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A Primer on the Social Determinants of Health

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1.1 Introduction

We begin this book with a simple example of cross-country comparisons of life expectancy that illustrates the striking differences in health across populations. The social determinants of health—fundamental social and economic conditions in which we live, work, and play—may help to shape and explain such stark population health inequalities. In this introductory chapter, I present a conceptual framework for the social determinants of health and two related population health frameworks—the 3 P's (people, places, and policies) Population Health Triad and the Health in All Policies (HiAP) approach. I next discuss approaches for studying the social determinants of health, highlight what we know so far about them, and give some practical examples of their estimated large public health impacts if we were to intervene and modify them.

1.2 The Health Olympics: Winners and Losers

The "Health Olympics" is a term that was coined to describe how rich countries perform relative to each other in life expectancy at birth (Population Health Forum 2003). Figure 1.1 shows these results for 2017 by sex and for the sexes combined based on data for Organisation for Economic Co-operation and Development (OECD) countries (OECD 2018). In these hypothetical Olympics, there are clear winners and losers.

Despite being one of the richest nations in the world, the United States fails to medal in this imaginary international competition; in fact, it falls well short of the podium, placing twenty-seventh, with an overall life expectancy of 78.6 years. By contrast, Japan wins the gold medal for life expectancy for men and women

New Horizons in Modeling and Simulation for Social Epidemiology and Public Health,
First Edition. Daniel Kim.
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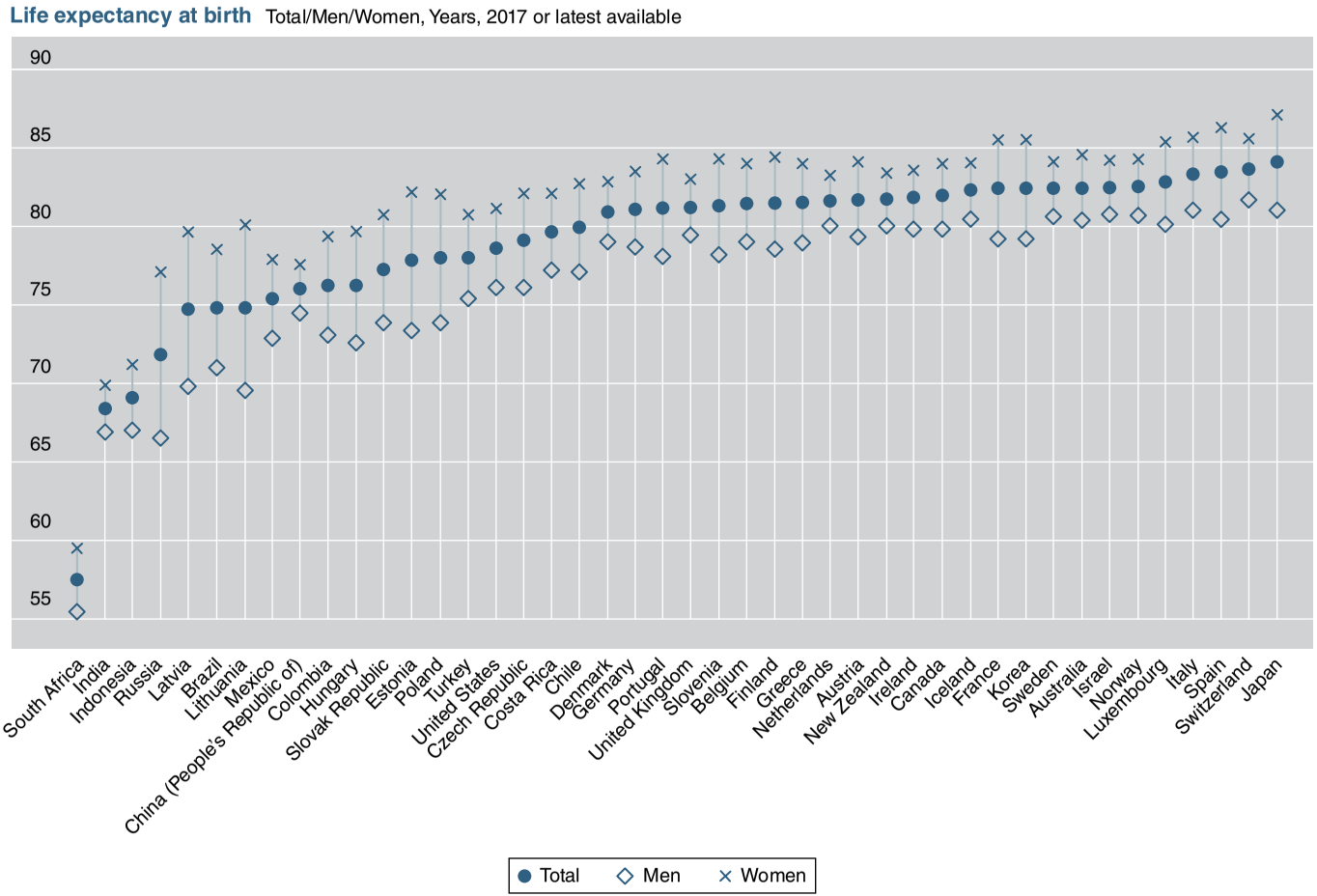

Figure 1.1 Life expectancy at birth for OECD countries. *Source*: From OECD (2018).

combined at 84.1 years—first among women at 87.1 years, second among men at 81.0 years—and bests the United States by 5.5 years, an enormous gap in life expectancy at a population level. Meanwhile, Australia and a number of countries in the European Union either land on the medal podium or are at least very close to it (Figure 1.1).

Differences in life expectancy at birth are often ascribed to a number of factors, including variations in living standards, lifestyle risk factors, education, and access to health services. But what additional insights can research shed in relation to such patterns? In 2013, the U.S. National Academy of Sciences (NAS) commissioned a scientific panel to explore such cross-national comparisons in life expectancy. This panel released its findings in a report entitled *U.S. Health in International Perspective: Shorter Lives Poorer Health* (National Research Council and Committee on Population 2013). The panel compared health outcomes in the United States to those of 16 comparable high-income countries, including whether the US health disadvantage exists across all ages. It also explored potential explanations and assessed the broader implications of these findings. The panel identified a strikingly consistent and pervasive pattern of higher mortality and worse health among Americans compared to those in other nations between the late 1990s and 2008. This health disadvantage starts at birth, affects all age groups up to age 75, and encompasses multiple health and disease outcomes and conditions (e.g. injuries and homicide, infections, heart disease, obesity, and arthritis) and biological and behavioral risk factors (National Research Council and Committee on Population 2013).

Furthermore, the NAS panel reported that premature deaths occurring before age 50 accounted for as much as two-thirds of the difference in life expectancy in men between the United States and other countries and one-third of the difference in women (National Research Council and Committee on Population 2013). Skyrocketing overdoses of drugs, primarily due to opioids, are a major contributor to these premature deaths (National Center for Health Statistics 2017). These fatal overdoses played a role in declines in life expectancy among Americans for a second consecutive year in 2015 and 2016 (Kochanek et al. 2017), marking the first time this has happened in more than half a century. Gun deaths also rose in 2016 for a second consecutive year. Firearm-related injuries contribute substantially to life expectancy, accounting for 7.1% of premature deaths or years of potential life lost before the age of 65 (Fowler et al. 2015).

Americans reach the age of 50 in worse health than their counterparts in other high-income countries as older adults experience higher levels of morbidity and mortality from chronic diseases. Even socioeconomically advantaged (i.e. college educated or higher income) Americans fare worse than their counterparts in England and other countries (National Research Council and Committee on Population 2013). In offering potential explanations for these patterns, the panel

referenced underlying societal factors—which we now commonly refer to as the *social determinants of health*—as possible root causes of the higher levels of morbidity and mortality and shorter life expectancies in the United States (National Research Council and Committee on Population 2013). For instance, despite its vast economy, the United States possesses considerably higher poverty rates and levels of income inequality than most high-income countries. In addition, although the United States once led the world in educational performance, students in many other countries now routinely outperform US students; these findings are analogous to the relative standings of these countries in the Health Olympics. Finally, in contrast to the United States, a number of other countries such as Sweden and Norway in Scandinavia offer larger public welfare and other social safety net programs. Such programs and services could conceivably help residents to better weather the storm of adverse effects on health caused by poor economic and social conditions (Adema et al. 2011; Kim 2016).

1.3 What are the Social Determinants of Health?

In 2005, the World Health Organization (WHO) established a Commission on the Social Determinants of Health that was tasked with the job of supporting countries to address the upstream social factors that shape population health and health inequities (WHO Commission on the Social Determinants of Health 2008). The overall goal of the Commission was to draw the attention of governments and society to the social determinants of health and to create better social conditions for health, particularly amongst the most vulnerable populations. The commission delivered its final report to the WHO in 2008 (WHO Commission on the Social Determinants of Health 2008).

As defined by the WHO Commission, the social determinants of health are "the conditions in which people are born, grow, live, work, and age" (WHO Commission on the Social Determinants of Health 2008). These social determinants extend well beyond the confines of the health care system and include aspects of our neighborhood and workplace environments (e.g. the food, built, and social environments) and the social and economic policies (e.g. tax policies) that govern the regions in which we live. It is these "upstream" nonmedical social determinants that are increasingly understood as the root causes of population health inequalities, even within rich nations (Marmot and Bell 2009; Woolf and Braveman 2011). Such social determinants offer a critical lens to explain why the average life expectancy in America has lagged well behind other nations, despite the fact that the United States remains one of the richest nations in the world and spends more on a per-capita basis on health care than all other developed nations globally (Marmot and Bell 2009). Identifying what impacts various social determinants have on population

health is now the central focus of the growing public health field known as social epidemiology.

The WHO Commission on the Social Determinants of Health developed a conceptual framework of the social determinants of health (Solar and Irwin 2007; WHO Commission on the Social Determinants of Health 2008). Figure 1.2 shows an adaptation of this conceptual framework. As illustrated in this figure, the social determinants of health are composed of the material living and working conditions and social environmental conditions in which people are born, live, work, and age, along with the structural drivers of these conditions. These structural drivers include individual- and area-level socioeconomic status (SES), race/ethnicity, residential segregation, gender, social capital/cohesion, and the macroeconomic and macrosocial contexts, e.g. macroeconomic and social policies including labor market regulations (Muntaner et al. 2012), political factors including governance and political rights (Chung and Muntaner 2006; Bezo et al. 2012), and cultural factors. Examples of macroeconomic determinants include the gross domestic product

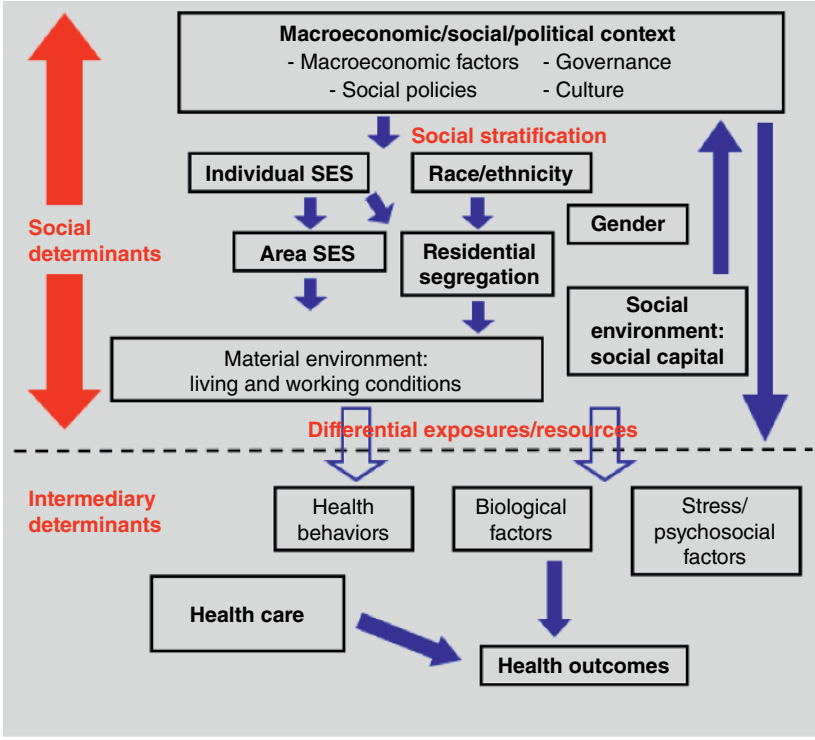

Figure 1.2 A social determinants of health conceptual framework. *Source*: Adapted from Kim and Saada (2013) and Solar and Irwin (2007).

(GDP) per capita and income inequality—the gap between the rich and the poor within societies.

The broader macroeconomic and social context generates social stratification, that is, the sorting of people into dominant and subordinate SES, racial/ethnic, and gender groups (Figure 1.2). Through social stratification and differential exposures of individuals to levels of material factors/social resources, social determinants such as individual/area-level SES, race/ethnicity, and social capital shape individual-level intermediary determinants, including behavioral factors (e.g. maternal smoking), biological factors, and psychosocial factors (e.g. social support), which in turn produce differential risks of, and inequities in, health outcomes (Figure 1.2). Access to health care and the quality of health care are also determinants of these outcomes, yet health care factors are believed to play lesser roles compared to societal factors (Figure 1.2). This is supported by cross-national evidence on health care spending and life expectancy. Moreover, even in societies with a national health system in place (e.g. Canada and the United Kingdom), socioeconomic disparities and gradients in health are salient and well established.

1.4 The 3 P's (people, places, and policies) Population Health Triad

Implicit in this conceptualization of the social determinants of health is that more upstream population characteristics, places, and policies matter to population health. Jointly, we can refer to these three factors that are pivotal to population health as the "3 P's" (people, places, and policies) Population Health Triad (Figure 1.3). The classic Host–Agent–Environment epidemiologic triad posits that a susceptible host, an external agent, and an environment are needed to produce disease. Similarly, both places and policies interact with populations to manifest disease. For example, neighborhoods where we live can influence our health through

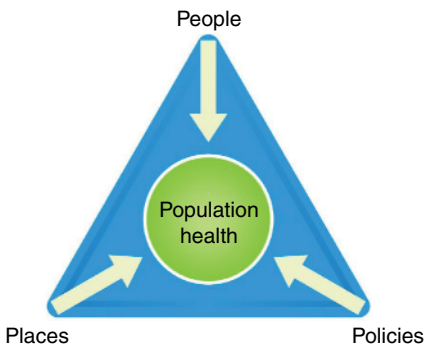

Figure 1.3 The 3 P's (people, places, and policies) Population Health Triad.

physical and material characteristics such as air quality, access to nutritious foods and opportunities for leisure and exercise, health services, and education/schools and employment opportunities (Braveman et al. 2011). Policies in nonhealth sectors (e.g. transportation, education, and housing) can also intersect with and shape health. Social policies such as those that affect levels of welfare spending and tax policies that determine the rich–poor gap have plausible linkages to the social environment, health behaviors, and individual health and disease endpoints. Reciprocal interactions are also possible, with populations being able to shape both policies and places, such as by mobilizing together through social capital (e.g. political activism) to effect change (Figure 1.2).

To help address the social determinants of health at a government level, in 2010, the WHO and the Government of South Australia (2010) developed the HiAP approach through the Adelaide Statement on HiAP. In this comprehensive population health strategy, health considerations in policymaking permeate and encompass multiple public sectors that may influence health, such as transportation, agriculture, housing and urban development, and education (Figure 1.4). The HiAP approach was founded on the notion that many social determinants of health are outside the purview of public health agencies. The roots of this radical approach can be traced back to the seminal ideas put forth

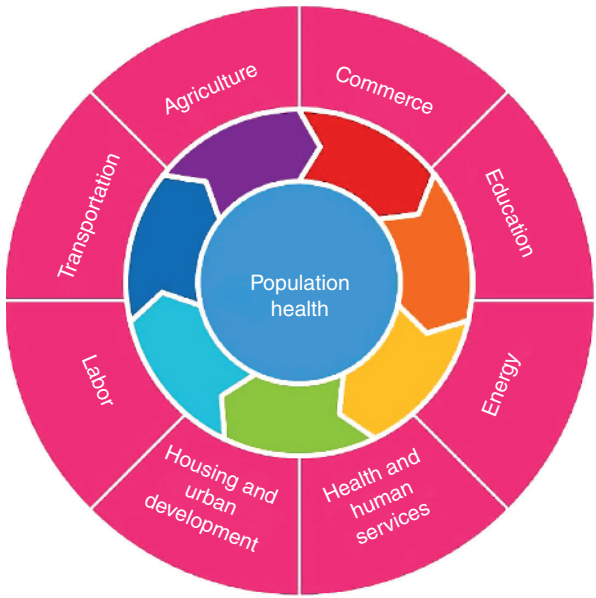

Figure 1.4 Examples of multiple public sectors collectively adopting a Health in All Policies (HiAP) approach.

in the Alma Ata Declaration on Primary Health Care (1978) and the Ottawa Charter for Health Promotion (1986). The HiAP approach became reinforced in the 2011 Rio Political Declaration on Social Determinants of Health (World Health Organization 2016a).

The HiAP approach has been increasingly adopted in jurisdictions around the world. For example, the Department of Housing and Urban Development (HUD) in the United States has embraced a HiAP approach and is collaborating with the U.S. Department of Health and Human Services (HHS) to ensure the integration of the elderly and disabled into the community via housing and human service agencies to enable them to live as long and as healthily as possible (Bostic et al. 2012). HUD further encourages applicants to regional planning and neighborhood initiative grants to incorporate health metrics into their baseline assessments of neighborhoods and asks them to indicate how they will support regional planning efforts that consider public health impacts (Bostic et al. 2012). Moreover, to attain objectives on the social determinants of health, the HiAP approach has been encouraged by Healthy People 2020 (2010), the U.S. Centers for Disease Control and Prevention initiative that establishes national goals and objectives for policy, programs, and activities to address the major health challenges facing our country today. The Secretary's Advisory Committee on Healthy People Objectives for 2020 (Office of Disease Prevention and Health Promotion 2010) has further advised that all federal agencies (e.g. the Departments of Education, Transportation, and HUD) should be required to include Healthy People in their strategic plans.

In 2010, the US state of California created a HiAP Task Force, with representation of 19 state agencies, offices, and departments. Employing a HiAP framework, this statewide effort brought policymakers together to identify and recommend programs, policies, and strategies to improve health, including multiagency initiatives addressing transportation, housing, affordable healthy foods, safe neighborhoods, and green spaces. Additional recommendations included the development of health criteria in the discretionary funding review process and incorporating health issues into statewide data collection and survey efforts (Health in All Policies Task Force 2010).

The region of South Australia has also implemented the HiAP approach. Its HiAP model is based on the twin pillars of central governance and accountability and a "health lens" analysis process, which aims to identify key interactions and synergies between South Australia's Strategic Plan (SASP) targets, policies, and population health (Kickbusch and Buckett 2010). Notably, it was in Adelaide, the capital of South Australia, that the 2010 Adelaide Statement of HiAP was first developed. The South Australian Public Health Act was developed during the early implementation stages of HiAP and provided a legislative mandate to allow HiAP approaches to be systematically adopted across state and local governments within the region (Delany et al. 2015).

To strengthen the overall accountability for the HiAP pledges made by countries in the 2011 Rio Political Declaration on Social Determinants of Health, the WHO is currently developing a global monitoring system for intersectoral interventions on the social determinants of health to improve health equity (World Health Organization 2016b).

1.5 Conventional Approaches to Studying the Social Determinants of Health

Randomized experiments are the gold standard of study designs to establish cause-and-effect relationships. Yet, it is often neither feasible nor ethical to conduct experiments that randomly assign people or places to different levels of social determinants of health. As a result, evidence on the impacts of the social determinants of health has been largely based on observational studies, i.e. ecological, cohort, case–control, and cross-sectional studies. Within such observational studies, traditional epidemiological approaches for studying the impacts of social determinants of health include multivariate analysis, which controls for factors that predict both the social determinants and health outcomes, i.e. so-called potential "confounders."

In addition, studies have explored these relationships by testing for single or multiple factors as potential mediators of the population health impacts of social determinants that could lend plausibility to the presence of causal associations. Because such social determinants are often contextual or area-based factors (e.g. factors at the neighborhood or regional level), multilevel models that incorporate the hierarchical structure of data—such as individuals living within neighborhoods or states—are used to account for similarities and statistical nonindependence of individuals living within the same geographical areas (Goldstein et al. 2002).

1.6 Novel Approaches to Strengthen Causal Inference in Studying the Social Determinants of Health

A growing body of literature is attempting to reduce alternative explanations and other sources of bias in nonexperimental studies on the social determinants of health and more generally within public health. These novel approaches to strengthen causal inference include but are not limited to instrumental variable (IV) analysis, fixed effects analysis, propensity score analysis, inverse probability weighting, and natural experiments. By isolating random variation in the exposure, IV analysis can yield unbiased estimates of the causal association between

an exposure and outcome, including through reducing attenuation bias due to measurement error and confounding bias due to both observed and unobserved factors (Kim 2016). Such approaches are increasingly being used to evaluate the causal roles of risk factors in public health, including obesity, neighborhood conditions, the social environment, and state policies (Davey Smith et al. 2009; Fish et al. 2010; Kim et al. 2011; Mojtabai and Crum 2013; Hawkins and Baum 2014; Kim 2016).

Similar to multivariable regression, propensity score analysis can control for imbalances between comparison groups and can thereby control for confounding. It has the advantage of being more efficient than traditional regression when there are relatively fewer events (Cepeda et al. 2003). However, like multivariable regression, propensity score analysis cannot control for unobserved or unmeasured confounders. Inverse probability weighting has also been used as an approach to estimate the counterfactual or potential outcome if all subjects were assigned to either exposure/treatment (Mansournia and Altman 2016). Finally, natural experiments or other quasi-experimental designs such as regression discontinuity designs (Moscoe et al. 2015) can exploit random variation in exposures as in an experimental study and can thereby minimize confounding due to both observed and unobserved factors as a source of bias.

Results from individual studies can also be qualitatively reviewed in aggregate to identify existing gaps in methodological approaches, potential sources of bias, and similarities/differences in their results. Results across studies can be quantitatively summarized in meta-analyses that yield overall point estimates of exposure–outcome associations, although, importantly, such estimates are only as good as the quality of the studies that are included in the meta-analyses (Egger et al. 2001).

1.7 What Do We Know About the Social Determinants of Health?

As Bambra et al. (2010) have noted, there are clear limitations to the existing evidence based on the social determinants of health. First, observational studies that dominate the literature can only hint at possible interventions and their associated health effects; causal inference is an inherent limitation. Second, there is still only sparse evidence on the impacts of interventions on the social determinants of health. Bambra et al. (2010) conducted an "umbrella review" of the existing systematic reviews of the evidence on specific interventions on the social determinants of health spanning housing/living environment, work environment, transportation, health and social care services, agriculture and food, and water and sanitation. They identified some suggestive evidence that certain categories

of interventions may impact inequalities regarding the health of specific disadvantaged groups, particularly in the fields of housing and work environment. Yet in other areas, such as evidence on policies in education, the health system, food and agriculture, and more generally on the influences of macro-level policies on health inequalities, the empirical literature on interventions was more limited (Bambra et al. 2010).

In a more recent umbrella review, Thomson et al. (2017) adopted a systematic review approach to summarize the state of knowledge on how public health policy interventions (e.g. taxation and educational campaigns) may impact health inequalities such as differential effects across socioeconomic groups or effects of interventions targeted at disadvantaged groups. After searching studies published up to May 2017 within 20 databases (e.g. Medline, EMBASE, CINAHL, PsycINFO, Social Science Citation Index, Sociological Abstracts, and the Cochrane Library), the authors identified 24 systematic reviews reporting 128 relevant primary studies. They then summarized the evidence on policies (fiscal, regulation, education, preventive treatment, and screening) across eight public health domains (tobacco; food and nutrition; the control of infectious diseases; screening; road traffic injuries; air, land, and water pollution; built environment; and workplace regulations). The systematic reviews were mixed in quality, and the results were mixed across public health domains. For the tobacco, food and nutrition, and control of infectious diseases domains, the authors found evidence to suggest that fiscal and regulation policies were more beneficial for reducing or preventing health inequalities than educational campaigns (Thomson et al. 2017).

1.8 How Addressing the Social Determinants of Health Could Change Lives

In principle, intervening on the social determinants of health should have profound effects on population health outcomes and health equity. These outcomes include the numbers of lives saved and the occurrence of disease and other morbidity outcomes such as Disability-Adjusted Life Years (DALYs) (Murray et al. 2015). If we consider the distal nature of these social determinants in Figure 1.2, the impacts of these determinants on population health may in fact be stronger than those of proximal biological and behavioral factors at the individual level (such as smoking and high cholesterol), because upstream social determinants likely shape many of these biological and behavioral factors.

Yet what does the empirical evidence show about the impacts of social determinants of health at a population level? Drawing on studies from the public health literature, the numbers of adult deaths attributable to six social determinants of

health have been estimated (Galea et al., 2011): low education, poverty, low social support, area-level poverty, income inequality, and racial segregation. The investigators calculated summary relative risk estimates of mortality, and used prevalence estimates for each of these social determinants to estimate the associated population attributable risks (PARs, the percentage of deaths attributed to each factor), and then project the total number of deaths attributable to each social determinant in the United States. Through this approach, the authors estimated that 245 000 deaths would have taken place among Americans in the year 2000 due to low education, 176 000 deaths to racial segregation, 162 000 deaths to low social support, 133 000 deaths to individual poverty, 119 000 deaths to income inequality, and 39 000 deaths to area-level poverty. These estimates due to social determinants of health were comparable to the total numbers of deaths due to the leading pathophysiological causes such as heart attacks (192 898 deaths), strokes (167 661 deaths), and lung cancer (155 521 deaths) (Galea et al. 2011). To further put the size of these numbers into perspective, in the year 2000, it was estimated that smoking resulted in 269 655 deaths among men and 173 940 deaths among women in the United States (Centers for Disease Control and Prevention (CDC) 2008).

In another study, Krueger et al. (2015) estimated the mortality attributable to education under three hypothetical scenarios: (i) individuals having less than a high school degree, (ii) individuals having some college education but not completing a bachelor's degree, and (iii) individuals having any level of education but not completing a bachelor's degree. The authors used National Health Interview Survey data (1986–2004) linked to prospective mortality through 2006 and discrete-time survival models to derive annual attributable mortality estimates. The estimated numbers of attributable deaths were striking: 45 243 deaths in the 2010 US population were attributed to individuals having less than a high school degree rather than a high school degree; 110 068 deaths were due to individuals having some college education; and 554 525 deaths were attributed to individuals having anything less than a bachelor's degree but not a bachelor's degree (Krueger et al. 2015). The total numbers of deaths due to having less than a high school degree was similar among women and men and among non-Hispanic Blacks and Whites and was greater for cardiovascular disease than for cancer. Overall, these estimates point to the substantial impacts that policies that increase educational opportunities could have on reducing the burden of adult mortality (Krueger et al. 2015).

Using nationally-representative data, Kim (2016) estimated the impacts of state and local spending on welfare and education on the risks of dying from major causes. Each additional $250 per capita spent on welfare predicted a 3-percentage point lower probability of dying from any cause, and each additional $250 per capita spent on welfare and education predicted a 1.6-percentage point lower probability and a nearly 1-percentage point lower probability of dying from coronary heart disease (CHD). To put such numbers into context, these changes are

on the order of reductions achieved through treating a patient with high blood pressure or cholesterol—representing clinically meaningful changes (Kim 2016).

In a cross-national study that implemented IV analysis to enhance causal inference, Kim et al. (2011) further estimated the population health impacts of raising social capital across 40 countries. Among those aged 15–74 years in 40 nations with at least 40% of the country trusting of others, raising country percentages of social trust by 20 percentage points in countries with at least 30% of a country's citizens trusting of others and by 10 percentage points in countries with 30–40% average country trust was predicted to avert nearly 287 000 deaths per year.

Finally, Kondo et al. (2009) conducted a meta-analysis of cohort studies including roughly 60 million participants in which people living in regions with high-income inequality had an excess risk for premature mortality independent of their SES, age, and sex. The estimated excess mortality risk was 8% for each 0.05 unit increase in the Gini coefficient (a common measure of income inequality theoretically ranging from 0, representing perfect equality, to 1, corresponding to perfect inequality). While this excess risk appears modest, all of society is exposed to income inequality, such that the aggregate effects can be significant (Kondo et al. 2009). The authors estimated that if the inequality–mortality relation is truly causal, more than 1.5 million deaths (9.6% of total adult mortality in the 15–60 age group) could be averted in 30 OECD countries by reducing the Gini coefficient to below the threshold value of 0.3 (Kondo et al. 2009).

Notably, according to Figure 1.2, there should also be substantial impacts of intervening on the social determinants of health on health inequities across population groups, as defined along social axes such as gender, race/ethnicity, and SES. For example, government spending on public assistance programs (e.g. Aid to Families with Dependent Children) and tax credit programs (e.g. the Earned Income Tax Credit) should reduce income disparities between the rich and the poor and thereby reduce associated gaps in health, since income is a strong determinant of health and disease.

As the U.S. National Academy of Sciences panel concluded in its report, if the United States fails to address its growing health disadvantage in the near future, it will lag even further behind comparable countries in life expectancy and across a wide range of other population health outcomes. By adversely affecting the productivity of the workforce through worse population health, the economy of the United States would also continue to suffer, whereas other countries would continue to reap the economic benefits of having healthier populations. Because of how much is at stake, the panel concluded that it would hence be at the United States' peril that it continue to ignore its growing health disadvantage (National Research Council and Committee on Population 2013). Meanwhile, other countries will still need to maintain their efforts on addressing the social determinants of health if they wish to sustain and/or improve their relative standings in the Health Olympics.

Overall, the findings summarized in this chapter make a strong case for intervening at the policy level on social determinants to improve population health and reduce population health inequities. It is also clear that much more empirical evidence is needed if we wish to establish the population health impacts of the social determinants of health. These evidence gaps include estimates of the effects of social determinants of health on the incidence of diseases and on morbidity outcomes such as DALYs; the estimated population-wide health impacts of intervening on the social determinants of health through scaled-up interventions and policies; and economic evaluations (e.g. cost-effectiveness) of such interventions.

In the next chapter, we move beyond traditional analytic approaches to provide a rationale for the use of systems science methods. In particular, we introduce two major sets of analytical tools for modeling and simulating impacts of the social determinants of health: agent-based modeling and microsimulation models. These two novel system science tools and their growing applications in social epidemiology and public health form the primary substance of this book.

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