender, Race and ethnicity, Sexual orientation
Public Health Foundation of India	No	Employment conditions		Child undernutrition		Unimproved sanitation		Air pollution	Gender inequality
Robert Graham Center	No	Employment, Housing Instability, Income	Education						
Robert Wood Johnson Foundation	No	Occupation	Education		Health equity, Health equity, Health literacy		Social factors		
Unity Health Toronto- Pinto et. al.	No	Employment, Income, Material Hardship	Education		Healthcare access and quality		Family stability		
University of Connecticut School of Medicine- Davey et. al.	No	Housing Instability, Poverty	Parental educational attainment	Food Insecurity	Health insurance, Transportation Insecurity		Immigration status		
WHO	No	Income, Occupation	Education				Social class		Gender, Race and ethnicity

Appendix Table 2: Macroeconomic determinants of health domains by institution

Institution	Variables
NHS Scotland	Access to health care, Compulsory education, Fair trade policies, Health and safety policy, High public spending, High-quality, affordable housing, Income inequality, Microfinance initiatives, Social democratic welfare states
University of Cape Town South Africa	Armed conflict and colonial legacy, Gender-related violence, Harmful traditional culture, Immigration, Lack of good governance, Literacy, Poverty, Technical skills, Tribalism
Imperial College London- Naik et. al	Economic crises, Employment policies, Income inequality, Left of center government, Market regulation of tobacco and alcohol, Public utilities
Harvard School of Public Health- Subramanian et. al.	Income inequality, Relative poverty
Indian Health Service	Structural violence

Appendix Table 3: All data sources included in the review

Database	Title	DOI
Web of Science	Lack of social health determinants on risk prediction tools for cardiovascular disease: A systematic review of systematic reviews.	10.5334/ijic.ICIC21002
Web of Science	Social Determinants in Machine Learning Cardiovascular Disease Prediction Models: A Systematic Review	10.1016/j.amepre.2021.04.016
Web of Science	Impact of social determinants of health on outcomes for type 2 diabetes: a systematic review	10.1007/s12020-014-0195-0
Web of Science	Social capital, mortality, cardiovascular events and cancer: a systematic review of prospective studies	10.1093/ije/dyu212
Web of Science	A systematic approach to analyze the social determinants of cardiovascular disease	10.1371/journal.pone.0190960
Web of Science	Nutrition Disparities and Cardiovascular Health	10.1007/s11883-020-0833-3
Web of Science	Social, Economic, Technological, and Environmental Factors Affecting Cardiovascular Diseases: A Systematic Review and Thematic Analysis	10.4103/ijpvm.IJPVM_105_20
Web of Science	Cardiovascular Health among U.S. Indigenous Peoples: A Holistic and Sex-Specific Systematic Review	10.1080/26408066.2019.1617817
Web of Science	Material Need Support Interventions for Diabetes Prevention and Control: a Systematic Review	10.1007/s11892-014-0574-1
Web of Science	Effects of education and income on cardiovascular outcomes: A systematic review and meta-analysis	10.1177/2047487317705916
Web of Science	Enhancing Social Support Among People with Cardiovascular Disease: a Systematic Scoping Review	10.1007/s11886-019-1216-7
Web of Science	Non-HIV chronic disease burden among transgender populations globally: A systematic review and narrative synthesis	10.1016/j.pmedr.2020.101259
Web of Science	The Role of Behavioral Science Theory in Development and Implementation of Public Health Interventions	10.1146/annurev.publhealth.012809.103604
Web of Science	Social support and its relationship to morbidity and mortality after acute myocardial infarction - Systematic overview	10.1001/archinte.164.14.1514
Web of Science	Perceptions of Aboriginal and Torres Strait Islander Australians toward cardiovascular primary prevention programs: A qualitative systematic review	10.1111/phn.12837
Web of Science	Social capital and physical health: An updated review of the literature for 2007-2018	10.1016/j.socscimed.2019.112360
Web of Science	How Hypertension Guidelines Address Social Determinants of Health A Systematic Scoping Review	10.1097/MLR.0000000000001649
Web of Science	Sedentary Behavior and Health Outcomes: An Overview of Systematic Reviews	10.1371/journal.pone.0105620
Web of Science	Disparities in cardiovascular disease among Caribbean populations: a systematic literature review	10.1186/s12889-015-2166-7
Web of Science	Physical and social factors determining quality of life for veterans with lower-limb amputation(s): a systematic review	10.3109/09638288.2015.1129446
Web of Science	Food Insecurity and its Impact on Body Weight, Type 2 Diabetes, Cardiovascular Disease, and Mental Health	10.1007/s12170-021-00679-3

Web of Science	Food insecurity and housing instability as determinants of cardiovascular health outcomes: A systematic review	10.1016/j.numecd.2022.03.025
Web of Science	Socioeconomic Correlates and Determinants of Cardiorespiratory Fitness in the General Adult Population: a Systematic Review and Meta-Analysis	10.1186/s40798-018-0137-0
Web of Science	Systematic Review of Health Disparities for Cardiovascular Diseases and Associated Factors among American Indian and Alaska Native Populations	10.1371/journal.pone.0080973
Web of Science	Advancing Liver Cancer Prevention for American Indian Populations in Arizona: An Integrative Review	10.3390/ijerph19063268
Web of Science	Multi-morbidity of non communicable diseases and equity in WHO Eastern Mediterranean countries	10.1186/1475-9276-12-60
Web of Science	Systematic review of the influence of childhood socioeconomic circumstances on risk for cardiovascular disease in adulthood	10.1016/j.annepidem.2005.06.053
Web of Science	The development and experience of epidemiological transition theory over four decades: a systematic review	10.3402/gha.v7.23574
Web of Science	Systematic review and meta-analysis of patient race/ethnicity, socioeconomics, and quality for adult type 2 diabetes	10.1111/1475-6773.13326
Web of Science	Prospective cohort studies of coronary heart disease in the UK: a systematic review of past, present and planned studies	10.1097/00043798-200304000-00006
Web of Science	Health-related quality of life in homozygous familial hypercholesterolemia: A systematic review and meta-analysis	10.1016/j.jacl.2021.11.014
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Web of Science	The cascade of care in managing hypertension in the Arab world: a systematic assessment of the evidence on awareness, treatment and control	10.1186/s12889-020-08678-6
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PubMed	Country-level interventions for the prevention and management of hypertension through the modification of social determinants of health: a systematic review protocol	10.1186/s13643-020-01392-9
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PubMed	Social determinants of common metabolic risk factors (high blood pressure, high blood sugar, high body mass index and high waist-hip ratio) of major non-communicable diseases in South Asia region: a systematic review protocol	10.1186/s13643-017-0576-6
PubMed	A Systematic Review of Interventions to Minimize Transportation Barriers Among People with Chronic Diseases	10.1007/s10900-018-0572-3
PubMed	The cascade of care in managing hypertension in the Arab world: a systematic assessment of the evidence on awareness, treatment and control	10.1186/s12889-020-08678-6
PubMed	Lower socioeconomic status is associated with higher rates of critical limb ischemia presentation and post-revascularization amputation	10.1016/j.jvs.2021.10.032
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Global Index Medicus	A meta-analysis of salicylates for type 2 diabetes mellitus	
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embase	Prevalence of depression in cardiovascular patients in Iran: A systematic review and meta-analysis from 2000 to 2017	
embase	Gender differences across social, behavioral, and mental determinants of cardiovascular health among U.S. indigenous peoples: A systematic review	
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