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MECHANISMS OF LEGAL EFFECT: PERSPECTIVES FROM PUBLIC HEALTH

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Summary

Public health approaches dating back to the late eighteenth century were primarily focused on environmental conditions that increase risk of morbidity and mortality. As public health and medical breakthroughs of the early twentieth century advanced the control of infectious diseases and expanded life expectancy, public health shifted its attention from infectious to chronic disease. For several decades public health primarily focused on individual-level risk factors and intervention approaches. Now, once again, infectious diseases are of paramount concern with policy playing an important role in the control of COVID-19. The movement to reemphasize the importance of fundamental determinants of health and disease, with attention to the distribution of resources, exposures, and environmental conditions, is urgently needed to enable all people to experience optimal health and well-being.

The public health perspective highlights many mechanisms through which laws affect economic, social, and physical conditions that, in turn, affect population distributions of risky or protective exposures and risky or protective behaviors. Exposures and behaviors, in turn, affect population health outcomes. Smoke-free laws, anti-discrimination laws, and the Earned Income Tax Credit (EITC) illustrate causal pathways from law to population health outcomes.

Learning Objectives

- Identify the central processes through which law can influence population health outcomes from a public health perspective.
- Illustrate the influence of law on economic, social, and physical environments, and, in turn, effects on population-level risks and protections.
- Formulate study hypotheses on specific causal pathways by which law affects population health outcomes.

The advent of public health as a discipline can be traced back to the late eighteenth century, when the first organized attempts were made to confront disease collectively. With the rise of industrialism and globalization, people shifted to urban centers and seaports, producing dense populations living and working in unsanitary conditions ideal for spreading infectious diseases. As incidences of typhoid, smallpox, influenza, cholera, tuberculosis, and other diseases reached unacceptable levels, the first boards of health were formed in urban centers to respond to the epidemics (McNeill, 1977). The formation of boards of health illustrated the start of infrastructural public health law, and their actions in quarantining ill persons illustrate early use of police powers on behalf of public health. Right from the start, law was central to public health action.

Public health pioneer John Snow implemented corrective environmental actions long before science determined that microorganisms were the causes of widespread infectious diseases. In 1854, Snow traced a cholera outbreak in London to well water drawn from the Broad Street pump. By simply removing the pump handle, he prevented perhaps thousands of additional cases (Brody, Rip, Vinten-Johansen, Paneth, & Rachman, 2000). Snow's action illustrates the practical orientation of the field – preventive action need not wait until all the detailed mechanisms and mediators are understood. More important, Snow's action illustrates the simplicity and effectiveness of changing the physical environment to improve the public's health, in contrast to attempts to change the behavior of thousands or millions of individuals, in the cholera case by boiling water thoroughly every time before drinking.

During the twentieth century, major public health achievements were realized through law. Vaccination laws resulted in the control of many preventable diseases, including smallpox and polio. Smallpox and polio were eliminated, and morbidity associated with seven other vaccine-preventable diseases reduced by nearly 100% (Centers for Disease Control and Prevention, 1999b). Annual death rates per vehicle miles traveled declined 90% as a result of mandated improvements in vehicle and road design and laws shaping driver behavior, such as safety belt use and drinking and driving (Centers for Disease Control and Prevention, 1999c).

As public health, safety, and medical breakthroughs of the early- to mid-twentieth century controlled infectious disease epidemics, increased safety, and expanded life expectancy (Centers for Disease Control and Prevention, 1999e), public health shifted attention to chronic disease prevention (Omran, 1971). Epidemiological studies of chronic disease showed that most cases in the population do not occur among those at high risk but rather among those at moderate risk, because there are more people with moderate risk levels than there are with very high risk levels (Epstein, 1996; Rose, 1985). Recognition of the widespread distribution of risk might have led to a return to addressing the environmental and social conditions that elevated risks in so much of the population, but in the second half of the twentieth century, chronic disease prevention efforts focused primarily on individual-level strategies designed to alter specific risk factors that are proximal causes of disease, such as education, screening, and use of antihypertensive and lipid-lowering drugs (Centers for Disease Control and Prevention, 1999a). In the late twentieth century, population-level strategies using law to prevent chronic diseases emerged, with particularly notable achievements in tobacco control (Centers for Disease Control and Prevention, 1999d, 2011b).

A limitation of the focus on proximal risk factors is the de-emphasis of "fundamental," structural or antecedent determinants of population health (such as broader political and economic conditions and one's social class position in society) that influence multiple proximal risks and maintain an association with disease even when specific proximal risks change (Link & Phelan, 1995; Solar & Irwin, 2010). Although an intervention may temporarily reduce proximal risk factors for those individuals exposed to a particular intervention (for example, health education, screening), populations continue to be at-risk if the intervention fails to intervene on

forces in society and communities that cause the problems in the first place (Solar & Irwin, 2010; Syme, 2004).

The field of social epidemiology (Berkman & Kawachi, 2000) and the growing recognition of "social determinants of health" (Marmot, 2005; Solar & Irwin, 2010), structural racism (Pérez-Stable & Webb Hooper, 2021; Yearby & Mohapatra, 2020) and "structural interventions" (Blankenship, Friedman, Dworkin, & Mantell, 2006; Brown et al., 2019) signify that public health increasingly is returning to its classic emphasis on environmental and social conditions. Structural racism, income inequality, the climate crisis, and emerging infectious diseases/pathogens (e.g. the COVID-19 pandemic) lay bare the importance of structural determinants of health, and law as a fundamental tool to promote health and prevent ill health and loss of life (Atwoli et al., 2021; Komro, 2020; Perez-Stable & Webb Hooper, 2021; Siegler, Komro, & Wagenaar, 2020; Yearby & Mohapatra, 2020). Because law is such an important influence on environmental and social conditions, a return to classic public health action is also elevating empirical research on law's public health effects as an increasingly recognizable and critical field of study.

How Laws Affect Population Health

Figure 3.1, Legal Determinants of Population Health Model, illustrates the central processes through which law can influence population health outcomes from a public health perspective. The causal diagram highlights the central public health focus on altering the economic, social, and physical environments in ways that reduce toxic exposures and increase protective opportunities, and ways that facilitate healthy behaviors and impede unhealthy behaviors. These many dimensions of the environment drive exposures, opportunities, and behaviors that, moderated by individual-level factors, ultimately affect aggregate levels of population health.

Law shapes environmental conditions through its effects on institutions, organizations, and other implementation structures and processes. Obviously, law can also have direct effects on individual behavior, as illustrated in the many other chapters in this volume. This chapter highlights the centrality of enhancing environmental conditions as a key role for law in improving population health. For simplicity, the many possible interactions across dimensions of environmental

conditions, and the cybernetic nature of this causal system, are not depicted. Our goal is much more modest than a complete depiction of how law affects health. Because history shows most public health gains have been achieved by altering environments, we highlight the central role of law in shaping environmental conditions. Following a description of the conceptual framework, we present three detailed examples.

LAW

Law affects the full range of institutions, organizations, and structures in society, and the resulting characteristics and actions of those organizations and structures affect the economic, social, and physical environments that the population experiences. Law shapes families, schools, churches, community organizations, businesses, and corporations. By affecting actions within such organizations and institutions, law influences the distribution of wealth, employment, health care, education, and other resources across a population. Economic factors such as family income, relative income, degree of inequality, employment status, occupation, and education level have been independently linked with health outcomes (Adler & Newman, 2002; Solar & Irwin, 2010). Tax law and welfare regulations have direct effects on family income and resources, and on the distribution of wealth within a society. One example is the Earned Income Tax Credit (EITC), first enacted in 1975, with federal and state expansions since then. The goal of the EITC is to incentivize work and raise the effective wages of low-income workers (Hotz, 2003). Multiple studies have indicated that the EITC has positive effects on maternal and child health outcomes (Arno, Sohler, Viola, & Schecter, 2009; Evans & Garthwaite, 2010; Markowitz et al., 2017; Strully, Rehkopf, & Xuan, 2010). Social Security is another example of a policy influencing the distribution of wealth. As a result of the Social Security Act (and its amendments), monthly cash benefits are provided to the majority of retired workers in the United States and constitute the major source of income for most of the elderly. Social Security dramatically lowered the rate of poverty and reduced health disparities among the elderly (Adler & Newman, 2002; House, 2015). Another example of law influencing the distribution of resources is food assistance programs (e.g. Supplemental Nutrition Assistance Program, National School Lunch Program), which have been found to have a protective effect for low-income children's health (Jones, Jahns, Laraia, & Haughton, 2003; Komro, 2020).

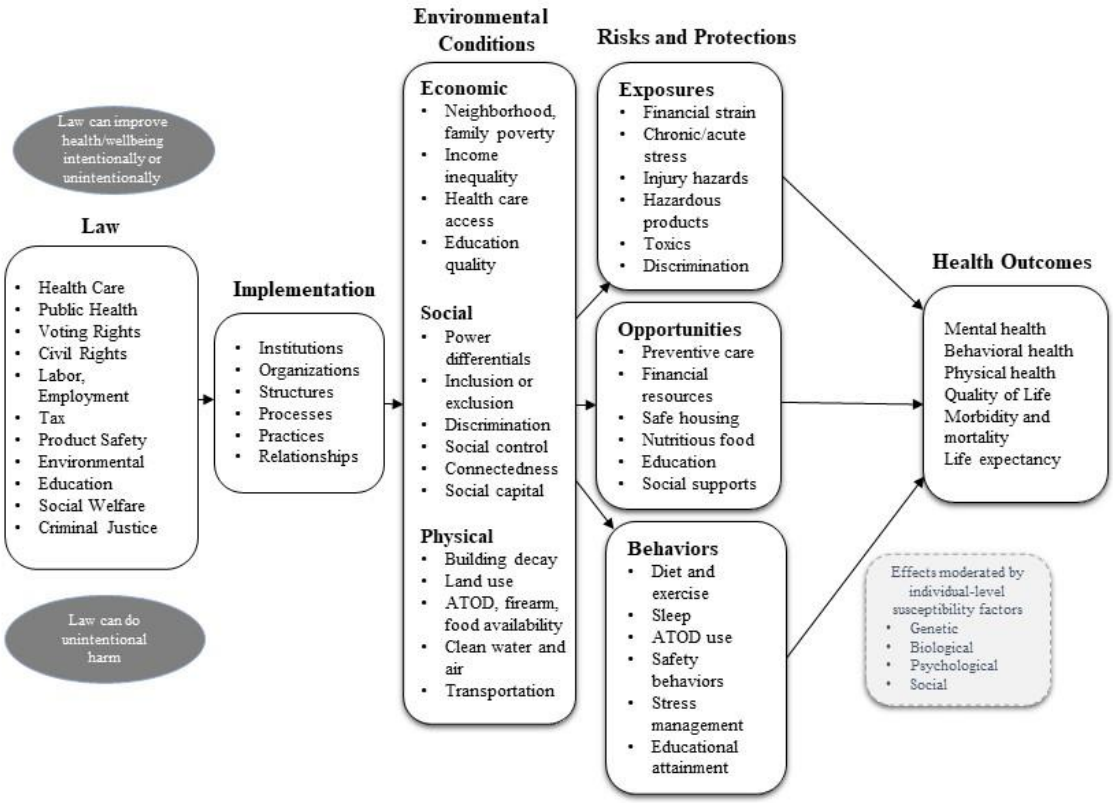

Figure 3.1. The Legal Determinants of Population Health Model.

Laws influence job creation, minimum wage, and collective bargaining rights. For example, in an attempt to increase jobs and reduce poverty, federal and state Enterprise Zone laws were created to target specific geographic areas where normal tax and regulatory laws are lifted (Greenbaum & Landers, 2009), although results have been disappointing (Neumark & Young, 2020). The goal of minimum wage and other labor laws is to reduce poverty and inequality at the lower end of the wage distribution (Autor, Manning, & Smith, 2010). There is growing evidence of health effects of increased minimum wage laws, including decreased smoking (Leigh, Leigh, & Du, 2019), infant mortality (Komro et al., 2016; Rosenquist et al., 2019), and suicide (Kaufman et al., 2020). Collective bargaining and trade union laws structure workplace relations in ways that influence wages, income inequality, and worker participation, all of which appear to affect health (Hirsch, 2008; Kahn, 2000).

Occupational health and safety regulations directly affect workplace dangerous exposures, and other workplace regulations can encourage (or conversely discourage) healthy practices such as breastfeeding (Fan et al., 2020).

Federal securities laws and state corporate governance standards influence corporate conduct and affect relations between corporate executives, investors, and the public. Law attempts to curb undesirable effects of markets by reducing health, safety, and environmental risks; limiting market power; and preventing unfair discrimination. Laws that influence collective bargaining and the rights of, or limitations on, unions have an effect on power dynamics between employers and employees. Anti-discrimination and diversity policies promote the rights and freedoms of disadvantaged groups (Kalev, Dobbin, & Kelly, 2006; Moreau, 2010). Criminal law sets standards of conduct necessary to protect individuals and the community and defines formal social control structures and practices to minimize violence and injury.

Family law in the United States includes a complex mixture of state and federal laws (Estin, 2010), defining what constitutes a family, family responsibilities, and protections for children. Bogenschneider and Corbett (2010) argue for a much-expanded view of family policy, and advocate for a whole field of inquiry examining social policy effects on family functioning. They define four main functions of families: family creation, economic support, childrearing, and caregiving, all of which contribute to the health and well-being of its members.

The family is only one example of a social structure affected by law. Laws define and shape a wide range of social and institutional structures and functions in society. Such laws affect population health by directly influencing broad social conditions within a society, including power dynamics, social stratification, inclusion or exclusion of specific subpopulations, and connectedness and social capital in the population, that in turn affect health outcomes (Sampson, Morenoff, & Gannon-Rowley, 2002; Solar & Irwin, 2010).

Laws and regulations provide guidelines and rules that directly alter physical conditions, thereby influencing exposures to risks or protections. Laws prohibit or regulate dangerous products. For example, many states and local governments prohibit or limit consumer fireworks due to the risk of injury and death. Laws are often successfully used to reduce the amount of hazard in products or the

environment, such as regulations on the design and manufacture of products (for example, car air bags, safety locks on firearms, alcohol concentration, number of pills per prescription).

Laws and regulations protect food supplies and provide safe housing. For example, the US Food Safety Modernization Act of 2011 transformed the system of food safety oversight by shifting the focus from responding to foodborne illness to preventing it. Local and state governments define building codes and housing quality standards to protect the safety and health of residents.

Many laws directly change the physical environment, such as road design, alcohol outlet density regulation, building codes, and pollution control standards. Rules imbedded in law are also used to separate hazards from people, such as smoke-free rules to limit exposure to environmental tobacco smoke (Brownson, Eriksen, Davis, & Warner, 1997; Levy, Yuan, Luo & Mays, 2018), minimum legal drinking age to reduce availability of alcohol to underage youth (Wagenaar, Finnegan, Wolfson, et al., 1993), and pool fence requirements to protect children from drowning (Deal, Gomby, Zippiroli, & Behrman, 2000). Urban design and land use rules determine walkability and safety of neighborhoods and are shaped by public health professionals to create safe and walkable communities.

These examples illustrate the wide range of laws and regulations that affect the environments in which the population lives. We turn now to a brief discussion of implementation considerations, followed by a detailed look at environments, the most important intervening concept between law and population health when viewed from a public health perspective. Our most notable public health successes have used law to shape those environments, rather than using law to shape individual health behavior directly.

IMPLEMENTATION

As with all public health preventive interventions, how effective a law is in improving health depends on how well the law is implemented. Implementation fidelity is a key component to the effectiveness of any program, practice, or policy, and implementation science is an entire field of study in itself (Fixsen, Naoom, Blase, Friedman, & Wallace, 2005; Rabin, Brownson, Haire-Joshu, Kreuter, & Weaver, 2008),

to which Brownson and colleagues (2012) provide a comprehensive introduction. A specific focus on policy implementation science is needed to study policy implementation processes, particularly how policy effects can be both health-promoting and equitably distributed (Brownson, Kumanyika, Kreuter, & Haire-Joshu, 2021; Emmons & Chambers, 2021). Laws shape environments through effects on institutions, organizations, personal and professional practices, relationships, and systems. Fidelity of implementation can be assessed through measures of exposure, awareness, receptivity, participation, enforcement, and compliance. Effects of any statute or regulation are necessarily mediated by many dimensions of the way it is implemented.

ENVIRONMENTS

We distinguish three broad types of environments relevant to health: economic, social, and physical. We have previously summarized the links between these three domains of environmental conditions and child health and developmental outcomes (Komro, Flay, Biglan, & the Promise Neighborhoods Research Consortium, 2011; Komro, 2020). Here, we expand upon our previous work on how environmental conditions affect health outcomes more broadly across the lifespan.

Economic Environment

Low income and lack of resources put individuals and families at increased risk of exposure to a multitude of health-compromising factors. Socioeconomic status is linked to a wide range of health outcomes and all-cause mortality (Adler & Rehkopf, 2008). Higher incomes promote exposure to health protections, such as better nutrition, housing, education, and recreation (Adler & Newman, 2002). Lower-status jobs expose workers to both physical and psychosocial risks (Adler & Newman, 2002). Families face multiple challenges when they live in neighborhoods with a high poverty rate (Sampson, Morenoff, & Gannon-Rowley, 2002). Residents of high-poverty neighborhoods are more likely to be exposed to health risk factors, less likely to be exposed to health protection factors, and more likely to have poor health outcomes (Krieger, Chen, Waterman, Rehkopf, & Subramanian, 2005; Sampson, Morenoff, & Gannon-Rowley, 2002).

In addition to absolute poverty, relative deprivation and income inequality affect exposures to risks and health outcomes. Wilkinson and Pickett (2009) provide an overview of the relationship between economic inequality and various measures of health and well-being. Countries and US states with greater inequality in wealth have higher levels of health and social problems. They have lower life expectancy and higher rates of teenage births, obesity, mental illness, and homicides. In an analysis of the 50 US states, income inequality was associated with all indicators of child well-being (Wilkinson & Pickett, 2009). Material conditions, psychosocial factors, and behaviors help explain socioeconomic inequalities, with material conditions contributing most to differences in self-reported health, through direct and indirect effects (Moor, Spallek & Richter, 2017).

Low-income families are much less likely to have health insurance or access to dental and medical care, which results in many consequences, including being unlikely to have a regular source of health care; unhealthy parents, which adds to financial distress; less prenatal care, resulting in unhealthy infants and increased infant mortality; less medical and dental care for children; and poorer health outcomes among children (National Research Council & Institute of Medicine, 2002).

Household income is also linked with the quality of schools that children attend and, through earnings of offspring, contributes to the growth of income inequality in the United States. (Chetty & Friedman, 2011). Numerous studies have found a link between educational attainment and health outcomes (Egerter, Braveman, Sadegh-Nobari, Grossman-Khan, & Dekker, 2009). Educational attainment affects health outcomes through health knowledge, literacy, and behaviors; better employment opportunities and higher income; and social and psychological factors (Egerter et al., 2009).

Social Environment

Social cohesion and social capital are defined as the extent of connectedness and solidarity within groups, enhancing the ability to reinforce social norms and provide help and support (McNeill, Kreuter, & Subramanian, 2006). Communities with greater social cohesion and social capital have lower overall population mortality (Lochner, Kawachi, Brennan & Buka, 2003). There is consistent evidence for a positive

association between social capital and self-reported health (Rodgers, Valuev, Hswen & Subramanian, 2019). Social support has been defined as a related, yet separate dimension of the social environment (associated with but distinct from social cohesion or social capital) (McNeill et al., 2006). Social support enhances access to resources, material goods, and coping responses (McNeill et al., 2006). There is strong empirical support for the association between greater social integration and lower mortality risk (Seeman & Crimmins, 2001).

Social exclusion and discrimination break social cohesion. Discrimination creates psychological trauma, limits opportunities for advancement, and increases exposures to risks (McNeill et al., 2006). Perceived discrimination is linked to multiple deleterious health outcomes (Williams & Mohammed, 2009). Discriminatory policies and practices limit the power, status, and wealth of particular subgroups, contributing to patterns of social isolation and concentrated poverty (Wilson, 2009). As a result, residents in high-poverty neighborhoods tend to experience lower levels of physical and mental health, educational attainment, and employment than residents of other neighborhoods (Lamberty, Pachter, & Crnic, 2000; Pachter & Coll, 2009).

Physical Environment

Many aspects of the physical environment affect exposures to risks and health outcomes. Neighborhoods with greater physical disorder and decay (that is, abandoned buildings, trash, and crumbling structures) have higher levels of social and health problems, including crime, higher levels of fear, lack of social cohesion, and more physical illness (Sampson et al., 2002). Evidence suggests that improving neighborhood physical conditions can increase social cohesion and mental health outcomes (Williams, Costa, Odunlami, & Mohammed, 2008). Changing community- and street-scale urban design, and land use laws such as zoning, can achieve significant increases in physical activity and social interaction (Heath, Brownson, Kruger, et al., 2006).

Availability of health-compromising products poses a significant risk for health outcomes. Tobacco availability and promotion are associated with all stages of smoking among children and adolescents, from experimentation through addiction (US Department of Health and Human Services, 2004). Ease of access and low cost of

alcohol influence patterns of alcohol use and alcohol-related problems (Popova, Giesbrecht, Bekmuradov, & Patra, 2009; Wagenaar & Perry, 1994). Firearm availability, affected by numerous laws and regulations, similarly affects health. A 10-year time-series analysis of data from the 50 states indicated a significant association between firearm availability and the rates of unintentional firearm deaths, suicides, and homicides among five- to 14-year-olds (Miller, Azrael, & Hemenway, 2002).

Residents of low-income and minority neighborhoods have limited access to supermarkets and healthy foods, and greater access to fast-food restaurants and energy-dense foods (Powell, Chaloupka, & Bao, 2007). Increasing fruit and vegetable availability in low-access neighborhoods appears to improve dietary choices (Glanz & Yarock, 2004). Research suggests that neighborhood residents with better access to supermarkets and limited access to convenience stores tend to have healthier diets and lower levels of obesity (Larson, Story, & Nelson, 2009). Residents of majority-minority and high-poverty neighborhoods face a greater risk of exposure to a range of physical toxins and carcinogens (Crowder & Downey, 2010). Living near toxic exposures is related to an increased risk for adverse health outcomes (Braun, Kahn, Froelich, Auinger, & Lamphear, 2006; Brender, Maantay, & Chakraborty, 2011).

RISKS, PROTECTIONS, AND HEALTH OUTCOMES

Economic, social, and physical environmental conditions affect exposures to health risk and protection factors, as well as affect health behaviors. Income and resources affect multiple risks and protections including affordability of nutritious food; safe housing and neighborhood quality; stress; preventive health care, screening and treatment; and educational attainment. Social conditions affect exposure to social support, positive or negative role models, norms, and stress. The physical environment affects exposure to high-fat and high-sugar (that is, low-nutrient-density) food, physical toxins, and injury hazards. Environments not only have direct effects shaping health-relevant behaviors, but also have indirect effects operating through material conditions that affect exposures to risks and protections, and those effects are moderated by other individual-level susceptibility factors (for example, genetic, biological, psychological, social). Finally, some physical and social toxic exposures have particularly large and long-lasting deleterious effects if the exposure occurs at

particularly vulnerable times in the lifespan, such as during pregnancy or early child development.

The leading causes of morbidity and mortality are heavily influenced by exposures to risks and protections and health behaviors. Major types of exposures include physical and biological contaminants such as chemicals, gases, metals, radiation of various types, smoke, and infectious bacteria, protozoa, and viruses (related to cancers, other chronic disease, and infectious disease); access to specific foods and demands or opportunities for exercise (related to obesity and its consequences); access to alcohol, tobacco, and other drugs for human consumption (related to many acute and chronic health problems); amounts and concentrations of kinetic, thermal, and other types of energy (concentrated energy is the fundamental cause of injuries of all types); and social supports and role models. Major categories of health behaviors include alcohol, tobacco, and other drug use; physical activity; eating behaviors; sexual behaviors such as partner selection and use of condoms and contraceptives; and safety behaviors such as driving under the influence of alcohol or drugs and safety belt use.

Laws affect environments in many ways, and the resulting changes in environmental conditions and ultimate population health outcomes are complex and involve a large number of causal paths. Understanding these complex mechanisms requires drawing on knowledge and theory across many disciplines, including biological sciences, medical and clinical sciences, environmental sciences, epidemiology, psychology, sociology, anthropology, economics engineering, urban planning, architecture, education, and social work. Nevertheless, all social and physical environmental influences on health outcomes operate broadly via two causal pathways – affecting exposures to risks and protections and affecting health-related behaviors.

Studying Causal Mechanisms

We now use smoke-free laws, anti-discrimination laws, and the Earned Income Tax Credit to illustrate ways laws might affect environments, the distribution of risky and protective exposures, and health-related behaviors. In each case we draw on the overall model in Figure 3.1 to hypothesize specific causal chains that could be empirically evaluated to better understand how law influences population health.

SMOKE-FREE LAWS

Smoke-free laws provide a straightforward example of law promoting better public health outcomes by engineering the physical and social environment. Smoke-free policies restrict smoking in venues such as workplaces, public transportation, and restaurants. There is a growing movement in the United States and other countries to extend smoke-free restrictions to outdoor public spaces such as college campuses, hospital grounds, and parks and beaches, thus creating expansive areas of involuntary tobacco abstinence.

Smoke-free laws operate primarily by influencing social and physical environments. Laws that restrict smoking influence the physical environment via the simple expedient of making it harder to find places where smoking is allowed. They also promote and support a social norm against exposing others to smoke in public spaces. The force of social norms not to smoke, and to obey the rules, appears to contribute to widespread compliance even without enforcement (Kagan & Skolnick, 1993). After implementing campus-wide smoke-free requirements, for example, hospital administrators reported more support, less difficulty, and lower costs than anticipated, as well as few negative effects and numerous positive effects on employee performance and retention (Sheffer, Stitzer, & Wheeler, 2009).

These laws are designed to reduce environmental tobacco smoke in public areas where smokers congregate (Klepeis, Ott, & Switzer, 2007). Even brief exposure to smoke can have immediate physiological effects, such as constricting blood vessels and causing platelets to clump together to form clots, which can trigger a heart attack or stroke in particularly susceptible individuals (US Department of Health and Human Services, 2006). These clinical findings are corroborated by a growing body of population-based studies documenting that hospital admission rates for cardiovascular events decline significantly in municipalities after public smoking bans are implemented (Pell et al., 2008), and these declines appear to be most pronounced among younger individuals and nonsmokers (Meyers, Neuberger, & He, 2009). Smoke-free laws lead to lower second -hand smoke exposure (Lin et al., 2020) reduced smoking (Azagba, Shan & Latham, 2020; Lin, Liu, & Chang, 2020; Titus et al., 2019) and better health outcomes, including a lower risk of cardiovascular disease among middle-aged adults (Mayne et al., 2018).

The general idea is simple, but research is needed to elucidate more precisely the means through which these effects are won by legal intervention. Implementation is a key mediating factor for achieving success in reducing exposure to secondhand smoke (Rashiden et al., 2020). Barriers to implementing smoke-free policies include lack of administrative and staff support to guide planners through the policy implementation process at their institution; lack of employee, student, or patient support and involvement; and lack of resources and tools to instruct planners how to initiate a smoke-free movement (for example, a step-by-step guide, media templates, and model local ordinances) (Harbison & Whitman, 2008; Whitman & Harbison, 2010). Increasing compliance with an outdoor smoking ban may require multiple enforcement strategies such as moving cigarette receptacles away from building entranceways, adding signage about the smoking ban, and specifying the smoke-free zone with prominent ground markings (Harris, Stearns, Kovach, & Harrar, 2009).

The major goal of smoke-free policies is to reduce exposure to second-hand smoke and its deleterious consequences. Therefore, a logical hypothesized causal pathway for the effect of smoke-free laws on population health is

> Smoke-free policies → implementation fidelity → reduced tobacco smoking → reduced exposure to smoke in public places → decreased cardiovascular risk factors or events

In addition to reducing tobacco smoke in public spaces, outdoor smoke-free policies may have other beneficial effects on the physical environment, such as reduced unintentional fires, the vast majority of which are caused by cigarettes being abandoned or carelessly disposed (Hall, 2010; Xiong, Bruck & Ball, 2017). Aside from the fire hazard, cigarette butt waste – the single most common form of litter, constituting up to 40% by weight of all litter (Chapman, 2006) – has become a growing environmental concern (Healton, Cummings, O'Connor, & Novotny, 2011). Cigarette filters are made of non-biodegradable cellulose acetate designed to capture the toxic chemicals found in cigarettes (Novotny, Lum, Smith, Wang, & Barnes, 2009), and disposed cigarette filters may leach these toxins into the environment, including groundwater supplies, causing harmful effects (Moerman & Potts, 2011; Slaughter, Gersberg, Watanabe, et al., 2011). Outdoor smoking bans might reduce exposure to such environmental hazards. We are not aware of any studies to date that have

examined the health effects of outdoor smoke-free policies mediated through water-borne exposures to toxins. A hypothesized causal pathway is

> Outdoor smoke-free policy → implementation fidelity → decreased cigarette butt waste → decreased exposure to toxins in water → reduced health risk

Beyond modifying the physical environment, smoke-free policies may also affect positively the social and economic environments. For example, smoking bans at workplaces may increase employee attendance and productivity (Parrott, Godfrey, & Raw, 2000); bans at hospitals may improve patient outcomes and hospital profits (Whitman & Harbison, 2010); bans at restaurants or bars may have positive effects on sales and employment (Scollo, Lal, Hyland, & Glantz, 2003); bans on beaches may increase tourism revenue (Ariza & Leatherman, 2012); and bans in any municipality may reduce cleanup and maintenance costs associated with litter abatement (Schneider, Peterson, Kiss, Ebeid, & Doyle, 2011). These economic effects could be examined on outcomes beyond smoke exposure, such as

> Outdoor smoke-free policies → implementation fidelity → increased community resources → increased health protection factors and decreased health risk factors → enhanced population health

Most important, smoking bans directly reduce prevalence and amount of tobacco use (Fichtenberg & Glantz, 2002; Azagba et al., 2020; Lin et al., 2020)) and indirectly affect public attitudes about smoking, making the practice less socially acceptable (Albers, Siegel, Cheng, Biener, & Rigotti, 2004; Heloma & Jaakkola, 2003). In turn, lower tobacco use reduces health care costs and productivity losses attributed to smoking (Centers for Disease Control and Prevention, 2008).

ANTI-DISCRIMINATION LAWS

Discrimination – the differential and unfair treatment of groups by individuals and social institutions (Allen, 2019; Bonilla-Silva, 1997) – represents one of the most studied social determinants of health and health inequalities. Perceived racial discrimination has received substantial empirical attention as a psychological stressor that has important consequences for mental and physical health (Allen, 2019; Pascoe & Richman, 2009; Williams & Mohammed, 2009). The stress literature indicates that discrimination affects health by causing negative emotional states such as depression

and anxiety, which create biological and behavioral stress responses that undermine health (Cohen, Kessler, & Underwood-Gordon, 1995). Consistent with this theorized stress mechanism, recent systematic reviews find robust associations between perceived racial discrimination and a broad array of adverse health consequences (Pascoe & Richman, 2009; Williams & Mohammed, 2009). The most persistent findings from these reviews are strong associations between perceived discrimination and negative mental health outcomes including depression and anxiety, psychological distress, and general well-being (for example, self-esteem, life satisfaction, quality of life). Weaker but consistent associations exist for physical health outcomes including hypertension, cardiovascular disease, low birth weight and prematurity, numerous diseases, physical conditions, and general indicators of illness. Furthermore, evidence from longitudinal studies suggests that discrimination precedes poor health status (Gee & Walsemann, 2009).

Intuitively, anti-discrimination laws are expected to reduce social and institutional exposure to discrimination, and therefore lessen the resulting health consequences of discriminatory practices. However, despite the consistency of findings that link perceived discrimination with poor health, few published studies examine the effects of anti-discrimination laws on perceptions of discrimination and related health outcomes. And there are challenges in assessing implementation fidelity and compliance with anti-discrimination laws. Many lessons about implementing anti-discrimination policies can be gleaned from experiences with the Americans with Disabilities Act of 1990 (ADA), a wide-ranging civil rights law that prohibits, under certain circumstances, discrimination based on a physical or mental impairment. Obstacles to ADA implementation include accommodations that entail substantial cost (for example, wheelchair accessibility in a public transit system), lingering questions about who is covered, challenges and prejudices regarding mental disability, and insufficient capacity to monitor implementation and compliance (Percy, 2001). Assessing implementation fidelity of such a wide-ranging antidiscrimination law requires an examination of many processes along the implementation pipeline such as ensuring that ADA language covers the full set of organizational and individual practices that can lead to discrimination based on handicap, confirming that administrative regulations are in place and enforced, measuring adherence to implementation guidelines, monitoring compliance by governing units and business

enterprises, registering complaints, and tracking settlements that have been negotiated or imposed (Moss, Burris, Ullman, Johnsen, & Swanson, 2001; Swanson, Burris, Moss, Ullman, & Ranney, 2006).

Several studies have examined the effects of anti-discrimination laws on health outcomes. In an analysis of women's health policies, Wisdom and colleagues (2008) found that state-level anti-discrimination laws were associated with population health status indicators for women. For example, state laws prohibiting insurance discrimination against domestic violence victims were associated with lower rates of hypertension and diabetes, while sexual orientation discrimination laws were associated with lower rates of smoking. The study authors conclude that state efforts to safeguard female residents from discrimination may not only protect civil rights but also protect public health by reducing stress for women. Similarly, King, Dawson, Kravitz, & Gulick (2012) found that diversity training policies at workplaces ameliorate minorities' experiences of discrimination as well as improve their job satisfaction, both of which could potentially reduce stress and improve health. Workplace anti-discrimination policies may also affect income and resources by mitigating financial costs of litigation (Goldman, Gutek, Stein, & Lewis, 2006), job turnover (Nunez-Smith, Pilgrim, Wynia, et al., 2009), and social isolation of women and minority workers (Kalev et al., 2006). Therefore, a testable mediation model is

> Anti-discrimination policies → implementation fidelity → reduced discrimination → reduced stress → improved health outcomes

In addition to reducing perceptions of discrimination and associated psychological stressors, anti-discrimination laws alter economic and physical conditions, reducing subtle non-perceived institutional forms of discrimination that foster differential access to societal goods, services, and opportunities (Allen, 2019). For example, anti-discrimination law can target racial residential segregation – the physical separation of races by imposed residence in certain areas (Williams & Collins, 2001). Racial segregation, which remains exceedingly high for African Americans in the United States, is a well-established contributor to racial differences in socioeconomic status, by limiting access to education and employment opportunities (Acevedo-Garcia, Osypuk, McArdle, & Williams, 2008; Allen, 2019; Williams & Collins, 2001). A housing experiment addressing racial segregation showed that single-parent, minority

women who took advantage of rent-subsidy vouchers (to help relocate their families to more affluent neighborhoods) were less likely to become obese or develop diabetes than were women who remained in poor neighborhoods (Ludwig, Sanbonmatsu, Gennetian, et al., 2011). A hypothesized mediation model is

> Anti-discrimination policies → implementation fidelity → enhanced living and working conditions → reduced exposure to risks, increased exposure to protections → improved health outcomes

Anti-discrimination laws have been applied to many forms of discrimination, including unfair treatment attributed to age, disability, gender, gender identity, race/ethnicity, religion, and sexual orientation. Important directions for future research include: (1) taking an intersectionality perspective to better understand the effects of anti-discrimination laws across multiple identities (e.g. Black men, American Indian women) (Allen, 2019); (2) further research on diversity policies within the workplace, because studies report that adults perceive more discrimination at work than any other place (Allen, 2019); and (3) understanding optimal implementation processes for achieving equality of opportunity and social inclusion (Gropas, 2021).

EARNED INCOME TAX CREDIT

The federal Earned Income Tax Credit is the largest US cash-transfer program for low- and moderate-income workers. There is growing evidence that federal and state EITCs positively affect families' economic circumstances; increase participation in the labor force, particularly by single mothers; reduce poverty, including child poverty; improve educational outcomes among children; and improve health outcomes among mothers and children (Gassman-Pines & Hill, 2013; Sherman et al. 2016; Spencer & Komro, 2017). Inasmuch as it has been credited with lifting more children out of poverty than any other government program (National Academies of Sciences, Engineering and Medicine [NASEM], 2019), it offers an example of how law in the form of the federal and state tax codes can be used in a public health model to influence health outcomes.

The EITC works primarily through altering the fiscal situation of families. The EITC is designed and implemented to promote work and lift families out of poverty. As such, most of the literature is focused on evaluating the law's effects on labor force

participation and poverty levels. Evidence linking income support policies to health outcomes is growing (Arno, Sohler, Viola, & Schecter, 2009), highlighting the need for research that explores this relationship and its mechanisms. A primary focus of the EITC is income support to families with young children, hypothesized to provide material resources at a critical period of child development. Those increased resources are expected to improve many dimensions of the immediate environment for such families (for example, more nutritious food, improved childcare, lower stress) with long-term positive outcomes expected as a result (Arno et al., 2009; NASEM, 2019). One hypothesized causal chain for the effects of the EITC on health outcomes is

> EITC → implementation fidelity → decreased family poverty → increased material resources → improved child development and child health → adult and lifelong health and quality of life

Alternatively, Arno and colleagues (2009) examined the effect of EITC on health insurance coverage for children, as a hypothesized mediator of an effect on child health outcomes. They found that single mothers with low or moderate incomes who were ineligible for the EITC program were 1.4 times more likely to lack health insurance for all of their children than single mothers who were eligible to receive the credit. They also examined EITC direct effects on infant mortality and found a statistically significant inverse association between EITC penetration and infant mortality. A causal interpretation of these results would be enhanced if they were to combine the two studies, directly examining the mediating influence of health insurance coverage on prenatal care and infant mortality, depicted as

> EITC penetration → implementation fidelity → increased health insurance coverage → increased prenatal care → decreased infant mortality

Strully and colleagues (2010) published an exemplary study examining the health effects of the EITC on birth weight mediated through maternal smoking during pregnancy. Low birth weight was chosen as an important outcome variable since it is predictive of various negative outcomes across the life course (for example, infant mortality, poor child health, and lifelong low educational attainment and earnings). Results of their analyses supported the mediational hypothesis. First, they found that those participants who received EITC experienced an increase in maternal employment and income, which was then associated with an increase in birth weight. They then

performed a mediation analysis and found that the association between EITC and increased birth weight was partially explained by a reduction in maternal smoking during pregnancy. The mediation model tested was

> EITC → implementation fidelity → increased maternal employment or income → reduced maternal smoking during pregnancy → increased birth weight

Markowitz and colleagues (2017) investigated the effects of state-level EITCs on maternal health behaviors and birth outcomes stratified by generosity of the tax credits. Generosity of EITCs was defined by the amount of the tax credit and whether or not it was refundable, meaning that if one's tax liability falls to zero, the government will send a refund check for the credit amount. Nonrefundable credits provide no further income beyond a zero-tax liability. They found that the largest birth weight improvements occurred at the lowest birth weights, and that prevalence of low-birth-weight births declined as EITC generosity increased. Moreover, the largest increases in birth weight and reductions in low-birth-weight births were in states with refundable EITCs. The results indicated that few of the maternal health behaviors were affected by state EITC generosity, and the size of the EITC effects did not differ by race or ethnicity (Komro et al., 2019). The pathway tested was

> EITC → policy dimensions of generosity → maternal health behaviors → increased birth weight

Evans and Garthwaite (2010) examined direct health effects of the EITC on mothers' health outcomes. Using national datasets (that is, Behavioral Risk Factors Surveillance System and the National Health Examination and Nutrition Survey), they compared low-educated mothers with two or more children, who are eligible for the maximum EITC benefits, to mothers with only one child. They found evidence of positive health effects among those mothers eligible for maximum benefits, including fewer days with poor mental health, greater percentage reporting excellent or very good health, and lower levels of biomarkers that indicate inflammation, which is associated with stress and is a risk for cardiovascular disease. However, they did not examine mediational hypotheses. On the basis of our conceptual framework and the work by Evans and Garthwaite, we present two potential causal pathways, one examining effects on access to health care and one on social conditions:

EITC → implementation fidelity → increased social inclusion, connectedness → decreased stress → maternal health

and

EITC → implementation fidelity → increased access to health care → preventive services → maternal health

Potential health effects of the EITC may also operate via economic effects on high-poverty neighborhoods. It was estimated that federal and state EITC refunds put $9.3 million per square mile into New York City communities (Arno et al., 2009). Spencer (2007) examined the effect of the EITC on the economies of poor neighborhoods in Los Angeles. Results indicate a positive effect on poor neighborhoods, with increased EITC income associated with retail job gains. More distal effects on health indicators in the neighborhoods were not examined. A hypothesized causal chain for effects of the EITC on health outcomes within high-poverty neighborhoods is

EITC → implementation fidelity → decreased neighborhood poverty → job and business generation → increased neighborhood protective exposures → improved neighborhood health

The Earned Income Tax Credit, anti-discrimination laws, and smoke-free laws each have many possible health effects deserving further study, and we have depicted only a few possible causal paths. These are just three examples from hundreds of laws that deserve careful theorizing and empirical testing of the many possible dimensions of economic, social, and physical environments affected by a law, and how those environmental changes are reflected in aggregate levels of population health and well-being.

Conclusion

The field of public health is fundamentally interdisciplinary, integrating knowledge and theory from many sciences and disciplines to develop effective ways to create the conditions that maximize the health and well-being of the entire population. Law is a critically important force in shaping the social, economic, and physical environments in which people live, and historically, most major public health accomplishments were achieved with the help of good law. Because law shapes so many dimensions of

society, and because so many dimensions of the economic, social, and physical environment affect one's odds of optimal health, opportunities for research on how law affects health abound. But research also needs to move beyond common "black box" studies that simply assess whether a given law is related to a given health outcome, as important as they are initially on new or understudied topics. Understanding the many ways law affects population health would be enhanced by increased focus on more-complex mediation studies testing specific theory-based, and potentially widely generalizable, mechanisms of effect.

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