

Understanding the Relationship Between Education and Health

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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 (Link and Phelan, 1995; CSDH, 2008), 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 the 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 found 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 classes (NRC and IOM, 2013).

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 (NRC and IOM, 2013) but mortality and life expectancy vary even more substantially across smaller geographic areas such as counties (University of Wisconsin Population Health Institute, 2013; Kulkarni et al., 2011) and census tracts. In many U.S. cities, life expectancy can vary by as much as 25 years across neighborhoods (Evans et al., 2012). 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 (Goldman and Smith, 2011; Olshansky et al., 2012) in all regions of the United States (Montez and Berkman, 2014), producing a larger gap in health status between Americans with high and low education. Among white Americans without a high school diploma, especially women, life expectancy has decreased since the 1990s,

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whereas it has increased for others (Olshansky et al., 2012). Death rates are declining among the most educated Americans, accompanied by steady or increasing death rates among the least educated (Jemal et al., 2008).

What accounts for the growing health advantages that exist among people with higher 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 numerous contextual covariables that provide a fuller back story? Despite decades of research documenting the connections between education and health, there is still much to learn about the mechanisms that enable this connection.

Unpacking the reasons for the connections 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 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 behaviors are embedded, across the lifespan, within a framework of nested institutional contexts (IOM, 2000; see Figure 1). 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, and 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.

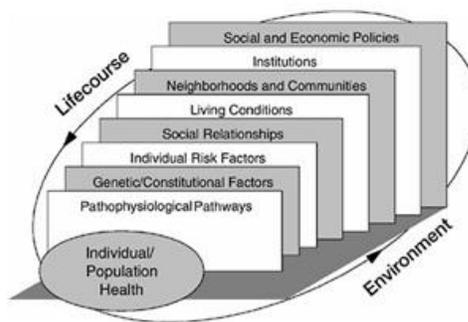


Figure 1: Socioecological Model

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 such obvious measures of the quality of education 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.

In addition, the relationship between years of education and health is not a purely linear function. As part of the literature attempting to clarify the functional form of the relationship between education and health, Montez et al. (2012) 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. The drop at high school graduation points to the importance of obtaining credentials in addition to the other benefits associated with educational attainment.

In this paper 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 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.

THE 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. 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 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 social policy.

IMPACT AT THE INDIVIDUAL LEVEL

Education can impart a variety of benefits that improve the health trajectory of the recipient. We discuss its role in enhancing noncognitive 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 also 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 (Mirowski and Ross, 2005). These various forms of human capital may all mediate the relationship between education and health.

Personality traits (also known as “soft” or noncognitive 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 (Heckman and Kautz, 2012). Roberts et al. (2007) postulate three pathways whereby personality traits may impact mortality: through disease processes (e.g., response to stress), health-related behaviors, and reactions to illness. A review by Roberts et al. (2007) suggests that the strength of association between the “Big Five” personality traits and mortality is to that of IQ and stronger than socioeconomic status (SES). 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 (Ross and Wu, 1995), is another soft skill associated with educational attainment. According to the authors, “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” (Ross and Wu, 1995, p. 723).

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 (Ross and Wu, 1995, p. 723).

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 understanding the increasingly complex choices

Impact of Education on Individuals' Ability to Navigate Health Care:

Achieving positive health outcomes in today's 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 low 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 (Berkman et al., 2011). 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 (Rosas-Salazar et al., 2012). People with higher levels of efficacy may be quicker to adopt innovative strategies and act on health knowledge (Pampel et al., 2010).

In a review of the impact of patient socioeconomic status on patient-physician communication, Willems et al (2005) 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 (Willems et al., 2005).

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 (Maitra, 2010). A strong education may be important in both navigating health care and making choices about lifestyle and personal health behaviors. Cutler and Lleras-Muney (2010) report that increased cognitive ability resulting from education contributes significantly to the education gradient in health behaviors.

Impact of Education on Personal Health Behaviors

Adults with higher levels of education are less likely to engage in risky behaviors, such as smoking¹ and drinking and are more likely to have healthy behaviors related to diet and exercise.² 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 (2010) find evidence for the importance of resources, cognitive ability (especially how one processes information), and social integration.

Education offers opportunities to learn more about health and health risks, both in the form of health education in the school curriculum and by giving individuals the health literacy to draw on, later in life, and absorb messages about important lifestyle choices to prevent or manage diseases. People who are more educated tend to be more aware of health risks and may be more receptive to health education campaigns.

Adults with higher levels of education also tend to have lower exposure to stress related to economic deprivation or relative deprivation (Pampel et al., 2010). 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 (Estabrooks et al., 2003; Brownell et al., 2010).

¹ Smoking is the leading cause of preventable deaths in the United States (Mokdad et al., 2004).

² Data from the National Survey on Drug Use and Health (NSDUH), sponsored by the Substance Abuse and Mental Health Services Administration (SAMHSA), indicate that in 2009-10, 35% of adults who did not graduate high school were smokers, compared to 30% of high school graduates and 13% of college graduates (Garrett 2013). People with more education are more likely to have healthy diets and exercise regularly. Analysis of several waves of NHANES data finds that intake of specific nutrients (e.g., vitamins A and C, potassium and calcium), as well as overall diet quality, increase with greater amounts of education (Kant and Graubard 2007). BRFSS data for 2010 indicate that only 61% of adults with less than high school and 68% of high school graduates said that they exercised in the past 30 days, compared to 85% of college graduates (CDC). However, not all behavioral risk factors are higher among those with the lowest educational attainment. BRFSS data for 2011 indicate that prevalence of binge drinking increases with higher levels of education (Kanny et al. 2013).

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. 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. Link and Phelan (1995) point out that the specific mechanisms linking 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” (p. 87).

Economic Resources

Adults with a higher education—especially in today's knowledge economy—have conspicuous advantages in gaining employment and finding desirable jobs (see Figure 2). 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,³ worksite health promotion programs, and worksite policies that protect occupational safety. An inadequate education markedly increases the risk of unemployment.^{4,5}

Income and wealth are leading predictors of health status (CSDH, 2008; Braveman et al., 2010), and accumulated financial strain has been shown to impact health above and beyond the effects of income and wealth (Shippee et al., 2012). 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 higher than high school graduates (BLS, 2013). Weekly earnings rise dramatically for Americans with a college or advanced degree. A higher education has an even greater effect on lifetime earnings, a pattern that is true for men and women, for blacks and whites, and for Hispanics and non-Hispanics.⁶

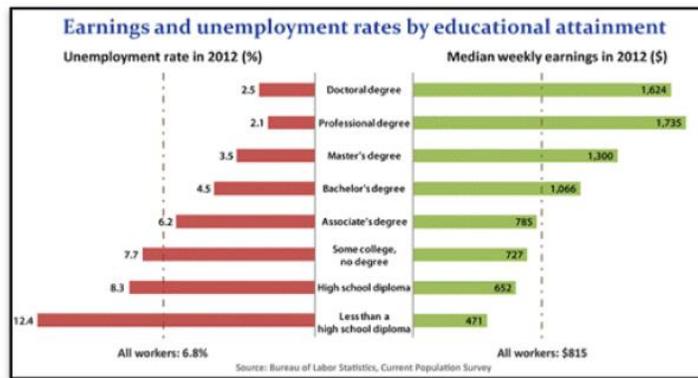


Figure 2. Current population data on education and employment.
Source: Bureau of Labor Statistics, Employment projections, 2013.

Economic vulnerability can affect health through a cascade effect on the ability to acquire resources that are important to health: food, stable housing, transportation, insurance, and health care (Braveman, et al., 2011). 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.⁷ Individuals with higher incomes have more resources to purchase healthy foods, to afford the time and expenses associated with regular physical activity, to have easy transportation to health care facilities or work locations, and to afford health care expenses.⁸ Accordingly, the costs of a healthy lifestyle

³ Adults with health insurance in the United States use more physician services and have better health outcomes compared to uninsured or inconsistently insured adults (NRC, 2009; Freeman et al., 2008; Hadley, 2003).

⁴ 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 (BLS, 2013).

⁵ 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 persons 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 (Athar et al., 2013).

⁶ According to 2006–2008 data, the lifetime earnings of a Hispanic male are \$870,275 for those with less than a ninth-grade education but \$2,777,200 for those with a doctoral degree. The corresponding lifetime earnings for a non-Hispanic white male are \$1,056,523 and \$3,403,123 (Julian and Kominski, 2011).

⁷ In 2012, one-fourth (24.9 percent) of people in households with annual income less than \$25,000 had no health insurance coverage, compared to 21.4 percent of people in households with income ranging from \$25,000 to \$49,999; the figure was 15.0 percent in households with income ranging from \$50,000 to \$74,999 and 7.9 percent with income of \$75,000 or more (DeNavas-Walt et al., 2013).

⁸ According to 2010 Behavioral Risk Factor Surveillance System (BRFSS) data, 27 percent of adults with less than a high school education reported not being able to see a physician because of cost, compared to 18 percent and 8 percent of high school and college graduates, respectively (CDC, 2014).

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 (HHS, 2013, p. 9-1), and they have a higher risk of death (IOM, 2003a).

Stress and Allostatic Load

Stress and allostatic load can impact health throughout the life course. Allostatic load results in an individual's inability to adapt to long-term stress, leading to chronic illness. A growing body of research is documenting that life changes, traumas, chronic strain, and discrimination 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 (Pearlin, 1989). Individual stressors accumulate over time and may, in turn, make individuals vulnerable to exposure to further stressors.

Individuals with lower levels of educational attainment are at greater risk of exposure to stress, such as chronic occupational stress or unemployment, and 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) (Thoits, 2010). Effects of stressors vary, depending on such factors as genetic makeup, development, early experiences, the availability of coping mechanisms, and responses to threats (McEwen and Stellar, 1993).

The biological consequences of stress and allostatic load are increasingly clear as are their effects on cognition. In a longitudinal study of high-functioning older adults, Seeman et al. (1997) found associations between baseline measures of allostatic load and cognitive function, physical performance, and the incidence of cardiovascular disease during the study period. A 4.5-year follow-up study of the same subjects found increased risk of mortality among individuals with higher baseline allostatic load scores as well as among those whose scores increased (Karlman et al., 2006). 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 (Krueger and Chang, 2008).

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 individuals 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 (Kaplan et al., 1994; Seeman, 1996) and poor mental health (Seeman, 1996). Berkman et al. (2000) linked social integration to health outcomes in a causal chain that begins with the macro-social and ends with psychobiological processes. They propose several mechanisms through which social integration affects health: social support, social influence, social engagement/attachment, and access to goods and resources (Berkman et al., 2000, p. 846). 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 (Smith and Christakis, 2008). The effect of social networks on smoking cessation is a well-known example (Christakis and Fowler, 2008).

IMPACT AT THE COMMUNITY LEVEL

Individuals with more 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 (Kawachi and Berkman, 2003; Kawachi and Subramanian, 2007), communities may 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.⁹ 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 (Kawachi and Berkman, 2003; Leventhal and Brooks-Gunn, 2000; Steptoe and Feldman, 2001).^{10, 11} 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) (Shankardass and Dunn, 2011). Furthermore, it is important to recognize the dynamic interaction that occurs between the individual and the environment (Rhodes et al., 2011) and conceptions of space as “relational geographies”¹² (Cummins et al., 2007).

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 (2003) categorize these as physical features, services, sociocultural features, reputation, and availability of healthy environments at home, work, and play. 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 (Sampson, 2003). Kawachi et al. (2013) 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.

⁹ For example, Ross and Mirowsky (2008), using multilevel analysis of survey data from Illinois, addressed the question of whether community SES impacts health above and beyond the contributions of individual SES measures. 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.

¹⁰ Kawachi and Berkman (2003) call attention to the methodological difficulties of estimating neighborhood effects while controlling for individual SES, when some neighborhood effects may operate via their impact on individual outcomes, thus “adjusting away the variation of interest” (p. 9).

¹¹ Winkleby et al. (2006) examined the interaction between neighborhood SES and individual SES and found that low SES individuals living in higher SES neighborhoods had higher mortality rates compared to low SES individuals living in low or moderate SES neighborhoods.

¹² Conceptualization of space as a “relational geography” emphasizes aspects such as networks rather than boundaries, social rather than physical distance, mobility of populations, and dynamic characteristics of places (Cummins et al., 2007).

Through a combination of resources and characteristics, communities 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 available. 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, including 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, access¹³ to healthier food outlets was 1.4 times less likely in census tracts with fewer college-educated adults (less than 27 percent of the population) than 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 (Grimmet al., 2013). Conversely, low-income 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 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 that enable residents to walk and cycle to work and shopping, exercise, and outside play. Lower-income neighborhoods and those with higher proportions of non-white residents are also less likely to have commercial exercise facilities (Powell et al., 2006). The health benefits of green space have been documented in urban environments, especially for lower-income, young, and elderly populations (Maas et al., 2006). A longitudinal study in Great Britain found immediate, positive mental health effects of moving to urban areas with more green space (Alcock et al., 2014).
- **Access to health care.** Because of the maldistribution of health care providers in the United States (HHS, 1998), access to clinicians and facilities tends to be in shortest supply in rural and low-income areas. Thus, apart from whether residents have the health insurance coverage and resources to afford health care, they may struggle to find local primary care providers, specialists, and hospitals 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, who 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.

¹³ Defined as at least one healthier food retailer within the census tract or within one-half mile of tract boundaries.

- **Crime and violence.** Community crime rates 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 (Stafford et al., 2007) or the cumulative stress of living in unsafe neighborhoods. The high incarceration rates of residents in some communities can have deleterious effects on social networks, social capital, and social control, further compromising public health and safety (Clear, 2007). 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 fewer than 1 of 33 high school graduates (Sum et al., 2009).
- **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 (Bullard et al., 2011; Calnan and Johnson, 1985). This exposure to toxins is perhaps the most indiscriminating 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 (O’Campo and Dunn, 2011). 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 (CSDH, 2008). 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.¹⁴ The Place Matters team in Alameda County, California, has identified five policy areas to impact health outcomes locally: economics, education, criminal justice, housing, and land use and transportation (Alameda County Public Health Department, n.d.).

Decisions made by society, voters, and policy makers—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

¹⁴ See <http://www.healthypeople.gov/2020/topicsobjectives2020/default.aspx>.

groups. Bradley et al. (2011) found that while most OECD¹⁵ countries spent more on social services than on health expenditures, the converse was true in the United States.¹⁶ Likewise, economic policies have a large influence on the employment and wealth-building opportunities of workers. 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 (Spence and Hlatshwayo, 2011). 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.¹⁷ Although early studies failed to find a strong relationship between school funding amounts and student achievement, more recent meta-analysis has confirmed the importance of school funding for individual achievement (Greenwald et al., 1996).

Inequality by gender, race, ethnicity, sexual orientation, and disability affect risks and opportunities for people throughout the world. Figure 3¹⁸ shows persistent gender and race disparities in earnings. Ridgeway (2014) calls attention to the cultural as well as the material dimensions of inequality: “Cultural status beliefs work their effects on inequality primarily at the *social relational level* by shaping people’s expectations for themselves and others and their consequent actions in social contexts” (p. 3). Social status hierarchies based on “categories” of difference solidify and perpetuate differentials in power and control of resources—thus leading to material inequalities. Indeed, 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. This division has continued during

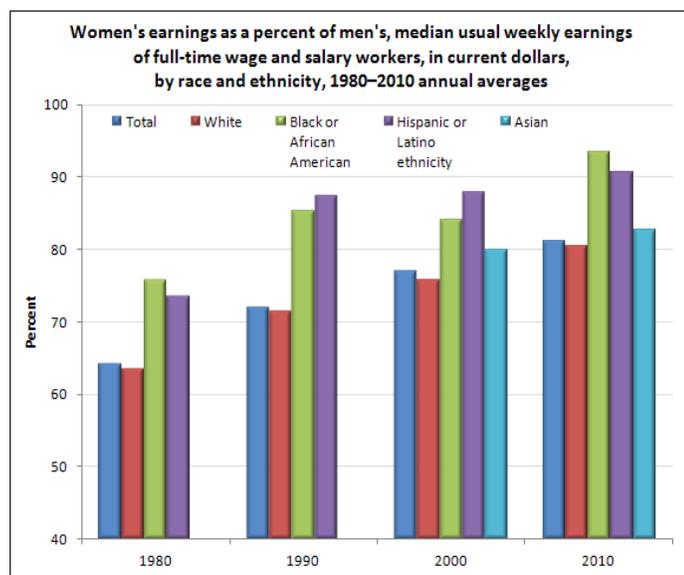


Figure 3. Women’s earnings as a percentage of men’s.
 Note: Data for Asians were not tabulated prior to 2000.
 Source: Bureau of Labor Statistics, 2012.

¹⁵ Organisation for Economic Co-operation and Development.

¹⁶ The average ratio of social to health expenditures in OECD countries from 1995 to 2005 was 2.0; the ratio in the U.S. was 0.91. (Bradley et al. 2011).

¹⁷ In 2011, total state per pupil education expenditures ranged from \$6,200 to \$16,700; among the 100 largest school systems in the United States, per pupil funding ranges from \$5,400 to almost \$20,000 (Census Bureau, 2013).

¹⁸ See Women’s earnings as percent of men’s in 2010. http://www.bls.gov/opub/ted/2012/ted_20120110.htm.

recovery from the Great Recession, during the first three years of which 95 percent of income gains accrued to the top 1 percent of earners (Saez, 2013). The Census Bureau reports that the Gini coefficient, which measures income inequality, has risen 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.¹⁹

Historical, economic, and cultural factors play a central role in opportunities, values, and behaviors. 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” (Massey and Denton, 1993, p.3). Massey and Denton argue that residential segregation and “hypersegregation” expose residents to higher levels of social problems. Wilson (1987) links historical and economic factors in his description of the racial division of labor resulting from “decades, even centuries, of discrimination and prejudice” with the result that “because those in the low-wage sector of the economy are more adversely affected by impersonal economic shifts in advanced industrial society, the racial division of labor is reinforced” (p. 12).

REVERSE CAUSALITY AND SELECTION

Education’s association with health may reflect not only the health benefits of education but also a *selection phenomenon* caused by the detrimental effects of illness on educational success. Basch (2011) identifies five causal pathways by which health may impact motivation and ability

Impact of the Cultural Context on Health Disparities and 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) has been shown in numerous studies to have a relationship to stress and stress-related health disparities (Williams and Mohammed, 2009), as well as to health care seeking and treatment adherence and risky health behaviors (Williams and Mohammed, 2009). Mistrust among patients and bias among health care providers can affect the quality of care (IOM, 2003b). 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 other outcomes (Gaston, 2013). Care is also affected by the cultural competency of providers—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 (Brotaneka et al., 2008).

to learn— sensory perceptions, cognition, school connectedness and engagement, absenteeism, and temporary or permanent dropping out (p. 596). For example, chronic health conditions can impact children’s development and educational performance (Taras and Potts-Datema, 2005). 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 (Currie, 2009), and findings of the overall

¹⁹ Table A-3: Selected Measures of Household Income Dispersion: 1967 to 2010.
<https://www.census.gov/hhes/www/income/data/historical/inequality/IE-1.pdf>

effects range from about 1.4 years reduced attainment²⁰ (Gan and Gong 2007) to about half a year (Goldman and Smith 2011), but there are notable exceptions. For example, evidence across countries and time periods demonstrates the harmful effect of low birth weight on education (Currie, 2009; Eide and Showalter, 2011). Disease, malnutrition, and prenatal and childhood exposures to toxins can also impact physical and cognitive development and educational achievement (Pridmore, 2007).

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 Showalter (2011) 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 for 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 on college attendance on preventive health care later in life. Link and Phelan (1995) 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” (p. 83).

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 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 (Denhem, 2006), family socioeconomic status,²¹ neighborhood socioeconomic status (Jencks and Mayer, 1990; Mayer and Jencks, 1989), and early childhood education (Barnett and Belfield, 2006) — but some of these same exposures also appear to be vital to the

²⁰ Estimated for 16-year-old white males from 1979 youth cohort of the National Longitudinal Surveys of Youth (NLSY) using a dynamic programming model of joint decisions of young men on schooling, work, health expenditure, and savings (Gan and Gong, 2007).

²¹ 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 (Williams Shanks and Robinson, 2013; Chapman et al., 2008; Currie, 2009).

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 (Avchen et al., 2001).
- 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 (Heckman, 2006). One example of this is the importance of child-directed speech during infancy for language skills (Weisleder and Fernald, 2013). The effects of stress can be reduced when children have a responsive and supportive caregiver available to help cope with stress and provide a protective effect (Shonkoff and Garner, 2012).
- Unstable home and community life, such as economic factors, family transitions, housing instability, and school settings, can harm child development and later outcomes (Sandstrom and Huerta, 2013). In one study,²² 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 (Burgard et al., 2012).
- Family and neighborhood socioeconomic status not only affect education but also predict developmental and health trajectories as children grow and develop (Case et al., 2002; Duncan et al., 1994). Duration and timing of childhood poverty are important. Longitudinal studies indicate that the largest effects of poverty on child outcomes are during early childhood development, when children experience poverty for multiple years, and when they live in extreme poverty (Brooks-Gunn and Duncan 1997). Guo (1998) also found that timing of poverty during early adolescence is important for adolescent achievement.

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 track into adulthood. There is some evidence that stress affects areas of the brain associated with reward and addiction (Shonkoff, 2009). 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 (Braveman, et al., 2011), Mistry et al. 2012, NRC and IOM, 2000).

²² Data were based on research by the National Poverty Center on the basis of the Michigan Recession and Recovery Study (MRRS) 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.

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 (Evans and Kim, 2010), mediated by chronic stress (Evans et al., 2011). These disruptions, along the pathways listed below, can thereby shape educational, economic, and health outcomes decades and generations later (NRC and IOM, 2000).

- *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 (Hackman, 2010; Gottesman and Hanson, 2005).
- *Endocrine disruption*: Early life stressors also appear to cause physiological increases in allostatic load that promote stress-related diseases later in life (Shonkoff and Garner, 2012). Such stressors may, for example, disrupt the hypothalamic-pituitary-adrenal axis of the endocrine system and stimulating 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 (McEwen, 2012).
- *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 (McEwen, 2012).
- *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 (Zhang and Meaney, 2010).

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. (1998) surveyed more than 13,000 adult patients at Kaiser Permanente and asked whether they recalled exposure to seven categories of ACEs: psychological, physical, or sexual abuse; violence against the mother; living in a household with members who are substance abusers; mentally ill or suicidal; or imprisonment (Felitti et al., 1998). More than half 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 faced 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).

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 maintains a website that is cataloguing the burgeoning research on ACEs (CDC, 2014), 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.

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 this paper, 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 it 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. They 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.

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