

Understanding the Relationship Between Education and Health: A Review of the Evidence and an Examination of Community Perspectives

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Abstract

Education is critical to social and economic development and has a profound impact on population health. We review evidence for the health benefits associated with education in the context of a socioecological model of health. The health benefits of education accrue at the individual level (e.g., skill development and access to resources); the community level (e.g., the health-related characteristics of the environments in which people live); and the larger social/cultural context (e.g., social policies, residential segregation, and unequal access to educational resources). All of these upstream factors may contribute to health outcomes, while factors such as ability to navigate the health care system, educational disparities in personal health behaviors, and exposure to chronic stress act as more proximate factors. It is also important to consider the impact of health on educational attainment and the conditions that occur throughout the life course that can impact both health and education, such as early childhood experiences. After exploring the literature linking health and education, we describe a project to engage residents of a low-income, urban community in a process of creating causal models to try to identify new links between education and health and help refine our understanding of the complex phenomena that shape this relationship. We asked community researchers to map out the pathways linking education and health in an effort to explore the possibility that people outside of academia might be able to help refine our understanding of complex phenomena by positing factors and relationships from their lived experience.

Introduction

It is now widely recognized that health outcomes are deeply influenced by a variety of social factors outside of health care. The dramatic differences in morbidity, mortality, and risk factors that researchers have documented within and between countries are patterned after classic social determinants of health, such as education and income,^{1,2} as well as place-based characteristics of the physical and social environment in which people live and the macrostructural policies that shape them.

A 2013 report from the National Research Council and Institute of Medicine cited these socioecological factors, along with unhealthy behaviors and deficiencies in the health care system,

as leading explanations for the “health disadvantage” of the United States. In a comparison of 17 high-income countries, age-adjusted all-cause mortality rates for 2008 ranged from 378.0 per 100,000 in Australia to 504.9 in the United States. The report documented a pervasive pattern of health disadvantages across diverse categories of illness and injury that existed across age groups, sexes, racial and ethnic groups, and social class.³

Recent attention has focused on the substantial health disparities that exist within the United States, where life expectancy varies at the State level by 7.0 years for males and 6.7 years for females,³ but mortality and life expectancy vary even more substantially across smaller geographic areas such as counties^{4,5} and census tracts. In many U.S. cities, life expectancy can vary by as much as 25 years across neighborhoods.⁶ The same dramatic geographic disparities can be seen for other outcomes, such as infant mortality, obesity, and the prevalence of diabetes and other chronic diseases.

Of the various social determinants of health that explain health disparities by geography or demographic characteristics (e.g., age, gender, race-ethnicity), the literature has always pointed prominently to education. Research based on decades of experience in the developing world has identified educational status (especially of the mother) as a major predictor of health outcomes, and economic trends in the industrialized world have intensified the relationship between education and health. In the United States, the gradient in health outcomes by educational attainment has steepened over the last four decades^{7,8} in all regions of the United States,⁹ producing a larger gap in health status between Americans with high and low education. Among white Americans without a high school diploma, especially women,¹⁰ life expectancy has decreased since the 1990s, whereas it has increased for others.⁸ Death rates are declining among the most educated Americans, accompanied by steady or increasing death rates among the least educated.¹¹ The statistics comparing the health of Americans based on education are striking:

- At age 25, U.S. adults without a high school diploma can expect to die 9 years sooner than college graduates.¹²
- According to one study, college graduates with only a Bachelor’s degree were 26 percent more likely to die during a 5-year study followup period than those with a professional degree. Americans with less than a high school education were almost twice as likely to die in the next 5 years compared to those with a professional degree.¹³
- Among whites with less than 12 years of education, life expectancy at age 25 fell by more than 3 years for men and by more than 5 years for women between 1990 and 2008.⁸
- By 2011, the prevalence of diabetes had reached 15 percent for adults without a high school education, compared with 7 percent for college graduates.¹⁴

What accounts for the growing health disadvantages that exist among people with lower educational attainment? Is it what they learn in school, such as how to live a healthy lifestyle, or the socioeconomic advantages that come from an education? Or is the cross-sectional association between education and health more complex, involving nuanced contextual covariables in our society that provide a fuller back story?

This chapter explores the relationship between education and health from the perspective of the peer-reviewed literature and that of community members, engaged through a research exercise, to

blend insights from lived experience with the empirical data accumulated from scholarly research. Unpacking the reasons for the connection between education and health is not just an exercise in scientific inquiry, it is also essential to setting policy priorities. As increasing attention is focused on the need to address social inequity in order to address health inequities, understanding the links between broad upstream factors such as education and health outcomes becomes a critical challenge. Awareness of the importance of education might help drive investment in education and improvements in education and educational policy.

Conceptual Framework

An overarching theoretical framework for the impact of social determinants on health is provided by an ecological model in which individuals and their behavior are embedded, across the lifespan, within a framework of nested institutional contexts (Figure 1).¹⁵ The individual and his or her characteristics are situated within and affected by the family and household, the community and its institutions (e.g., school, workplace, civil institutions), and policies of the larger society. Each level brings access to opportunities, as well as constraints on actions and opportunities. Furthermore, these levels interact with one another, such that family resources, for example, may mediate or moderate the resources available within the community. Social scientists widely agree that unequal social status creates unequal access to resources and rewards. Social structure, as embodied in social position, structures individual behaviors and values and therefore affects many of the mediators in the relationship between education and health.

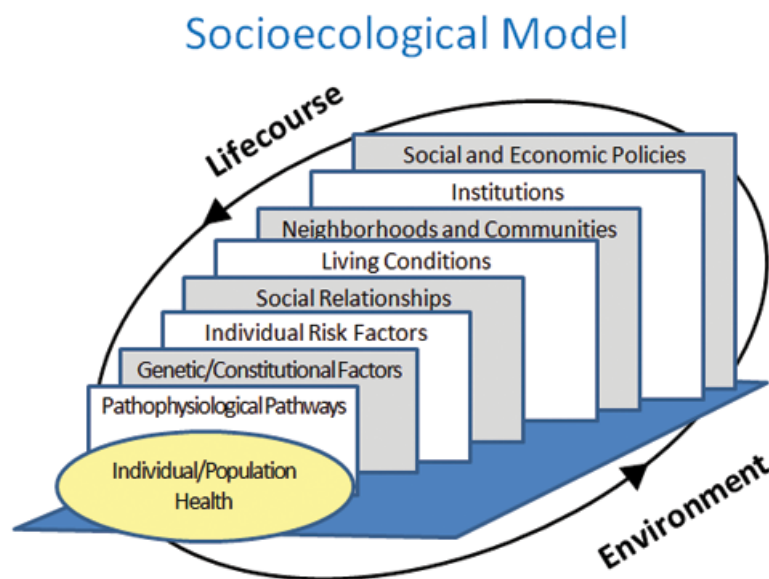


Figure 1. The Socioecological Model

Source: Kaplan GA, Everson SA, Lynch JW. The contribution of social and behavioral research to an understanding of the distribution of disease: a multilevel approach. In Smedley BD, Syme SL (eds), *Promoting health: intervention strategies from social and behavioral research*. Washington, DC: National Academies Press; 2000. Used with permission.

Note: Figure depicts a multilevel approach to epidemiology.

Education is one of the key filtering mechanisms that situate individuals within particular ecological contexts. Education is a driving force at each ecological level, from our choice of partner to our social position in the status hierarchy. The ecological model can therefore provide a context for the numerous ways in which education is linked to our life experiences, including health outcomes. It also provides a framework for understanding the ways in which educational outcomes themselves are conditioned on the many social and environmental contexts in which we live and how these, in turn, interact with our individual endowments and experiences.

Within this rich contextual framework, educational attainment (the number of years of schooling completed) is important but is far from the whole story. Educational attainment is often a key indicator in research studies, not least because it is often measured and recorded; life expectancy is compared by educational attainment because it is the only information about education recorded on death certificates. Besides obvious measures of the quality of education such as proficiency scores and understanding of mathematics, reading, science, and other core content, other dimensions of education are clearly important in the ecological context as well; cognitive development, character development, knowledge, critical thinking, and problem solving are a few examples.

Additionally, the relationship between years of education and health is not a purely linear function. As part of a literature attempting to clarify the functional form of the relationship between education and health, Montez et al. have documented a negative relationship between years of education and mortality risk for attainment less than high school graduation, a steep decline for high school graduates (with reduction of risk five times greater than attributable to other years of education), and a continued yet steeper negative relationship for additional years of schooling (Figure 2).¹⁶ The drop at high school graduation points to the importance of obtaining credentials in addition to other benefits of educational attainment.

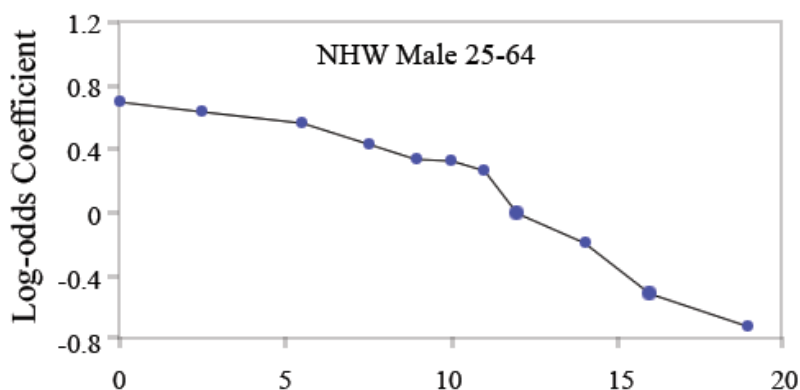


Figure 2. Log-odds coefficients for semi-nonparametric levels of educational attainment (functional form 1) by race-gender-age

Source: Montez JK, Hummer RA, Hayward MD. Educational attainment and adult mortality in the United States: a systematic assessment of functional form. *Demography* 2012;45:315-36. Used with permission.

In order to present a nuanced picture of the relationship between education and health, this chapter is presented in two parts. First, we review the health benefits associated with education, focusing on the primary mechanisms, both distal and proximate, by which education may be considered a driving force in health outcomes. We take a socioecological approach by presenting these concepts in a hierarchy, moving from the level of the person to the community/institution and then the larger social/policy context. Next, we turn to issues of causality that can make it difficult to draw conclusions about the relationship between education and health. These include reverse causality and selection, in which education may actually be impacted by ill health, and confounding, where both education and health are affected by some other causal factor(s) that may also provide important clues about the root causes of poor education and poor health.

Finally, this chapter moves beyond abstract academic models to discuss alternate ways of understanding and prioritizing these mechanisms. We look at preliminary results from a project to garner a “view from the inner city” based on the lived experiences of residents of a disadvantaged neighborhood and how their insights may highlight, broaden, or reinterpret our understanding of the mechanisms presented earlier in the chapter. Our goal is not to settle the question of which are the most important mechanisms by which education and health are related, but rather to call attention to the value of engaging people within communities in enabling researchers and policymakers to better understand and operationalize the importance of education in everyday life and the meaning of empirical evidence from the literature. Our work is part of a larger trend in community-based participatory research (CBPR) that is invigorating a dialogue that incorporates community engagement into the important discussions surrounding social and health inequalities.¹⁷

Readers are cautioned that this chapter touches on a diverse spectrum of factors—all linked to education—that vary from urban design to psychosocial characteristics, access to health care, air pollution, and economic policy. These very diverse domains are each the subject of large literatures that cannot be systematically catalogued in this space. Rather than offering a systematic review, our goal is to draw attention to these factors as part of the education-health relationship and to cite representative sources where readers can explore these topics in more detail; we encourage this research because the quality of evidence linking these factors to health outcomes is uneven and in some cases speculative. Education is linked to established health determinants supported by extensive evidence, such as tobacco use and poverty, but also to factors with less developed evidence, such as allostatic load and social cohesion. Research on methods for improving educational outcomes and learning is not catalogued here due to space constraints but is of vital importance. Finally, the individual elements of the socioecological model exist in a context, and disciplinary and transdisciplinary research is highly relevant in understanding the interplay of contextual factors in a complex systems relationship.^{18,19}

Health Benefits Associated with Education

Among the most obvious explanations for the association between education and health is that education itself produces benefits that later predispose the recipient to better health outcomes. We may think of these returns from education, such as higher earnings, as subsequent “downstream”

benefits of education (later in the chapter we will discuss “upstream” factors that may influence both education and health throughout the life course, especially before children ever reach school age). Following the socioecological framework presented in the introduction, we describe a range of potential downstream impacts of education on health, starting with the ways individuals experience health benefits from education, but then going on to discuss the health-related community (or place-based) characteristics that often surround people with high or low education, and closing with the larger role of social context and public policy.

Impact at the Individual Level

Education can impart a variety of benefits that improve the health trajectory of the recipient. Below we discuss its role in enhancing non-cognitive and cognitive skills and access to economic resources, and we highlight the impacts of these on health behaviors and health care usage. Although this section focuses specifically on the health benefits of education, we do so in full knowledge that education is impacted by health, development, and a host of personal, community, and contextual factors.

Education Impacts a Range of Skills

Education contributes to human capital by developing a range of skills and traits, such as cognitive skills, problem solving ability, learned effectiveness, and personal control.²⁰ These various forms of human capital may all mediate the relationship between education and health. Personality traits (also known as “soft” or non-cognitive skills) are associated with success in later life, including employment and health. The ‘Big Five’ personality factors include conscientiousness, openness to experience, extraversion, agreeableness, and neuroticism/emotional stability.²¹ Roberts et al. postulate three pathways whereby personality traits may impact mortality: through disease processes (e.g., response to stress), health-related behaviors, and reactions to illness. They suggest that the strength of association between the ‘Big Five’ personality traits and mortality is comparable to that of IQ and stronger than socioeconomic status.²² Although enduring, these skills are also mutable, and research indicates that educational interventions to strengthen these skills can be important, especially among children in disadvantaged areas, who may find it more difficult to refine these skills at home and in their social environments.

Personal control, also described in the literature in terms of locus of control, personal efficacy, personal autonomy, self-directedness, mastery, and instrumentalism,²³ is another soft skill associated with educational attainment. According to Ross and Wu (p. 723), “Because education develops one’s ability to gather and interpret information and to solve problems on many levels, it increases one’s potential to control events and outcomes in life. Moreover, through education one encounters and solves problems that are progressively more difficult, complex, and subtle, which builds problem-solving skills and confidence in the ability to solve problems.”²³

Personal control can impact individuals’ attitudes and behaviors, potentially including health behaviors. Furthermore, an individual’s sense of mastery and control may mediate stress, possibly by facilitating better coping mechanisms. Lack of personal control, on the other hand, may provoke physiological responses, leading to suppression of the immune system.²³

Box 1. Impact of Education on the Ability to Navigate Health Care

Achieving positive health outcomes in today's health care environment requires a variety of factors to come together that may be affected by educational attainment and a combination of soft and hard skills. Patients benefit from the ability to understand their health needs, follow or read instructions, advocate for themselves and their families, and communicate effectively with health providers. A systematic review of health literacy and health outcomes found that individuals with lower health literacy had poorer health-related knowledge and comprehension, ability to demonstrate taking medications properly, and ability to interpret medication labels and health messages. They also had increased hospitalizations and emergency care, decreased preventive care, and, among the elderly, poorer overall health status and higher mortality.²⁶ For example, low literacy and low levels of other basic skills such as listening and numeracy have been associated with greater difficulty in asthma care in adults.

In a review of the impact of patient socioeconomic status on patient-physician communication, Willems et al.²⁸ concluded that communication is influenced in part by patients' communicative ability and style, which depend largely on education and other personal attributes. Education contributes to more active communication, such as expressiveness and asking questions. In response, physicians tend to communicate less to patients who seem less educated and to provide care that is more directive and less participatory.

In addition to its impact on soft skills, education has the potential to impart skills in reading, mathematics, and science/health literacy that could contribute to an individual's health. Learners of English as a second language are helped to overcome language barriers that can interfere with understanding of health needs. Education may also improve a range of other skills, such as cognitive ability, literacy, reaction time, and problem solving. Pathways from these skills to health outcomes may be indirect, via attainment of better socioeconomic circumstances or behavior, but they may also apply directly in clarifying the increasingly complex choices individuals face in understanding health priorities and medical care needs. Skills such as higher cognitive ability and health literacy may also lead directly to improved health outcomes because of an enhanced "ability to comprehend and execute complex treatment regimens," and better disease self-management.²⁴ A strong education may be important in both navigating health care (see Box 1) and making choices about lifestyle and personal health behaviors (see Box 2). Cutler and Lleras-Muney report that increased cognitive ability resulting from education contributes significantly to the education gradient in health behaviors.²⁵

Education Increases Economic and Social Resources

A large part of the impact of education on health flows through the attainment of economic resources, such as earnings and wealth, as well social resources such as access to social networks and support.³⁶ Adults with more education are less likely to experience unemployment and economic hardship and will have greater access to a variety of important material, financial, and social resources (see Box 3). Link and Phelan (p. 87) point out that the specific mechanisms linking socioeconomic status (SES) to health have changed over time but that SES remains a fundamental social cause of disease because it involves "access to resources that can be used to avoid risks or to minimize the consequences of disease once it occurs."¹

Box 2. Impact of Education on Personal Health Behaviors

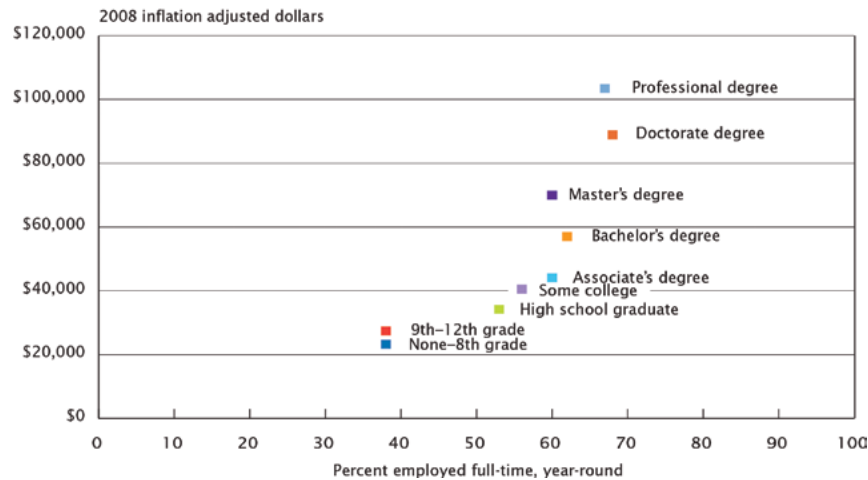
Adults with higher levels of education are less likely to engage in risky behaviors, such as smoking and drinking, and are more likely to have healthy behaviors related to diet and exercise. Data from the National Survey on Drug Use and Health (NSDUH) indicate that in 2009-10, 35 percent of adults who did not graduate high school were smokers, compared to 30 percent of high school graduates and 13 percent of college graduates.²⁹ The impact of education on health behaviors likely stems from education's impact on skills as well as socioeconomic status. Examining competing explanations for the education gradient in health behaviors, Cutler and Lleras-Muney find evidence for the importance of resources, cognitive ability (especially how one processes information), and social integration.²⁵

Education offers opportunities to learn more about health and health risks, both in the form of health education in the school curriculum and also by giving individuals the health literacy to draw on, later in life, and absorb messages about important lifestyle choices to prevent or manage diseases. For example, people with more education are more likely to have healthy diets and exercise regularly. Analysis of several waves of data from the National Health and Nutrition Examination Survey (NHANES) found that intake of specific nutrients (e.g., vitamins A and C, potassium, calcium), as well as overall diet quality, are associated with education.³⁰ In addition, Behavioral Risk Factor Surveillance System (BRFSS) data for 2010 indicate that only 61 percent of adults with less than a high school education and 68 percent of high school graduates said that they exercised in the past 30 days, compared to 85 percent of college graduates.³¹ It must be noted, however, that not all behavioral risk factors are higher among those with the lowest educational attainment. BRFSS data for 2011 indicate that the prevalence of binge drinking increases with higher levels of education.³²

Finally, adults with higher levels of education tend to have lower exposure to stress related to economic deprivation or relative deprivation,³³ and may therefore be less inclined than those with lower levels of education to adopt unhealthy coping behaviors for stress. Individuals with more education tend to have greater socioeconomic resources for a healthy lifestyle and a greater relative ability to live and work in environments with the resources and built designs for healthy living.^{34,35}

Economic Resources

Adults with a higher education—especially in today's knowledge economy—have conspicuous advantages in gaining employment and finding desirable jobs (Figure 3). Advanced degrees give workers an advantage in obtaining rewarding jobs that offer not only higher salaries and job satisfaction but other health-related benefits such as health insurance coverage. For example, adults with health insurance in the United States use more physician services and have better health outcomes compared to uninsured or inconsistently insured adults.³⁷⁻³⁹ Worksite health promotion programs and policies that protect occupational safety also play a role. An inadequate education markedly increases the risk of unemployment. In 2012, unemployment was 12.4 percent among adults who did not graduate high school, compared to 8.3 percent among adults with a high school diploma and 4.5 percent among college graduates.⁴⁰ A body of evidence links unemployment to adverse health outcomes. For example, a higher percentage of employed persons reported in 2010 that they were in excellent or very good health (62.7 percent) than did individuals who were unemployed for less than 1 year (49.2 percent) or unemployed for more than 1 year (39.7 percent). The unemployed also reported more physically and mentally unhealthy days in the past 30 days.⁴¹

Education, Work Status, and Median Annual Earnings**Figure 3. Education, work status, and median annual earnings**

Source: Education and Synthetic Work-Life Earnings Estimates. American Community Survey Reports, United States Census Bureau. September 2011. Used with permission.

The income and wealth that come from a good education are leading predictors of health status,^{2,42} and accumulated financial strain has been shown to impact health above and beyond the effects of income and wealth.⁴³ In today's society, economic resources are inextricably linked to education. In 2012, the median wage for college graduates was more than twice that of high school dropouts and more than one and a half times that of high school graduates.⁴⁰ Weekly earnings are dramatically higher for Americans with a college or advanced degree. A higher education has an even greater effect on lifetime earnings (Figure 4), a pattern that is true for men and women, for blacks and whites, and for Hispanics and non-Hispanics. According to 2006-2008 data, the lifetime earnings of a Hispanic male are \$870,275 for those with less than a 9th grade education but \$2,777,200 for those with a doctorate degree. The corresponding lifetime earnings for a non-Hispanic white male are \$1,056,523 and \$3,403,123.⁴⁴

The economic vulnerability that can arise from an inadequate education can affect health through a cascade effect on the ability to acquire resources that are important to health (e.g., food, stable housing, transportation, insurance, and health care).⁴⁵ People with low income are more likely to be uninsured and to be vulnerable to the rising costs of health care, which insurance carriers are increasingly shifting to patients through higher copayments, deductibles, and premiums. In 2012, one-fourth (24.9 percent) of people in households with an annual income less than \$25,000 had no health insurance coverage, compared to 21.4 percent of people in households with incomes ranging from \$25,000 to \$49,999; 15.0 percent in households with income ranging from \$50,000 to \$74,999; and 7.9 percent with incomes of \$75,000 or more.⁴⁶

Median Synthetic Work-Life Earnings by Education, Race/Ethnicity, and Gender: Full-Time, Year-Round Workers



Figure 4. Median synthetic work-life earnings by education, race/ethnicity, and gender: full-time, year-round workers

Source: Reprinted with permission of the Center on Society and Health, Virginia Commonwealth University.

Individuals with the higher incomes that accompany education have more resources to purchase healthy foods, afford the time and expenses associated with regular physical activity, have easy transportation to health care facilities or work locations, and afford health care expenses. According to 2010 BRFSS data, 27 percent of adults with less than a high school education reported not being able to see a physician due to cost, compared to 18 percent and 8 percent of high school and college graduates, respectively.⁴⁷ Accordingly, the costs of a healthy lifestyle pose more of a barrier for people with less education. The health implications of these financial barriers to health care are well documented: the uninsured are less likely to receive preventive care or help with disease management,⁴⁸ and they have a higher risk of mortality.⁴⁹

Box 3. Stress and Allostatic Load

Allostatic load results in an individual's inability to adapt to long-term stress, leading to chronic illness. Individuals with lower levels of educational attainment are at greater risk of exposure to stress, such as chronic occupational stress or unemployment, and they may be less likely to have buffers that reduce the impact of stress (e.g., social support, sense of control or mastery over life, and high self-esteem).⁵⁵ Effects of stressors vary depending on factors such as genetic makeup, development, early experiences, the availability of coping mechanisms, and responses to threats.⁵⁶

A growing body of research is documenting that life changes, traumas, chronic strain, and discrimination—all of which can accompany an inadequate education—can be harmful to both physical and psychological health. Chronic stressors can be related to a wide variety of circumstances, such as social roles, interpersonal conflict, and the environment or living conditions. Stressful events may interact with the experience of chronic stress to affect outcomes, and these stressors are, in turn, influenced by one's personal traits and values and mediated by factors such as coping mechanisms and social support.⁵⁷ For those confronting life without a good education, individual stressors can accumulate over time and may, in turn, heighten exposure to further stressors.

The biological consequences of stress and allostatic load are increasingly clear, as are their effect on cognition. For example, a longitudinal study of high functioning older adults found associations between baseline measures of allostatic load and cognitive function, physical performance, and the incidence of cardiovascular disease during the study period.⁵⁸ A 4.5-year followup study of the same subjects found increased risk of mortality among individuals with higher baseline allostatic load scores as well as among those whose score increased.⁵⁹ The combination of high perceived stress and risky health behaviors has been found to be associated with increased mortality among individuals of low socioeconomic status.⁶⁰

Social Resources

Educational attainment is associated with greater social support, including social networks that provide financial, psychological, and emotional support. Social support includes networks of communication and reciprocity. Individuals in a social network can relay information, define norms for behavior, and act as modeling agents. Those with higher levels of education may also have higher levels of involvement with civic groups and organizations. Conversely, low social support (i.e., not participating in organizations, having few friends, being unmarried, or having lower quality relationships) is associated with higher mortality rates and poor mental health.^{50,51} The social integration that often accompanies education has been linked to health outcomes in a causal chain that begins with the macro-social and ends with psychobiological processes.⁵² Berkman et al.⁵² propose several mechanisms through which social integration affects health: social support, social influence, social engagement/attachment, and access to goods and resources. Social connection can be an

important buffer to the negative health consequences of health stressors. Marriage imparts benefits in longevity, but weaker network ties can also have important health effects, such as the effects of peers on behavior.⁵³ The effect of social networks on smoking cessation is a well-known example.⁵⁴

Impact at the Community Level

Individuals with education benefit not only from the resources that schooling brings to them and their families but also from health-related characteristics of the environments in which they tend to live, work, and study. Although there are many methodological challenges in estimating community-level effects on individuals,^{61,62} communities appear to confer a range of benefits or risks that can impact health. In the midst of growing recognition that “place matters” to health, many studies have tried to estimate neighborhood effects on outcomes such as child/youth educational attainment, behavioral/well-being outcomes, or health status and mortality. For example, Ross and Mirowsky⁶³ used multilevel analysis of survey data from Illinois to address the question of whether community SES impacts health above and beyond the contributions of individual SES. They found that individual-level indicators of SES explained most of the variation in physical functioning (about 60 percent), but that neighborhood-level measures had a significant influence as well. Given the wide range of methodologies and data sources utilized, findings are not uniform among such studies, but there is general agreement that a relatively modest neighborhood effect exists independent of individual and family-level factors such as education or income.^{61,64,65} Effects that appear to occur at the neighborhood level may represent aggregated individual characteristics (compositional effects), neighborhood variability (contextual effects), or local manifestations of larger scale processes (e.g., higher-level planning or regulatory decisions).⁶⁶ Furthermore, it is important to recognize the dynamic interaction that occurs between the individual and the environment⁶⁷ and conceptions of space as “relational geographies.”⁶⁸

At one level, community characteristics matter because access to resources that are important to health is contingent on community-level resources and institutions. Macintyre and Ellaway categorize these as physical features, services, sociocultural features, reputation, and availability of healthy environments at home, work, and play.⁶⁹ Theories about the mechanisms by which social environments affect the health of individuals also focus on community characteristics such as social disorganization, social control, social capital, and collective efficacy.⁷⁰ Kawachi et al. note that communities with higher social capital tend to be more resilient in the face of disasters and are better able to employ informal control mechanisms to prevent crime.⁷¹

People with low education tend to live in certain communities that, through a combination of resources and characteristics, expose individuals to varying levels of risk versus safety (e.g., crime, unemployment, poverty, and exposure to physical hazards) and provide different levels of resources (e.g., food supply, green space, economic resources, and health care). One notable resource that differs among communities is the quality of education itself. Low-income neighborhoods often have fewer good schools, not least because public schools tend to be poorly resourced by low property taxes and cannot offer attractive teacher salaries or properly maintain buildings, supplies, and school safety. Adverse community factors can compound the difficulty that children face in obtaining a good education while also compromising their health trajectory.

Below we touch on several additional community characteristics that have been linked to health outcomes and tend to vary with the level of education of the population. These characteristics include

food access, spaces and facilities for physical activity, access to health care, community economic resources, crime and violence, and environmental exposure to toxins.

Food Access

Unhealthy eating habits are linked to numerous acute and chronic health problems such as diabetes, hypertension, obesity, heart disease, and stroke, as well as higher mortality rates, but access to healthier foods tends to be limited in neighborhoods with lower median incomes and lower levels of educational attainment. In one study, access to healthier food outlets (defined as at least one healthier food retailer within the census tract or within 1.5 miles of tract boundaries) was 1.4 times less likely in census tracts with fewer college-educated adults (less than 27 percent of the population) as in tracts with a higher proportion of college-educated persons; these differences varied by region and were highest in the South and lowest in the West and Northeast.⁷² Conversely, low-SES neighborhoods often have an oversupply of fast food restaurants, convenience stores, bodegas, liquor stores, and other outlets that sell little fresh produce but promote inexpensive calorie-dense foods and unhealthy beverages.

Spaces and Facilities for Physical Activity

People with higher education and income are more likely to live in neighborhoods that provide green space (e.g., parks), sidewalks, and other places to enable residents to walk and cycle to work and shopping, exercise, and play outside. Lower-income neighborhoods and those with higher proportions of non-white residents are also less likely to have commercial exercise facilities.⁷³ The health benefits of green space have been documented in urban environments, especially for lower income, young, and elderly populations.⁷⁴ A longitudinal study in Great Britain found immediate, positive mental health effects of moving to urban areas with more green space.⁷⁵

Access to Health Care

Because of the maldistribution of health care providers in the United States,⁷⁶ access to clinicians and facilities tends to be in shortest supply in the rural and low-income areas populated by people with limited education. Thus, apart from whether residents have the health insurance coverage and resources to afford health care, they may struggle to find primary care providers, specialists, and hospitals in their area that provide quality health care services.

Community Economic Resources

The lack of jobs in low-income communities can exacerbate the economic hardship that is common for people with less education. Such individuals are more likely to live in communities with a weak economic base that is unattractive to businesses, employers, and investors and are thereby often caught in a self-perpetuating cycle of economic decline and marginalization.

Crime and Violence

Elevated crime rates in neighborhoods populated by people with low education can impact health through the direct effects of violent crimes on victims, such as trauma and high youth mortality rates. Crime can also affect health indirectly, such as through fear of crime or the cumulative stress of living in unsafe neighborhoods.⁷⁷ The high incarceration rates of residents in some low-SES communities can have deleterious effects on social networks, social capital, and social control, further compromising public health and safety.⁷⁸ The 2006 and 2007 rounds of the American Community Survey found that,

among young male high school drop-outs, nearly 1 in 10 was institutionalized on a given day in 2006-2007 versus less than 1 of 33 high school graduates.⁷⁹

Environmental Exposure to Toxins

People of color and those with less education are more likely to live in neighborhoods that are near highways, factories, bus depots, power plants, and other sources of air and water pollution. A large body of research on environmental justice has documented the disparate exposure of low-income and minority neighborhoods to hazardous waste, pesticides, and industrial chemicals.⁸⁰ This exposure to toxins is perhaps the most undiscriminating place-based characteristic because residents' personal socioeconomic advantages (e.g., education, income) offer no protection against the adverse health consequences of inhalation or ingestion of such toxins.

The Larger Social Context and Social Policy

Health inequities are driven, in large part, by the social context in which people are born, live, and work—that is, the social policies that shape resources, institutions, and laws; the economic system through which material and financial resources are created and distributed; and the social norms that govern interactions. The conditions in which people live—for example, the built environment, public transportation, urban design, crime rates, food deserts, and the location of polluting factories—are determined by macrostructural policies and the cultural values that shape them. Formulation of effective analyses and solutions to problems affecting health must address factors that go beyond the level of the individual and proximal risk factors.⁸¹ These influences have been recognized by organizations concerned with health outcomes locally, nationally, and internationally. The World Health Organization calls for improved living and working conditions, social protection policy supportive of all, reduced inequality, and strengthened governance and civil society.² Healthy People 2020 has many policy objectives for health, including improved environmental conditions (e.g., air/water quality and exposure to hazards), violence prevention, poverty reduction, and increased rates of postsecondary education.⁸² The Place Matters team in Alameda County, CA has identified five policy areas to impact health outcomes locally: economics, education, criminal justice, housing and land use, and transportation.⁸³

Decisions made by society, voters, and policymakers—both within and outside of government—exert deep influences on education itself, as well as on the institutions and resources that populate the socioecological framework linking education and health. For example, in other societies, the adverse health consequences of poverty are often buffered by social services that act to safeguard the health of children, young parents, and other vulnerable groups. Bradley et al. found that while most high-income countries spent more on social services than on health expenditures, the converse was true in the United States. The average ratio of social to health expenditures in OECD countries from 1995 to 2005 was 2.0; the ratio in the United States was 0.91.⁸⁴

Economic policies have a large influence on the employment and wealth-building opportunities of workers and the marketability of an education. Major economic and technological shifts of the last few decades have favored “non-tradable” service jobs in sectors such as government and health care, while manufacturing jobs have moved to less developed countries in large numbers. Remaining jobs in the “tradable” sectors such as technology and finance increasingly require advanced skill sets.⁸⁵ These employment trends provide a critical context in the relationship between education and health—those unable to acquire the necessary education to be competitive in an increasingly restrictive job environment are vulnerable to long-term economic hardship.

Educational opportunities, however, are not equally distributed in the United States. Public school funding, largely dependent on local property taxes, varies widely both within and between States. The best funded school systems in the United States have per pupil expenditures almost four times the per pupil expenditures in the lowest spending schools.⁸⁶ Although early studies failed to find a strong relationship between school funding amounts and student achievement, some meta-analyses have supported the link between school funding and individual achievement.⁸⁷

Inequalities by education cannot be disentangled from the backdrop of inequalities by gender, race, ethnicity, sexual orientation, and disability and their effects on both risks and opportunities.

Figure 5 shows persistent gender and race disparities in earnings.⁸⁸ There are cultural as well as material dimensions of inequality (see Box 4), as when cultural status beliefs influence inequality primarily at the social relational level by shaping people's expectations for themselves and others.⁸⁹ Societies that impose social status hierarchies based on "categories" of difference solidify and perpetuate differentials in power and control of resources—thus leading to material inequalities. Income inequalities in the United States are significant and have become more pronounced, with wages at the lower or middle of the income distribution stagnating or falling while those at the top continue to rise. Income inequality persisted during the recovery from the Great Recession, during the first 3 years of which 95 percent of income gains accrued to the top 1 percent of earners.⁹⁰ The Gini coefficient, which measures income inequality, rose from 0.394 in 1970 to 0.469 in 2010; the share of household income earned by the bottom quintile was 3.3 percent in 2010, compared to 50.2 percent among the top quintile.⁹¹



Figure 5. Women's earnings as a percentage of men's median usual weekly earnings (full-time wage and salary workers) in current dollars, by race and ethnicity (1980-2010 annual averages)

Source: Women's earnings as a percent of men's in 2010. Bureau of Labor Statistics, U.S. Department of Labor, The Economics Daily, January 10, 2012.

Note: Data shown are from the Current Population Survey (CPS). To learn more, see *Women in the Labor Force: A Databook* (2011 Edition), BLS Report 1034, December 2011.

The continuing racial residential segregation and increasing economic segregation of urban landscapes affect the life chances of those living in concentrated poverty “irrespective of personal traits, individual motivations, or private achievements” and expose residents, many of whom lack adequate education, to higher levels of social problems.⁹² These historical, economic, and cultural factors have also shaped and reinforced the racial division of labor and adverse impact on the low-wage sector.⁹³

Box 4. Impact of the Cultural Context on Health Disparities and the Use of Health Care

Cultural influences can be important features of the causal web linking education and health. Experience with discrimination and racism (e.g., perceived discrimination, segregation, institutional discrimination, reduced access to goods and services), which may occur more commonly among people with less education, has a known relationship to stress and stress-related health disparities, as well as to health care seeking, treatment adherence, and risky health behaviors.⁹⁴ Mistrust among patients and bias among health care providers can affect the quality of care.⁹⁵ For example, a study of 202 African American patients with HIV in a primary care setting found that patients with higher educational attainment reported higher levels of trust, better communication with providers, and higher levels of shared treatment decisions. It also found that health outcomes were related to the belief that the health care provider should integrate culture in HIV treatment and to the perceived quality of provider communication. Trust was related to medical self-care but not to other outcomes.⁹⁶ Care is also affected by the cultural competency of providers—that is, their ability to recognize and appropriately respond to key cultural features that affect health care, which may include language, cultural values, patient beliefs, folk illnesses, and provider practices.⁹⁷

Reverse Causality and Selection

The association between education and health may reflect not only the health benefits of education but a selection phenomenon caused by the detrimental effects of illness on educational success. Basch identifies five causal pathways by which health may impact motivation and ability to learn—sensory perceptions, cognition, school connectedness and engagement, absenteeism, and temporary or permanent dropping out.⁹⁸ For example, chronic health conditions can impact children’s development and educational performance.⁹⁹ Such children are more likely to have absences for medical reasons and to be distracted by health concerns. Nonetheless, research evidence demonstrating that poor health has a causal relationship with educational outcomes is incomplete,¹⁰⁰ and findings of the overall effects range from about 1.4 years reduced educational attainment¹⁰¹ to about half a year,⁷ but there are notable exceptions. For example, evidence across countries and time periods demonstrates the harmful effect of low birth weight on education.^{100,102} Disease, malnutrition, and prenatal and childhood exposures to toxins can also impact physical and cognitive development and educational achievement.¹⁰³

The extent to which reverse causality contributes to the association between education and health requires further study, but longitudinal data—the most compelling evidence to resolve the controversy—tend to suggest that most of the association is attributable to the downstream benefits of education. Eide and Showalter¹⁰² reviewed studies incorporating a range of methodologies that attempted to examine causal links between education and health outcomes. Studies of natural experiments in the United States (e.g., changes in compulsory school laws) generally found evidence of a causal link with mortality. Twin studies found evidence for causal links between years of schooling and self-reported health, the probability of being overweight (among men but not women),

and the effects of college attendance on preventive health care later in life.¹⁰² Link and Phelan also discussed research attempting to show the direction of causality using quasi-experimental approaches, longitudinal designs, and analyses of risk factors that cannot be attributed to individual illness (e.g., plant closings). They concluded that these studies “demonstrated a substantial causal role for social conditions as causes of illness.”¹

Conditions Throughout the Life Course that Affect Both Health and Education

A third way that education can be linked to health is when education acts as a proxy for factors throughout the life course—most notably in early childhood—that affect both education and health. For example, as noted earlier, the social and economic environment facing individuals and households and the stresses and allostatic load induced by material deprivation can affect success in school (and work) while also inducing biological changes and unhealthy behaviors that can increase the risk of disease. Although this can occur throughout the life course, increasing attention is being placed on the role of these factors on children before they ever reach school age.

Early Childhood Experiences

The education community has long understood the connections between early life experiences and educational success. It is well-established that school readiness is enhanced by positive early childhood conditions—for example, fetal well-being and social-emotional development,¹⁰⁴ family socioeconomic status,^{a,100,105,106} neighborhood socioeconomic status,^{107,108} and early childhood education¹⁰⁹—but some of these same exposures also appear to be vital to the health and development of children and their future risk of adopting unhealthy behaviors and initiating adult disease processes.

Below are several examples from the literature of early childhood experiences that influence health:

- Low birth weight affects not only educational outcomes but also health and disability.¹¹⁰
- Nurturing relationships beginning at birth, the quality of the home environment, and access to stimulation provide a necessary foundation for children to grow and thrive.¹¹¹ One example of this is the importance of child-directed speech during infancy for developing language skills.¹¹² The effects of stress can be reduced when children have a responsive and supportive caregiver available to help them cope with stress and provide a protective effect.¹¹³
- Unstable home and community life, such as economic factors, family transitions, housing instability, and school settings, can harm child development and later outcomes spanning education and health.¹¹⁴ In one study,^b homelessness and struggles with mortgage payments and foreclosure were predictive of self-rated health, and these combined with other categories (e.g., moved for cost in past 3 years, behind on rent) also predicted mental health problems.¹¹⁵
- Family and neighborhood socioeconomic status not only affect education but also predict developmental and health trajectories as children grow and develop.^{116,117} The duration and timing of childhood poverty are important. Longitudinal studies indicate that the largest effects of

^a Children’s birth weight, developmental outcomes, health status (e.g., obesity and specific health conditions), disability, and success in school are strongly linked to parents’ education and family income and assets.

^b Data were based on research by the National Poverty Center on the basis of the Michigan Recession and Recovery Study of adults ages 19-64 in southeastern Michigan. The researchers examined the relationship between various forms of housing instability and health, controlling for prior health problems and sociodemographic characteristics.

poverty on child outcomes are during early childhood development, when children experience poverty for multiple years, and when they live in extreme poverty.¹¹⁸ The timing of poverty during early adolescence is also important for adolescent achievement.¹¹⁹

Biological Pathways

A growing body of research suggests that the similar root causes that lead children to poor educational outcomes and poor health outcomes may not operate via separate pathways but may relate to the biology of brain development and the pathological effects of early childhood exposure to stress and adverse childhood events (ACEs). Children in low SES households are more likely to experience multiple stressors that can harm health and development,¹²⁰ mediated by chronic stress.¹²¹ These disruptions can thereby shape educational, economic, and health outcomes decades and generations later.¹²²

- *Neuroanatomy and neuroplasticity*: Infants and toddlers exposed to toxic stress, social exclusion and bias, persistent poverty, and trauma may experience changes in brain architecture and development that affect cognition, the ability to learn new skills, behavioral and stress regulation, executive function, and the capacity to adapt to future adversity.^{123,124}
- *Endocrine disruption*: Early life stressors also appear to cause physiological increases in allostatic load that promote stress-related diseases later in life.¹¹³ Such stressors may, for example, disrupt the hypothalamic-pituitary-adrenal axis of the endocrine system and stimulate overproduction of stress-related hormones that are thought to adversely affect end organs and lead later in life to heart disease and other adult health problems.¹²⁵
- *Immune dysregulation*: The release of interleukins and other immune reactant proteins is thought to create conditions of chronic inflammation that may increase the risk of heart disease and other chronic diseases later in life.¹²⁵
- *Epigenetic changes*: Chronic stress is thought to affect methylation of DNA and cause epigenetic changes that “turn on” expression of genes that may cause cancer and other diseases.¹²⁶

Enhanced understanding of these biological pathways is shedding light on research, first reported in the 1990s, that called attention to the correlation between adult disease rates and a history of childhood exposure to ACEs. In a seminal study on the subject, the Adverse Childhood Experiences Study, Felitti et al. surveyed more than 13,000 adult patients at Kaiser Permanente and asked whether they recalled childhood exposure to seven categories of ACEs: psychological, physical, or sexual abuse; violence against the mother; or living with household members who were substance abusers, mentally ill/suicidal, or had a history of imprisonment. More than half of the adults recalled ACEs as children, and those with greater trauma were more likely to report unhealthy behaviors as adults (e.g., smoking, physical inactivity, alcoholism, drug abuse, multiple sexual partners) and to have a history of depression or a suicide attempt. The researchers reported a dose-response relationship: those who recalled four categories of ACEs had significant odds ratios for adult diseases, including ischemic heart disease (2.2), cancer (1.9), stroke (2.4), chronic lung disease (3.9), and diabetes (1.6).¹²⁷

The ACE study and subsequent studies with similar results relied on retrospective designs that faced the limitation of recall bias (relying on the memory of adults); recollections of ACEs were vulnerable to the criticism that sick adults might have skewed perceptions of their childhood experiences. Nevertheless, prospective studies that documented ACEs contemporaneously during childhood have also documented higher rates of disease when the children were followed into adulthood. The Centers

for Disease Control and Prevention (CDC) maintains a Web site that is cataloguing the burgeoning research on ACEs,¹²⁸ and increasing attention is shifting toward strategies for policy and clinical practice to help ameliorate childhood exposure to ACEs and to buffer their adverse biological and psychosocial effects (see Box 5). This work has relevance to understanding of the education-health relationship to the extent that prior exposure to ACEs affects both educational success and health trajectories.

Box 5. Behavioral Responses to Stress

Children exposed to stress may also be predisposed to take up unhealthy behaviors, such as smoking or unhealthy eating, during adolescence, the age when risky behaviors are often first established and then carried into adulthood. This may be an important contextual factor in understanding the higher prevalence of unhealthy behaviors among persons with limited education, especially if toxic stress affects both education and health outcomes. There is some evidence that stress affects areas of the brain associated with reward and addiction.¹²⁹ Dysfunctional coping skills and these changes in brain function may draw children to unhealthy behaviors (e.g., smoking, alcohol or drug use, unsafe sex, violence) as adolescents. These risk factors for disease, along with harmful stress-related physiological changes discussed above, not only increase their subsequent risk of illness and injury but also stifle success in school and employment.^{45,122,130}

Summary: What Accounts for the Association of Education and Health?

The building evidence that stress and other contextual factors can have effects on both education and health throughout the life course—as in the lasting effects on development, behavior, learning and health of children—adds important insights for understanding the correlation between education and health. As discussed earlier in the chapter, reverse causality plays some role in the association, and a much larger influence comes from the downstream benefits of education (e.g., greater socioeconomic resources and personal skills), but the upstream influence of adverse experiences on the young child also cannot be ignored. The effects of ACEs on the developing brain and on behavior can affect performance in school and explain setbacks in education—but they can also affect health outcomes. Thus, the correlation between reduced education and illness may have as much to do with the seeds of illness that are planted before children ever reach school age than with the consequences of education itself. The children end up with fewer years of education and greater illness, but an important way to improve their health is to address the root causes that expose children to stress in the first place.

Exploring the Lived Experience

The above conclusions spring from the pages of published research and the theoretical models of scholars in social science, economics, and social epidemiology, but an overlooked perspective is the lived experience of those who contend daily with these living conditions. Our research team at the Center on Society and Health has become increasingly interested in eliciting this perspective and blending the more nuanced insights from community members who face conditions on the ground with the more abstract empirical findings published by academia. In the work described in the second part of this chapter, as well as other recent pilot studies,¹³¹ we have demonstrated that this fresh perspective helps transform causal models emanating from the literature to more sophisticated frameworks that incorporate mediators, moderators, and outcomes that are unfamiliar to academics. Although empirical evidence may be lacking to scientifically document the association between these new elements and health outcomes, we believe the insights are powerful tools to help define a research agenda that outlines testable hypotheses that future research can explore.

The recent focus on patient and stakeholder engagement stimulated by the Patient-Centered Outcomes Research Institute (PCORI)^{132,133} has merged with the established discipline of CBPR to bring new energy and interest in community engagement in research and greater respect among academia in studying how insights gathered through engagement affect the design and results of studies. With support from our university's Clinical and Translational Science Awards (CTSA) grant, we have been working since 2011 to engage community members in sharing their perspectives about the influence of social determinants of health. Using an approach we had previously tested to engage community members in developing a causal model *de novo* without knowledge of published research findings, we asked residents of a low-income urban community to map out the pathways linking education and health, and we compared the results with the empirical findings discussed above.

Stakeholder Engagement in Modeling Health Outcomes

Background

The research community increasingly seeks to involve stakeholders in health research, both to enhance accountability and to improve the quality of the research, including increased validity, relevance, acceptance, and sustainability.¹³⁴⁻¹³⁸ Until recently, lay explanations of health and disease have been denied a “place at the etiological table”¹³⁹ and have rarely been used to generate new conceptualizations of the link between social conditions, behavior, and health outcomes. The problem with this has been recognized for two decades: “If research in the field of public health is to develop more robust and holistic explanations for patterns of health and illness in contemporary society, then it must utilize and build on lay knowledge—the meanings that health, illness, disability, and risk have for people”¹³⁵ (p. 760).

Participatory research methods have become an important framework for including stakeholders in understanding and addressing health disparities.^{17,140-143} The principles of CBPR can provide entrée into more meaningful lay engagement in understanding health outcomes. CBPR “aims to make research more democratic, ensure the poor and people of color are not excluded from decisions that impact their lives, and incorporate local knowledge and lived experience into research and action.”¹⁴⁴ CBPR partnerships have engaged in diverse topics, interventions, and study designs that have strengthened methodology in areas such as research design, recruitment, and cultural appropriateness.¹⁴⁰

Community Engagement in Causal Modeling

CBPR efforts aimed at conceptualization and causal modeling have been uncommon. As long ago as the late 1970s, causal modeling by stakeholders, including community participants, was utilized in development projects, particularly on nutrition. For example, in Zaire a participatory causal modeling approach was used in 1987 to address nutritional problems by engaging a multidisciplinary group that included two international nutrition consultants and diverse local participants. The resulting causal model was used in research design, education, intervention, and community development.¹⁴⁵ This participatory causal modeling approach was described by Beghin et al. in a 1988 publication by the World Health Organization.¹⁴⁶ Lefèvre et al. described a focus-group causal modeling approach as a component of a participatory action research project in Bolivia

and Peru and proposed that this method might be useful for comparing perceptions or competing explanations.¹⁴⁷

More recently, The Dan River Partnership for a Healthy Community, composed of community stakeholders and researchers from the Department of Human Nutrition, Foods and Exercise at Virginia Tech, used the Comprehensive Participatory Planning and Evaluation (CPPE) process within a CBPR framework to focus on obesity in the region.¹⁴⁸ The problem-assessment phase of the project included a causal analysis workshop to explore potential mechanisms and root causes of obesity. “CPPE causal models do not necessarily have to portray a hierarchical structure or infer causation, rather they are meant to uncover the complexity of problems and encourage participants to discuss potential solutions”¹⁴⁸ (p. 49). The models were used to prioritize community interventions. Such exercises in causal modeling, as done in the CPPE process, are meant to build consensus among stakeholders on the factors affecting an identified problem, working backward from problems to root causes, with the goal of identifying appropriate solutions (and potential research hypotheses to study).¹⁴⁹

Another participatory modeling approach, applied in the field of systems dynamics, is group model building (GMB). GMB “is a participatory method for involving people in a modeling process” that focuses on understanding and solving systems problems. Community-based system dynamics explicitly includes community members in the process.¹⁵⁰ Stave describes using a participatory model building process to involve stakeholders in environmental decisions.¹⁵¹

In the study we present here, our specific aim was to explore whether community stakeholders would develop a causal model that added to the pathways and mechanisms already hypothesized in the academic literature (and reviewed earlier in this chapter). Secondly, we sought to explore whether the lived experiences of participants would elucidate new descriptions and nuances about pathways that are already recognized but are not fully understood. Although the theoretical model and empirical work involved in elaborating the relationship between education and health have evolved since health disparities first garnered wide attention,¹⁵² we believe this participatory approach provides a unique framework for testing and expanding the theoretical model.

Engaging Richmond

The CBPR partnership that conducted this exercise, known as Engaging Richmond, is an ongoing program that involves community researchers^c who are residents of the East End, a low-income African American neighborhood in Richmond City and faculty and staff of Virginia Commonwealth University. The Engaging Richmond community researchers have received Institutional Review Board (IRB)-certified research training, conducted and analyzed focus group and interview data,¹⁵³ successfully recruited participants for research, and disseminated findings in the community.^{154,155} The idea of engaging stakeholders in crafting conceptual models arose from the initial successes of the Engaging Richmond team in modeling various health-related outcomes for proposed ideas and a report on the potential connections between food stamp benefits and health.¹³¹

^c The community researchers on the CBPR team are residents of Richmond City’s East End who have an ongoing role on the research team and have received training in various aspects of the research process. The community researchers who collaborated in the process described here included two men and six women who received training in social determinants of health research and have experience living in communities with low educational attainment and poor health outcomes.

Methods

Members of the CBPR team worked together in a facilitated concept mapping exercise designed to tap into stakeholders' experiences of how education is related to health outcomes. The goal was to develop a conceptual model of the social, behavioral, environmental, biological, and other factors that link education and health and to place their lived experience—and their understanding of the cultural and social context—into an analytical framework. The process was not about attaining consensus but instead tapping stakeholders' experiences to generate new insights and ideas to inform the causal model.

The group's tasks were to list the potential factors influencing the relationship between health and education and, following some training, to sketch a diagrammatic model of how determinants are interrelated on an upstream-downstream (distal-proximate) continuum. The process was facilitated by a faculty member (E.B.Z.) who had worked with the team for more than 2 years. The venue for the meeting was a community center in the residents' neighborhood that was regularly used for team meetings. The facilitator introduced the goal of the exercise as follows:

“We are here to talk about how education affects health. We want to draw on the experiences of everyone here. The purpose of this exercise is to find new ways of looking at this relationship between education and health, and we are going to focus on various factors that you think might affect the relationship.”

In the first part of the exercise, the community researchers followed a series of facilitated steps to individually brainstorm, identify, and record a broad list of factors that they believed might be influential in the relationship between education and health. The facilitator encouraged them to list “everything that comes to your mind that you think might be part of this relationship between education and health... anything you can think of... that impacts how one's own education might affect their health.” Participants were encouraged to draw on a range of experiences in thinking through the topics. The community researchers then reviewed a prepared list of many potential factors, grouped into domains (social, behavioral, family/community, physical/mental, demographic, health care, genetic, environmental, and attitudes/beliefs), and were given the opportunity to expand or change their initial list of factors, as well as to eliminate any factors that they did not consider influential. They were then asked to highlight the factors they had selected which they perceived to be most important.

In the next step, the group discussed the factors they had highlighted, indicated which factors to include in the model and which to exclude, and decided how to group factors. Participants provided examples to illustrate why specific factors were important. As they began listing behavioral factors, the facilitator instructed them that, “You need to kind of think through: How does this happen? How does education affect diet?... Whatever it is, you've got to think these things through.” Box 6 shows two examples of how this process unfolded. After listing and discussing factors across the various domains, the group agreed on a final list of factors.

Training in conceptual modeling was provided by the facilitator. Although this team had been exposed to causal path diagrams on previous projects,¹³¹ the training was useful to present key terminology and review the purpose and structure of path diagrams.

In the final step, the facilitator worked with the team to sketch a causal path diagram of the factors listed in step one. Team members took turns presenting particular factors from the list and discussing where, in relation to other elements of the diagram, they might be important and elaborating through examples. In the process of sketching the path diagram, the group was asked to decide whether each factor added to the model was exogenous (a variable that influences the value of other variables in the model, but whose own value is determined outside of the model)¹⁵⁶ or a mediator (a variable that lies intermediate between independent causal factors and a final outcome).¹⁵⁷ Sketching the model was informed by encouraging the participants to consider how the factors interrelated (see example in Box 7), which in many cases pointed to the bi-directional linkages that make these relationships so complex. For instance, there was extensive discussion about the many factors that affect educational achievement.

Factors were iteratively added to the model as time permitted, and the group then reviewed the diagrammed relationships, adding or removing arrows between factors to more accurately reflect the participants' sense of the causal pathways.

The modeling session was transcribed, and the data were compared to the key elements identified in the literature for explaining the linkages between education and health (see results section below). The community researchers reviewed and provided feedback on the draft models, as well as the findings presented here.

Box 6. Identifying Relevant Indicators

Example 1: Social Skills and Sleep

Participant: *"I have social skills, sleep habits, exercise."*

Facilitator: *"Social skills - any example?..."*

Participant: *"For instance, when I think of social skills I think of the ability to interact with people, the ability to mingle with strangers, you know, go into environments that you are unfamiliar with... [continues]"*

Facilitator: *"And what about sleep habits? How would you describe that in terms of education and health?"*

Participant: *"From my experience, and my friends,' when exam time comes, and the pressure and all of that, those poor sleep habits or not being able to get enough sleep, leads to drug abuse..."*

The discussion continued, and reflected the bi-directional nature of education and health, as many of the examples illustrated how behavioral and health issues impact education.

Example 2: Accessing Information and the Internet

Participant: *"By us having Internet now, people that wouldn't have access to certain information can access it. When I was growing up and we used to have to do things that involved the encyclopedia, we never had the whole volume of the encyclopedia, so I would have to go to the library. But there was no libraries near where I was, so I had to wait 'til I got to school to do my projects. Whereas now my kids can go on the Internet and pull up whatever they need to pull up for anything."*

Facilitator: *"What about health information?"*

Participant: *"That's what I was getting to next. Over the past 3 months I was changing my health, as far as eating vegetables and things like that. A lot of the diets and the juices that I made, I found it on the Internet."*

Results

The community researchers on the CBPR team focused on numerous mediators in the link between education and health, many of which mirror the predominant frameworks in the existing literature. For example, Adler and Stewart¹⁵² have already articulated important components of the causal pathway. Here we focus on residents' insights that added new perspectives or emphasized different aspects of those causal factors, while highlighting certain specific aspects of the experiences of low income and minority groups. We present these in the next section, following the same structure as the first half of this chapter for consistency.

Box 7. Hypothesizing Pathways

Facilitator: *"So, where else is school going to take us, besides just what you learned about health?"*

Participant: *"The workplace."...*

Participant: *"My income is going to help work with my motivation and outlook, because I may be able to go to the gym. Possibly, I may do it; possibly not. My income is going to help my health behavior."*

Participant: *"My word was lifestyle."...* [discussion moves on to the community environment]

Facilitator: *"Does environment affect this [points to indicator] or does it go straight to health?"*

Participants: *"It affects your lifestyle too."*

Impact at the Individual Level

The first half of the chapter noted that an important pathway by which education impacts health is through the development of a range of skills and traits, including cognitive skills, problem solving, and diverse personality traits. The community researchers focused on the types of opportunities that help to develop non-cognitive skills, particularly social skills, as well as the reasons why social skills are important to health. They particularly focused on the development of effective social skills as a function not only of formal education but also the informal educational exposure that can occur outside the classroom. Some examples of educational opportunities leading to enhanced soft skills cited by the community researchers included opportunities they had experienced while young to attend art performances or read literature. They also mentioned the importance of community programs, such as summer camps and youth development programs, which provided the opportunity to engage young people in new experiences and interactions:

"Kids that participate in extra-curricular, the summer camps and things like that, they learn those social skills. They learn the environmental skills. They get exercise. They learn to... their attitudes and personalities tend to be a little better than the kid that stays locked up in the house playing video games. So it's like, it's a positive that goes to it."

Opportunities to develop non-cognitive skills at school, community programs, and even daily activities such as getting to and from school, were discussed within a larger framework that highlighted the many possible repercussions that these skills can offer throughout the life course. For example, they described situations in which social skills are an important precursor to other dispositions and behaviors that are important to good health. Strong social skills lay the foundation for opportunities to embrace new situations and get along with others:

"When I think of social skills I think of the ability to interact with people, the ability to mingle with strangers, go into environments that you are unfamiliar with."

To gain new information:

“I’m sure there’s probably some preventive measures I could have learned to strengthen or to help with that [medical condition], but at that point in time I wasn’t that social, literate person.

And, to reduce conflict:

“... you have to know how to deal with people. We don’t always agree, but we also know how to just disagree and part ways. And everybody doesn’t know how to do that. Sometimes they want to argue about it, and it’s not even that serious...”

Ultimately, the development of social skills and other non-cognitive skills was linked to a cascade of possible effects throughout life, impacting social networks and isolation, attitudes, ability to obtain and utilize health-related information, personal health behaviors, and the ability to navigate the health care system. This issue is salient to community researchers from low-income, segregated neighborhoods because despite the importance of participating in enriching activities, youth from lower income families are less likely to participate in most contexts, with the exception of tutoring. Participation rates also vary by ethnicity and race, with Latino youth particularly underrepresented.¹⁵⁸ Children who reside in poor urban neighborhoods and isolated rural areas tend to have reduced access to programs and greater barriers to participation.¹⁵⁹

The academic literature provides evidence that youth participation in organized activities affects educational attainment and achievement, behavioral problems (including substance abuse), and psychosocial competence (e.g., emotions, motivation, initiative, and self-esteem).¹⁵⁹ Literature that relates youth development opportunities to health outcomes is less extensive. A recent review of the impact of Positive Youth Development (PYD) programs failed to find evidence for improved health outcomes for youth with chronic illness due to a lack of rigorous evaluation.¹⁶⁰ Gavin et al. identified PYD programs associated with sexual and reproductive health, but the findings were still relatively weak.¹⁶¹ Studies tend to show a positive association between alcohol use and sports participation (as least for some types of sports) and a negative association with illicit drug use.¹⁶² These studies, which tend to focus on sports or formal youth programs, examine some health outcome measures but do not focus on the mechanism by which such opportunities may ultimately impact health. The community researchers point to possibilities such as reduction of anxiety, stress, isolation, and conflict and access to new forms of information and new opportunities.

As noted in Part I, education can impact health through its effects on personal health behaviors, including engagement in risky behaviors, opportunities to learn about health, and availability of resources to make healthy choices. The community researchers described the potential impact of a range of factors (e.g., knowledge, health beliefs, and mental status) on personal health behaviors. They also discussed the potential influence of traits and attitudes on health behaviors and how they may be affected directly by formal and informal education.

Through the modeling exercise, the community researchers noted a number of ways that attitudes can impact health, but much is unknown about whether these attitudes are impacted by education and how important the attitudes are to health outcomes. They provided a number of examples about how such attitudes could have an effect on health behaviors, including setting priorities, facilitating

or hindering access to information, and ability or willingness to seek help. Attitudes they felt might impact health behaviors included materialism, hostility, anger, and pessimism and willingness to change.

Materialism, or the importance attached to material possessions, was perceived by the community researchers as a barrier to effective decisionmaking and the setting of healthy priorities, especially for young people. They noted that materialism has “warped reality for a lot of people” and can have negative effects on resource allocation. Although likely an underexplored causal link in the education/health literature, materialism has been linked to subjective well-being, self-esteem, and stress^{163,164} and risky behavior.¹⁶⁵

Hostility, anger, and pessimism were other attitudes identified as potentially important. Although there are many possible mechanisms whereby hostility may impact health,¹⁶⁶ these community researchers focused on mistrust and its effects on receiving needed information or help:

“The hostility comes when a lot of times you talk to people and they think you’re talking against them or belittling them, and really you’re just trying to get them to go or just trying to educate them.”

As discussed previously, the cognitive and non-cognitive skills developed through education can also impact individuals’ ability to navigate the health care process.²⁶ This topic came up during the community researchers’ model development as well. They noted that education can improve access to quality health care by enhancing communication skills and the ability to advocate for quality care. They added that challenges in diverse skill domains may mean that individuals with less education do not benefit as much from the information that is available:

“The information is there. You see a lot of pamphlets getting dust on them, and they also have little things that they have around the community. Barely anyone shows up other than the service providers and who’s with them. And I’m just saying it’s like the information’s there, it’s a matter of going to get the information and participating and just being involved enough to find out about what is out there, what is going on.”

Or, they are less able to deal with the complexity of the health system:

“Bureaucracy of applying for health care, and not understanding all that whole co-pay, how it’s gonna affect your paycheck, when you apply for health care, when you have employment.”

Referrals for specialty and followup care seemed to be particularly difficult to navigate without the communication skills and cognitive skills necessary to engage in the interaction with health professionals:

“...you don’t know exactly why you’re being sent to another doctor, because it wasn’t worded so that you could relay that information when you were making your own appointment, if you needed to make that appointment yourself.”

Disparities in health care quality and access are well documented by socioeconomic status, race and ethnicity, and even while health care overall may improve, reducing disparities has proven to be quite difficult.¹⁶⁷ Attention to disparities in skills, communication, and access to resources (and how those play out in lived experience) that have their roots in educational disparities may prove a promising route to reducing otherwise intractable disparities in access, quality, and outcomes. This brief exercise has highlighted a few of these.

Another important set of factors at the individual level, discussed earlier in this chapter, includes access to economic and social resources. The community researchers, echoing the fundamental importance of the pathway between education and health via employment, discussed multiple pathways by which employment may impact health, including exposure to work-related stress, effects on motivation and outlook, ability to build social networks, and economic impact on the environment where one lives.

An important pathway runs from lower educational attainment to lower-status occupations and employment-related stress. The community researchers added nuance about the stresses of a poor education related to job insecurity, long work hours, work/family conflicts, and conflicts with co-workers.

“A father in a company misses a whole lot of plays, a whole lot of educational programs, a whole lot of PTA meetings.”

“[work-related stress] depends on your job. Depends on what you see and what you encounter that can lead to those sleepless nights or whatever...”

At a more fundamental level, the community researchers noted that the income resulting from one’s education can affect motivation, outlook, and lifestyle, which in turn may affect health behaviors.

“My income is going to help work with my motivation and outlook, because I may be able to afford to go to the gym. Possibly, I may do it. Possibly not. My income is going to help my health behavior.”

Social networks and peer groups play an important role in health.⁵³ The community researchers linked the development of social skills to effects throughout the life course on social integration and isolation. Many studies of the effects of social isolation on health focus on the elderly, whereas the community researchers felt that people who experience social marginalization due to behavior or various other reasons may suffer isolation that leads to ill health. In one example, their causal model connects lack of education to stress and anxiety, which may cause social isolation. They described the potentially negative impacts of social isolation, such as stress, impaired communication with others, and inability to solicit help.

“Living apart from others to the point where you can’t even get the help you need because you’re so isolated. People don’t know how to communicate with you because you keep yourself so isolated.”

Impact at the Community Level

The community researchers mentioned the role of place-based determinants of health, such as access to healthy food outlets and the greater risk of exposure to toxins and environmental risks in disadvantaged neighborhoods that are populated by people with limited education. Many of the deficiencies they noted in access to and the quality of health care transcended individual-level resources and abilities and related to the service environment in the community, such as the availability of treatments, appropriateness of care, coordination of care, cultural competency, and barriers to health care. Lack of access to services such as transportation has a significant effect on residents’ ability to access opportunities, including health care:

“That referral that you might have also, and I’m continuously saying, are you listening to me? I don’t have transportation. And they say you can go through the insurance to get this set up... I call transportation it’s like, I don’t fall short. I’m there. My transportation is 2 hours late.”

Unequal treatment was also a concern, including inadequate availability of preventive care. The community researchers felt that their community was less likely to receive the type of preventive health information that would be more accessible in the more affluent communities populated by people with higher education.

“...when you look at most things that are being done in our community, it’s always from that intervention side. Very little prevention is being offered to us. How do we prevent? Very little.”

“In certain places, there is certain information that they will give to this group of people that they wouldn’t give this group of people. So they will know how to prevent high blood pressure, as our information would be more so what to do after you get it. Cause you’re going to get it.”

Finally, children and adults in disadvantaged communities may be more likely to experience chronic stress or trauma, and community researchers were concerned about the appropriateness of their diagnostic evaluations and treatments:

“What would it be as far as misdiagnosis, as far as it could be a learning disability but it could be something else that’s preventing the child from being able to function in the classroom or preventing the adult from being able to function at work. And it could be a health problem or it could be a learning problem. It could be environmental. It could be literacy, or whatever. But if you don’t have the [resources] ..., it could be you don’t have the right kind of insurance to be able to find this. You don’t have the right kind of doctors available to your call. You could have that doctor that’s just doing enough to get you in and get you out.”

The problem of childhood trauma and its relationship to conditions such as attention deficit hyperactivity disorder (ADHD) appears in the clinical literature,¹⁶⁸ but insights about this relationship from parents and service providers in communities particularly affected by high levels of trauma exposure point to sources of concern and may help identify, through further research, areas of intervention.

Contextual Factors

The participants highlighted the intersections between access to health care (and other necessary social supports) and public policy. Policy decisions contribute to gaps in health insurance coverage for the underserved, and the participants discussed how this contributes to health complications.

“When people have to have major surgeries and stuff done and not having Medicaid or health insurance. And it can be life threatening and they are scared to go and get their self checked out, just checked out when they know there’s something major going on with them, because they don’t have health insurance or Medicaid.”

Their responses underscored the ways in which individuals with lower educational attainment, low skill levels, or poor mental health would be disadvantaged by the bureaucracy and documentation

required to access social welfare programs. Individuals with limited education and their families are more vulnerable due to the burdens placed on them by bureaucratic structures and regulations.⁹⁵ The group pointed out that often individuals who might otherwise qualify for services and supports (e.g., Medicaid or school programs) could miss out because they cannot keep up with paperwork and rules.

One participant discussed a local program for the uninsured:

“I think about the [program] and how that lasts for a year and then you have to reapply. I get that, but that can be a hardship too. Why should you have to apply every year? First of all, they don’t send you a notification asking you to reapply. So when that date comes around, oftentimes you forget. And so then you realize, oh, I don’t have insurance anymore. You know, if you don’t have certain documents to prove that you’re financially eligible they won’t accept you. So there are barriers to things that are designed for you.”

In addition, populations that are disadvantaged by an inadequate education are more likely to rely on public services that may fall short of expectations because society has invested insufficient resources. For example, public transportation may be inadequate, forcing patients who lack transportation alternatives to rely on medical transportation services that may not be trustworthy. Public services are subject to budget cuts, and restrictive welfare programs may inadequately cover the needy, leading to further disadvantage.

An overarching theme in the discussion that transcended the specific elements was a narrative of exclusion. Throughout the process, the team members made links to contextual factors that, more often than not, seemed to progressively diminish the chances that individuals with little education, poor skills, and few economic resources could achieve positive health outcomes. They described a tableau of contextual factors—ranging from failing schools to complex bureaucratic structures and ‘top down’ decisionmaking—that distance individuals from success in education and health but are not explicitly mentioned in published causal models. The risks associated with failing schools, under-resourced communities, and unequal access to quality health care are intensified when individuals with limited education and income face the additional challenges of fewer social skills and social networks, restricted access to information and the ability to use it, limited ability to advocate for quality care, and increased exposure to stress. The link between social exclusion and health has been recognized¹⁶⁹ but is not often explicitly included in the education/health model. Participatory modeling may serve to draw some attention toward the societal factors that are often overlooked in media and academic accounts of health outcomes and the recommendations and interventions subsequently developed to address disparities.^{170,171}

Throughout the exercise, the community researchers framed the connections between education and health not just as a causal path traversed by individuals, but as one whose shape and character were dependent upon the larger social context. The resounding impact of race, class, gender, and age discrimination was the backdrop for discussions of educational opportunity, workplace experiences, health care, and policy.

Discussion of Engagement Exercise

The process described in this section presents an approach that extends prior, predominantly practical, applications of participatory modeling (e.g., prioritizing community interventions) to a role in advancing theory and scholarly inquiry. It explores the possibility that people outside of

academia may be able to help refine our understanding of complex phenomena by positing factors and relationships less familiar to investigators who do not share their life circumstances. None of the observations described here are meant to stand as evidence, but they are intended to illustrate how the process (1) may provide the bases for hypotheses that can be further explored, or (2) provide deeper understanding of how the highlighted relationships may operate and why they may be important mediators or moderators of health disparities.

This small pilot has many limitations. The insights come from a limited sample of participants from one neighborhood of a southern city. Other findings would undoubtedly emerge with greater diversity and a larger number of participants. In any setting, delving into the broad expanse of variables that occupy the relationship between education and health—a web of influences noteworthy not only for its breadth but for the bi-directionality and endogeneity of the many factors involved—is not a simple task. Others may wish to continue gathering community perspectives on upstream social determinants by breaking this complex model into smaller components. Despite its limited scale and the complexity of the topic, the community researchers who participated in this exercise demonstrated not only a wealth of insight but an ability to put their personal experiences into context and breathe life into a critically important issue on which their voices are too infrequently heard.

Implications for Practice

The relationships between education and health are relevant to the clinician, beginning with the patient's ability to understand diagnostic information and treatment recommendations but extending to larger issues. Health care professionals, social workers, and other service providers must consider the knowledge and literacy of clients to ensure that instructions and choices are fully understood, ranging from reading prescription bottles to understanding how to file for claims. But the education-health relationship has relevance to practitioners beyond the level of one-on-one care, because their cachet creates leverage to promote efforts in the community to improve educational opportunities and create conditions in early childhood to put youth on a path for socioeconomic success and better health. Physicians and other health care professionals can speak to the health benefits of community investments that expand opportunities for preschool and primary/secondary education. However, this chapter has also emphasized that the links between education and health are influenced by policy decisions outside of schools, including neighborhood conditions ranging from sidewalks to street violence, food security, reliable housing, job training, and safety net programs for the disadvantaged. Better grades and higher graduation rates are vital goals, but meaningful effects on population health require an integrated plan for upstream and downstream determinants.

Implications for Research

As noted earlier, the factors surrounding the relationship between education and health are the subject of research in different disciplines that are of uneven quality, and closing the many holes in the evidence is a research priority. Chief among these is the reliance on cross-sectional and ecological evidence that does not adequately tease apart issues of endogeneity and leaves many unanswered questions about causal pathways. The research challenges are inherently transdisciplinary, requiring the integration of traditional population health sciences (e.g., epidemiology) with social and political science, education research, and the use of mixed methods to blend quantitative and qualitative insights. Standards of evidence used for clinical effectiveness are not always applicable to these topics.¹⁷² A particular need exists to bridge the divide between research in population health and

education and to share work across the silos to achieve more integrated research paradigms. Future research should also address the role of contextual factors surrounding the individual elements of the socioecological model, and their collective behavior as complex systems, through simulation modeling and other modern tools for predictive analytics.¹⁷³ Finally, the research agenda must address the information needs of policymakers, stakeholders, and change agents who are positioned to make improvements in education and health.¹⁷⁴

A criticism of social epidemiology and other efforts to identify social determinants of health has been a focus on establishing correlations between social factors and health, with comparatively little attention to the mechanisms through which these factors impact health outcomes, and in turn, inattention to promising leverage points for interventions or policy change.¹⁷⁵ While we reiterate that this pilot serves to illustrate the potential of participatory processes in extending our understanding of these mechanisms rather than providing an empirical base, by scanning the input from the community researchers one might begin to see an emergent list of possible leverage points, from greater access to youth development opportunities to changing bureaucratic processes that make participation in public benefit programs difficult for people with low levels of education or other challenges.

Our approach emphasizes respect and parity in patient/community engagement, an orientation that is gaining ascendance among health services researchers who increasingly recognize the insights and innovations in the design of studies and interpretation of results that become possible when those affected by interventions are invited to participate as research partners—not as human subjects but as coinvestigators. An approach in which patients and community members are treated as coequal partners in the research enterprise creates opportunities for scholarship that are forfeited by more traditional, and sometimes patronizing, engagement methods that examine data through a lens shaped by academics based on theoretical models rather than incorporating the perspective of those who live amid the conditions under study. The respect afforded by the new approach has the added, and important, advantage of helping to build trust with a lay public and especially with marginalized minority communities that were dubious about the sincerity of researchers who sought their input or the ability of professional investigators to truly understand real-world conditions. Communities that have historically experienced condescension rather than respect welcome such collaborative approaches.

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