

Cities and population health

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Abstract

A majority of the world's population will live in urban areas by 2007 and cities are exerting growing influence on the health of both urban and non-urban residents. Although there long has been substantial interest in the associations between city living and health, relatively little work has tried to understand *how* and *why* cities affect population health. This reflects both the number and complexity of determinants and of the absence of a unified framework that integrates the multiple factors that influence the health of urban populations. This paper presents a conceptual framework for studying how urban living affects population health. The framework rests on the assumption that urban populations are defined by size, density, diversity, and complexity, and that health in urban populations is a function of living conditions that are in turn shaped by municipal determinants and global and national trends. The framework builds on previous urban health research and incorporates multiple determinants at different levels. It is intended to serve as a model to guide public health research and intervention.

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“For better or worse, the development of contemporary societies will depend largely on understanding and managing the growth of cities. The city will increasingly become the test bed for the adequacy of political institutions, for the performance of government agencies, and for the effectiveness of programmes to combat social exclusion, to protect and repair the environment and to promote human development.”

United Nations, State of the Cities 2001

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Introduction

For the past 150 years urbanization has been a major historical trend, driving changes in economic development, education, criminal justice, transportation and housing, to name a few (Moore, Gould, & Keary, 2003; Vlahov & Galea, 2003; Lawrence, 1999; Satterthwaite, 2000). Today, city life is the norm for an ever growing proportion of the world's population. Recent projections suggest that half of the world's population will live in urban areas by 2007 and three-quarters by 2030 (United Nations Population Division, 2002; Gelbard, Haub, & Kent, 1999). The urban environment influences every aspect of health and well-being: what people eat, the air they breathe and the water they drink, where (or if) they work, the housing that shelters them, their sex partners and family arrangements, where they go for

health care, the danger they encounter on the street, and who is available for emotional and financial support. In the modern era, cities have been both the source of serious threats to the health of the public and the source of many public health innovations. More than ever, to understand what causes health and disease and to improve the health of the public requires an improved awareness of how characteristics of cities affect health and well-being. In this paper we first discuss the dominant approaches that are used in the study of urban health and then propose an integrative framework that can build on these approaches and guide public health inquiry into how urban characteristics affect health. We draw primarily on the US experience in discussing this framework but hope that our rationale for inclusion of specific elements in the framework can have broad applications to a range of countries. We intend this framework to serve as a model that can guide interventions aimed at improving health in cities.

Approaches to urban health

Research on the association between city living and health arises from several disciplines, including anthropology, urban planning, epidemiology, and sociology, and has focused on assessing differences between and within cities. Researchers have generally used one of three different approaches to considering the association between cities and health. The first, and most common approach, contrasts urban to non-urban (frequently rural) areas (e.g., van Niekerk, Weinberg, Shore, De V. Heese, & van Schalkwyk, 1979; Farbos, Resnikoff, & Peyramure, 2000; Telfair, Haque, Etienne, Tang, & Strasser, 2003). This work isolates living in urban areas as a primary determinant of interest and has often produced conflicting results. For example, while higher rates of mental illness have been documented in urban compared to rural areas in the United Kingdom (Paykel, Abbott, Jenkins, Burgha, & Meltzer, 2002), rural-urban differences in mental health have not been observed in Canada (Parikh, Wasylenki, Goering, & Wong, 1996) even though the studies used comparable methodology. In the US, some studies have documented urban-rural differences in mental health (Blazer et al., 1985) while others have found no differences (Blazer, Kessler, McGonagle, & Swartz, 1994). A study in Taiwan found a lower prevalence of mental health problems in urban compared to rural areas (Hwu, Yeh, & Chang, 1989). Studies of the prevalence of heart disease and cancer by urban vs. rural regions have similarly showed inconsistencies (e.g., Yamamoto & Watanabe, 2001).

A second group of studies has focused on differences across cities in one or more countries. Using the city itself as the key determinant of interest these studies compare different cities in order to reach conclusions

about urban characteristics associated with health. For example, cross-urban work has shed light on differences in health care and cardiac disease survival in some of the largest cities in the developed world (Rodwin & Gusmano, 2002).

A third line of inquiry involves the study of intra-urban differences and how they are associated with variability in health within cities. This research is rooted in the observation that specific characteristics of small areas may be associated with health; most empiric work in this regard has focused on how characteristics of neighborhoods of residence affect health (Ross, 2000; Diez-Roux, 2002). This research has shown associations, for example, between characteristics of the built environment and neighborhood socioeconomic status with sexually transmitted disease prevalence and cardiovascular disease mortality (Cohen et al., 2000; Diez Roux et al., 2001).

These disparate strands of research have contributed to a slowly emerging understanding of the relation between city living and health. We refer to this body of work in this paper as the study of urban health. Much of this work has suggested that urban residents have worse health than non-urban residents, a disparity sometimes called the urban health penalty (Gould, 1998; Freudenberg, Galea, & Vlahov, under review). However it is now evident that cities have positive as well as negative effects on health and well-being. For example, social and health services are frequently more available in cities than they are in non-urban areas (Sorgaard et al., 2003) which may contribute to better health and well-being among urban residents. In contrast, particulate pollution is higher in cities, particularly heavily industrialized cities, than it is in non-urban areas (Grima, Micallef, & Colls, 2002; Jedrychowski, Maugeri, & Bianchi, 1997). Particulate pollution has been associated with respiratory and cardiovascular disease morbidity and mortality (Shima, Nitta, Ando, & Adachi, 2002; Crimi et al., 1999).

Although this body of work suggests that a more nuanced appreciation of the complicated association between the urban context and health is necessary, most of the published literature has not explored *how* and *why* cities may affect health. In part, this limitation reflects the difficulty of parsing the complex set of questions that are embedded in the concept of urban health into evaluable components. Cities may have both positive and negative effects on health, suggesting that a full understanding of urban health needs to tease apart the factors that influence health and evaluate the circumstances, and the contexts, in which one factor may be more or less important than another. In addition, particular urban characteristics may have both positive and negative effects on health. For example, while city parks and green space may have a salutary effect on health (Takano, Nakamura, & Watanabe, 2002), these

same areas may provide breeding sites for vectors that transmit infectious diseases (Miller, 2001).

Also, the dynamics of urban change may influence health as much as the characteristics of cities at a given point in time. For example, as poor people become more concentrated in a densely populated older city, pressure on available housing may lead to increased exposures to a variety of allergens that trigger asthma symptoms (Perry, Matsui, Merriman, Duong, & Eggleston, 2003). However, if the same city were gentrifying and old housing was being renovated, the demolition and rebuilding could expose urban residents to displaced rodents, changing neighborhood racial/ethnic composition, and loss of well-established neighborhood social resources, all of which could affect health. Therefore, a fuller understanding of urban health will necessitate studies that include an appreciation of the dynamic nature of cities, the specificity of context, and a detailed consideration of the pathways by which changes in the urban context affect health.

The dominant approaches used to study urban health to date have often focused on a single line of inquiry. Thus, the inter-city studies of urban health suggest that municipal-level factors (e.g., policies) may be important determinants of the health of city residents (Rondinelli, 1986; Jerrett, Eyles, Dufournaud, & Birch, 2003). Studies that have focused on differences within cities suggest that intra-urban factors (e.g., residential segregation) play a role in shaping health (Acevedo-Garcia, 2001). Ultimately however, it is the multiplicity of factors at different levels that shape the health of urban residents. For example, municipal-level policies determine transportation routes that may pollute local neighborhood environments or increase accident rates while at the same time improving access to emergency medical services. State and federal authorities, influenced by national political and economic factors, allocate funds for the establishment of new roads or other types of transportation in cities. All levels play a role in determining how transportation affects the health of urban residents. While this complex causal chain is not unique to urban health, it is particularly germane given the complexity of the urban context.

Thus, a comprehensive model is needed that can incorporate and integrate the multiple levels of factors that affect health in cities and that considers features of cities that may either promote or harm health. Here, we propose a framework that posits that urban populations are defined by size, density, diversity and complexity, and that health in urban populations is a function of living conditions shaped by municipal determinants, and national and global trends. We propose a framework that can be used in all three dominant research strands discussed above, i.e., to study intra-urban differences in the health of populations, to compare the health of groups across cities, or to frame contrasts between

urban and non-urban populations. The rest of this paper discusses the proposed framework and how the different levels of influence may contribute to health in cities.

A conceptual framework for urban health

Our conceptual framework rests on the premise that multiple levels of influence shape population health. Our framework is grounded in our understanding of the extant public health literature and builds on several other published conceptual frameworks that have considered the social and economic determinants of population health. Over the past thirty years, several authors have considered how multiple determinants of health may affect the health of particular populations (McKeown, 1972; Lalonde, 1974). Early frameworks that described the relations between the social environment and population health were published in the 1970s (Blum, 1974; Morris, 1975; Travis, 1977). Seminal work by Evans and Stoddart (Evans & Stoddart, 1990) presented a conceptual framework for synthesizing research about the contribution of nonmedical determinants to population health that was highly influential and contributed to the development of several successive models, each offering refinements on how multiple determinants affected one another and ultimately affected the health of populations (Hamilton & Bhatti, 1996; Starfield & Shi, 1999; Evans & Stoddart, 2003). In many ways, urbanization, and the characteristics of urban living, are sociologic paradigms and the study of the relation between urban living and health falls squarely within the purvey of social epidemiology or social medicine (Kaufman, Kaufman, & Poole, 2003). During the past decade there have been a number of models proposed that consider the interrelations between social and economic influences and population health. The most successful of these models posit that there are multiple factors that influence one another and ultimately, the health of populations (Kaplan, 1999; Krieger, 1994).

In the specific context of the health of urban populations, there is a growing body of work, drawing to some extent on the aforementioned frameworks discussed here, that discusses the social and economic determinants of population health. Some of this work considers how social and economic determinants may affect health in cities. For example, the World Health Organization, primarily through its Healthy Cities activities (Price, 1997) has been instrumental in offering both frameworks and practical guides for governments and planners whose goal is to develop healthy urban environments (Hancock & Duhl, 1988; Hancock, 2004). The Healthy Cities movement has worked to make theories about multiple determinants of health accessible to policy makers and implementing bodies (Healthy

Cities and Urban Governance, 2004; Corburn. 2004). Among the frameworks developed through the efforts of the World Health Organization, the DPSSEEA (Driving Forces, Pressures, State, Exposure, Effect, Action) framework has been particularly useful to describe the relation between features of the physical environment and health and has been applied in various studies and reviews that have tried to understand the relation between cities and health (Hancock, 2004). In brief, the framework suggests that human activities and environmental conditions may be associated with factors such as economic development and social attitudes to shape population health. While this framework is not formulated explicitly as a means of understanding health in cities, it may be particularly relevant in the urban context, where, as we shall discuss, multiple factors interact to shape the health of diverse urban populations.

More specific to health in cities, there has recently been growing interest in the relations between the built environment and health and several frameworks have considered how features of the built physical environment may affect population health (Northridge, Sclar, & Biswas, 2003; Frumkin, 2002; Schulz & Northridge, 2004). However, we are not aware of published frameworks that have explicitly been formulated to integrate the range of social and economic determinants that shape the health of urban populations.

The core concept underlying the proposed framework is that the social and physical environments that define

the urban context are shaped by municipal factors such as government and civil society, and national and global trends that shape the context in which local factors operate. The framework assumes that the urban environment in its broadest sense (physical, social, economic, and political) affects all strata of residents, either directly or indirectly. In order to consider all these factors and how they affect the health of urban populations this conceptual framework proposes mechanisms through which these variables may influence the conditions that are the primary determinants of the health of urban populations.

The framework, presented in Fig. 1, is based on our own experience as urban health researchers and our understanding of the recent literature on the health of urban populations (Freudenberg, Galea, & Vlahov, 2005; Galea & Vlahov, 2005). While social and political scientists may tend to consider the model from left to right, thinking first about broader social and political movements and how these influence municipal determinants that shape the urban characteristics that determine health, clinicians and epidemiologists may consider the model from right to left, looking first at the level of health and disease in an urban population, next at the proximal “risk factors” of individuals, and then at various urban characteristics, and so on.

We note that our experience, and the examples chosen here, are rooted in the US urban experience. While we ground this framework in our national experience, we hope that it can have utility to researchers and

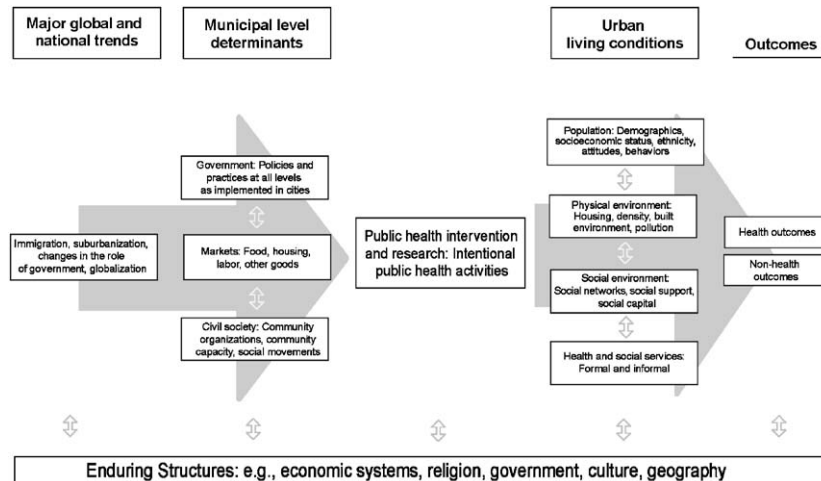


Fig. 1. A conceptual framework for Urban Health. Because of the complexity of the potential relations among the determinants of health of urban populations, our framework of necessity simplifies a number of potential relations between the domains shown here and discussed in the manuscript. A more detailed description of some of the plausible relations between key variables in the conceptual framework is provided in the text. We also note that the arrows in the figure are purely schematic and do not mean to be exhaustive or definitive. There are several interrelationships between the domains presented here and we would anticipate that most relationships would be multidirectional. This pictorial representation of the framework discussed in the text also is limited by its static nature. A fuller depiction of the determinants of the health of urban populations would incorporate the changes over time (e.g., growing city population) that in and of themselves are important determinants of health.

practitioners working in different urban environments in other nations. In the following sections we discuss the different elements of the proposed framework and the role they play in urban health.

Enduring social structures and conditions

Before considering the components of the model presented in the columns, we note that in the bottom row we highlight the role of *enduring social structures and conditions*. This reflects the prevailing political and economic systems that underlie all aspects of living in particular countries. For example, in the US, representative democracy and capitalism provide the context in which social conditions that affect health can change. In other countries, more authoritarian governments, more robust working class movements, or more centrally planned economies provide a different context in which conditions that affect health can change. While social structures are not immutable, they usually change on a slower time scale than what we call major national and international trends. Since social alterations occur only in the context of these political, social and economic structures, it is important to understand how they enable or constrain other determinants that may influence the health of urban populations. For example, free market capitalism, whether in its more regulated or unfettered models, shapes the opportunity structures in which individuals, corporations, and governments take action related to health. Being ultimately interested in modifiable urban living conditions and their proximal determinants, we do not here focus further on these more enduring social structures, but acknowledge their overall importance in shaping the other components highlighted in this framework. In the past, social movements seeking to modify these structures have made important contributions to improved living conditions, suggesting that such efforts may again emerge in the future (Hamlin, 1998; Piven & Cloward, 1979). In the proposed framework we also denote, using vertical arrows, the fact that enduring structures are likely to play a role in shaping the other key elements in the framework, including national and global trends, municipal determinants, public health practice, and more proximal urban characteristics.

Global and national social, economic, and political trends

Global and national social, economic, and political trends shape cities in both the long and short-term. These trends influence urbanization and determine the resources available to a particular city or region. In the past five decades four trends—migration, suburbanization, changes in the role of government, and globalization—arguably have had the greatest impact on cities and on the social conditions that determine health in

urban populations in the developed world. As a result, they explain an important portion of the variation in health within and between cities. Operating both directly and through the other determinants shown in Fig. 1, these trends structure the social and physical environments that determine cities' impact on health. We discuss each of these trends in turn.

Migration and immigration

Today, more than 140 million people in the world live outside their country of birth and migrants comprise more than 15% of the population of at least 50 nations (Central Intelligence Agency, 2003). Increasingly, people move from the countryside to the city or from a developing to a developed world city, making immigration primarily an urban phenomenon (Briggs, 1998; Edmonston & Passel, 1994). The number of legal immigrants entering the US during the 1980s doubled compared to the 1950s. In 2000, 31.1 million US residents, 11.1% of the population, were foreign born and 13.2 million of these, or 4.7% of the overall population, came to the United States between 1990 and 2000 (Bureau of the Census, 2001). Immigration to western countries has had a disproportionate effect on cities for much of the past century, with most immigrants settling in urban areas upon arrival to a developed nation (Briggs, 1998).

Immigration affects health in cities in a number of ways. Studies show that immigrants bring lifestyles and support systems that protect them against some of the adverse outcomes that other low-income urban residents experience, such as infant mortality and diabetes (Morales, Lara, Kington, Valdez, & Escarce, 2002). However, some of these protections fade after a generation or two of exposure to urban conditions (Durkin, 1998; Allensworth, 1997). On the other hand immigrants from some regions are often burdened with poverty and a higher prevalence of some diseases (e.g., tuberculosis) than long-term residents of the host country (Sakala, 1987; Cowie, Field, & Enarson, 2002). Providing health care to the growing number of immigrants, especially in big cities, can also be a problem (Wakabayashi, 1990). Children of immigrants face the task of balancing old and new worlds, a tension that, albeit relatively poorly studied, may affect health (Hernandez, 1999). Many immigrants to the US lack insurance coverage, face language and cultural barriers to medical care, and fear that encounters with public authorities, including health care providers, may lead to legal problems including deportation (Morales et al., 2002; Smith, 2001).

In the US (and other industrialized countries with a low birth rate), immigration has been an important source of population growth and contributed to prosperity (Tienda, 2002). In some cases however, this influx of immigrants to cities in search of jobs and

services has taxed available infrastructure including transportation, housing, food, water, sewage, jobs, and health care (Denton, Gafni, & Spencer, 2002). Over-taxed sanitary systems directly may lead to rapid spread of disease in cities as has been the case many times in North America during the past century and as continues to be the case in the developing world today (Ezcurra & Mazari-hiriart, 1996; Gutierrez et al., 1996; Lesne, 1998). Also, the population strain on available jobs may result in falling wages, higher unemployment, or other declines in socio-economic status for persons previously living in a given city; these factors have frequently been associated with poor health (Lin, Rogot, Johnson, Sorlie, & Arias, 2003). Immigration has also been associated with widening income disparities in cities (Slotte & Hayes, 1987). In some cities, immigration has become a contentious political issue, leading to conflict over public resources, including health care (The Atlantic Monthly, 1996).

Suburbanization

Suburbanization, or the movement of people from city center to surrounding areas, has been one of the hallmarks of growing urban areas in wealthy countries over the past 50 years. For example, between the 1940s and the 1990s, millions of middle class Americans left cities for the surrounding suburbs (Dreier, Mollenkopf, & Swanstrom, 2001). This migration led to dramatic reductions in population size, density, diversity and resources in many cities. The population of Cleveland, Ohio, for example decreased from 915,000 people in 1950 to fewer than 500,000 in 2000 (Dreier et al., 2001). These changes had substantial implications. Even though Cleveland now has 400,000 fewer people (and a smaller tax base) than it did 40 years ago, mostly poorer than before, it still has to maintain the same streets, sewers and water lines (Dreier et al., 2001). The exodus also deprived cities of many of the people who had been civic leaders, depleting urban social capital. As conditions in inner cities further deteriorated in the 1970s and 1980s, many middle class minorities also left, making it even harder for these communities to cope with changing economic and social circumstances (Wilson, 1987, 1996). Residential suburbanization supported a parallel movement of jobs. Lower land costs and an educated workforce encourage some employers to move, reducing job opportunities in the city (Altshuler, Morrill, Wolman, & Mitchell, 1999). Suburbanization also put new demands on the physical environment—factories once confined to urban industrial zones now polluted wider areas, new highways increased automobile traffic and pollution, and new housing reduced the amount of open space and tree cover that had surrounded cities (Frumkin, 2002). The evolution of large areas of urban development extending well beyond the traditional metropolitan boundaries has

been referred to as “urban sprawl” and associated with a number of problems including increased pollution, changing exercise patterns, and poor water quality (Frumkin, 2002).

As people move between cities and suburbs so do health and social problems. In the last two decades, for example, problems such as HIV infection, tuberculosis, drug use and violence (Wallace & Wallace, 1993, 1997; Wallace, 2001) have moved both within and between metropolitan regions. During the period of tuberculosis (TB) resurgence in New York, the TB incidence rates in suburban counties were associated with the proportion of residents commuting to the city, as well as with the county’s population density and poverty rate (Wallace, 2001). Various urban lifestyles spread first from city to suburb and then to the country as a whole. For example, heroin, crack and HIV infection first spread in urban sub-populations in the 1970s and 1980s, but were then disseminated throughout the country. On a more positive note, consumption of tropical fruits and vegetables, and exercise trends, starting in big cities, have also now proliferated throughout the country (Popkin, 2001; United States Department of Agriculture, 2002).

Changing role of government

National trends in the role of government affect the financial and political support that municipal governments can mobilize to confront new threats to health. For example, from the Depression through the 1970s, the US federal government played a growing role in improving urban conditions (Buenker, 1973; Gelfan, 1975). It supported urban economic development, created safety net programs to protect vulnerable populations, contributed to the construction of urban infrastructures for water, sanitation, and sewage and subsidized an increasing portion of municipal budgets (Melosi, 2000; Halpern, 1995; Gelfan, 1975; Kessner & Fiorello, 1989).

This federal involvement in urban conditions changed dramatically in the mid-1970s in many countries. For example, in 1975, as New York City was hit by its worst fiscal crisis of the century, the city cut funds for the Department of Health by 25% and staffing by 30%, laid off all narcotics detectives, and closed firehouses and TB control programs (Tabb, 1982). The federal government did not provide help to the city in what is still considered, to this day, the most difficult period in New York City’s modern history (Tabb, 1982). Some health researchers argue that these government decisions contributed to the resurgence of TB in the late 1970s and to the rapid spread of HIV infection and crack addiction among the city’s most vulnerable populations (Brudney & Dobney, 1991; Wallace & Wallace, 1991).

In the decades since, public resources available to meet needs in cities have declined further. In 1978, the

federal government was the source of 15% of municipal revenues in the US; this contribution had fallen to 3% by 1999 (Dreier et al., 2001). In the last 25 years, more government functions have devolved to state and local governments; taxes have been cut at the federal, state and local levels, some environmental and consumer regulations have been loosened, and many previously public services (e.g. sanitation, water, health care) have been privatized (Katz, 1989; Gans, 1995). This devolution of responsibility to lower levels of government has contributed to underfunded social and public health systems failing to meet emerging health threats. For example, limited regulation of municipal water supplies has been considered at least in part responsible for water-borne disease outbreaks in different North American cities (Krewski et al., 2002; Corso et al., 2003; Garrett, 2001). Fire station closings in New York City have been associated with an increase in significant structural fires in the City (Wallace & Wallace, 1999).

Globalization

Globalization describes the increased mobility of goods, services, labor, technology and capital throughout the world (Berlinguer, 1999). Although cities have always been connected to the global economy, beginning in the post World War II period, and accelerating in the 1990s, the economies of western countries became ever more dependent on international trade and more capable of moving capital from one part of the world to another (Scholte, 2000).

Globalization has affected the well-being of urban residents in several ways. The new mobility of capital has allowed corporations that had once been physically and politically tied to a place to move as the opportunity to reduce costs or increase profits emerged (Greider, 1997). Since many manufacturing corporations were located in or near cities, their departure led to reduced municipal revenues, unemployment and population loss. Combined with the losses of people and jobs to the suburbs, these changes had significant effects on some cities. For example, between 1975 and 1995 Detroit lost a third of its population but doubled its poverty rate (World Resources Institute, 1996). Also, in the first half of the 20th century, manufacturing jobs had attracted immigrants and provided a pathway out of poverty for many urban residents and sustained municipal tax bases and economies (Bluestone & Harrison, 1982; Wilson, 1987, 1996). Their loss contributed to urban unemployment and underemployment, poverty, and increasing racial and class segregation (Wilson, 1996; Jargowsky, 1997; Goldsmith & Blakely, 1992; Massey & Denton, 1993).

At the same time, a new urban economy of information and services emerged (Castells, 2000). On the one hand, cities continue to be the economic engine of many western economies and the focal point for global

interchanges of people, services, products and money (Standard and Poor's DRI Division, 1999, Norquist, 1998). On the other hand, the new economy creates relatively few high paying jobs and many low wage ones, contributing to economic inequality and poverty (Wilson, 1996).

This tension between better and poorer paying jobs has resulted in the growth of inequalities in many cities. Populations with high socio-economic status have had new opportunities to maintain their health using their higher levels of wealth and education. However, populations that lack the skills, networks, and education to succeed in the global economy become marginalized and increasingly have trouble meeting the needs for housing, education, and health care that contribute to well-being (Wilson, 1996; Katz 1989).

At the same time, however, all urban residents are increasingly faced with new global threats of infectious disease, terrorism, and other forms of political conflict. (Centers for Disease Control and Prevention, 2002; Garrett, 2001). Since most world travelers and commercial goods first enter the country through a city, urban residents are on the frontlines of global disease interchanges. Cities have long taken measures to protect their residents from "foreign" diseases (Markel, 1997; Rosner, 1995), but recent outbreaks of West Nile virus infections and Severe Acute Respiratory Syndrome (SARS) have shown how easily infectious diseases can spread in a world linked by travel and trade (Centers for Disease Control and Prevention, 2003).

Municipal level determinants

While recent national and international trends influence living conditions in cities directly, their impact is often mediated by a set of variables that we label *municipal level determinants* of health. Municipal level determinants of health (column 2 in Fig. 1) include all activities of government, markets, and the actions of civil society. Each of these spheres is influenced by enduring structures and global and national trends but operates and affects health at the municipal level. Thus, for example, local government policies on housing, the housing market, citizen action on housing conditions and local lead poisoning control programs interact to influence rates of lead poisoning in a particular city. Here we examine how municipal government, markets and civil society may influence the health of urban populations.

Municipal government

Municipal government influences the health of urban populations by providing services, regulating activities that affect health, and setting the parameters for urban development. Municipal governments have the capacity to modify the urban physical and social environments

and to deliver or oversee the delivery of public health, health care and social services. Government activities in many sectors affect health, including those in public education, public transportation, recreation, public safety, criminal justice, welfare, housing, and employment. While these municipal services are strongly influenced by state and federal government policies, implementation often rests at the local level.

Public transportation and local regulation of private transportation offers one example of how municipal services in non-health arenas can affect health. Public transportation reduces air pollution and facilitates population mobility in densely populated urban areas, increasing access to employment, health care or stores that sell fresh foods and vegetables. Lack of transportation has been identified as one determinant of low employment levels in inner cities (Wilson, 1996). Effective traffic management reduces automobile injuries and deaths and speeds the delivery of emergency medical services. Studies show that more densely populated cities have worse cardiovascular survival, perhaps due to the longer response times of emergency medical and fire services trying to reach persons after unexpected cardiac events (Lombardi, Gallagher, & Gennis, 1994).

Other examples that illustrate the role of municipal government in health include the resurgence of TB in New York and other cities in the 1980s (Brudney & Dobney, 1991) related in part to the establishment of crowded poorly ventilated homeless shelters and jails and the outbreak of cryptosporidium-related diarrhea in Milwaukee in 1993 that sickened 200,000 residents after a breakdown in the water filtration system (Garrett, 2003).

Markets

As a method of allocating scarce resources, markets are a quintessentially urban form (Mumford, 1961). Today, local, national and global markets play a central role in shaping the conditions that determine the health of urban populations. Markets allocate housing, food, employment opportunities, medical care, and transportation and, due to privatization, increasingly play a role in education, public safety, and others sectors previously confined to the public realm (Seidenstat, 1999).

A brief examination of housing provides an example of the importance of markets to the health of urban populations. Despite an unprecedented period of economic prosperity in the 1990s, the number of people who were homeless actually increased during that period in the US (National Coalition for the Homeless, 2002). For example, New York City, which led the 1990s' national prosperity in the US, had a shortage of 250,000–500,000 housing units at the end of the decade (Coalition for the Homeless, 2002). While homelessness has many determinants, most observers agree that the

fundamental cause of the increase in homelessness was a decreasing supply of affordable low-income housing (Foscarinis, 1991). Housing investors made higher profits in high and middle income housing markets, government reduced support for subsidized housing, and the housing market was unable to meet this pressing demand, placing hundreds of thousands of mostly urban residents at risk for homelessness. Homelessness has been associated with a variety of adverse health outcomes (Brickner & Scallan, 1986).

Markets can also affect the health of middle and upper income residents (as well as low-income groups) by making unhealthy products too available. The epidemic of obesity (Nestle, 2002), easy access to tobacco, guns and alcohol (Ashe, Jernigan, Kline, & Galaz, 2003), or the rapid spread of polluting, roll-over prone sport utility vehicles (Bradsher, 2002) in upscale urban neighborhoods demonstrate that market “successes” can be public health failures.

Civil society

Civil (or civic) society defines the space not controlled by government or the market where residents interact to achieve common goals. Related concepts include social capital, social cohesion, social support, community capacity and community competence (Freudenberg et al., 1995). Several participants in civil society influence the health of urban populations. For example, community-based organizations such as neighborhood associations and tenant groups provide services, mobilize populations, and advocate for resources. Community-based organizations (CBOs) have a long history of working to improve urban living conditions (Halpern, 1995). In the 1960s and 1970s, sometimes with government support, urban CBOs promoted economic development, established health centers, advocated for improved public education, and built new housing (Halpern, 1995). In the 1980s and 1990s, CBOs were at the forefront of the struggle against the AIDS epidemic, playing a key role in health education, linking people to services, and encouraging policy change (Freudenberg & Zimmerman, 1995).

Churches and faith-based organizations offer social support, safe space and political leadership (Lincoln & Mamiya, 1990; Thomas, Quinn, Billingley, & Caldwell, 1994). In the last half of the 20th century, new social movements emerged, many with roots in urban communities (Larana, Johnson, & Gusfield, 1994). The civil rights, women's, environmental, and gay rights movements each took on health issues, and their accomplishments contributed to higher levels of political participation, improved health care, reduced discrimination, and stronger environmental protection (Kramer, 1989; Zald & McCarthy, 1986). While some of these movements eventually developed a national perspective,

their origins and their most successful actions were usually in cities (Shepard & Hayduk, 2002).

Urban living conditions

Urban living conditions (column 4) describe the characteristics that shape the day-to-day life of urban residents. In our view they are the primary determinants of the health of urban residents. They include population characteristics such as individual behavior and demographics (e.g., socioeconomic status and race/ethnicity), the urban physical environment (e.g., housing stock, pollution levels, parkland), the social environment (e.g., social networks, community organization), and the service system, which either meets or fails to meet various needs. These urban characteristics can be viewed as both the “pre-existing conditions” which public health interventions seek to change, and intermediate outcomes, the pathways by which interventions lead to improvements in health. We focus here on four such characteristics of urban life that are especially important to health: the people who live there, the physical and the social environments in which they live, and the array of health and social services that are available.

Population

Changes in the characteristics of urban populations can influence health in two ways. First, changing population characteristics can create unique patterns of vulnerability. Cities today generally have higher concentrations of poor people, people of color, and recent immigrants compared to non-urban areas (Bureau of the Census, 2001, 2002), contributing to the higher prevalence of poverty-associated diseases. More millionaires also live in urban than in non-urban areas, contributing to greater income disparities in cities that have been associated with adverse health outcomes (Blakely, Lochner, & Kawachi, 2002). Second, changes in the knowledge, skills, culture or behavior of people living in cities can also influence health. For example, as urban middle class residents join fitness centers, they increase their own levels of physical activity and set an example for other groups to follow (Managed Care Interface Stats & facts, 2000).

Although urban and non-urban residents differ, it is important to acknowledge that these differences are not inherent within individuals; i.e., there is no urban genotype. Rather, social processes such as immigration and suburbanization have distributed people into various urban and non-urban settings. Similarly, other social processes, e.g. racial discrimination, housing markets, and access to higher education, sort urban residents into different communities and social strata. Within these niches, the inherent characteristics of individuals interact with the particular social and

physical environment to produce an “urban phenotype.” Biological and social markers of the “urban phenotype” might include immunity to prevalent infectious diseases, psychological distress related to the quality of the living environment, and membership in several social networks (including the potential for drug using and sexual networks and gangs, as well as a variety of civic and social clubs). Ultimately these characteristics of urban residents interact with other dimensions of urban living conditions discussed here to shape the health of urban populations.

The physical environment

The urban physical environment includes the built environment, the air city dwellers breathe, the water they drink and bathe in, the indoor and outdoor noise they hear, the parkland inside and surrounding the city, and the geological and climate conditions of the site where the city is located. What distinguished the twentieth century from previous ones and cities from non-urban areas in part is the degree to which humans have become the primary influence on the physical environment (McNeill, 2000).

The human built environment includes housing, which can influence both physical and mental health, including asthma and other respiratory conditions, injuries, psychological distress, and child development (Krieger & Higgins, 2002; Northridge, Sclar, & Biswas, 2003; Evans & Stoddart, 2003). Urban design may also influence crime and violence rates (Newman, 1986; Sampson, Raudenbush, & Earls, 1997), demonstrating the close interactions among urban physical and social environments.

Highways and streets can pollute water through runoff, destroy green space, influence motor vehicle use and accident rates, and contribute to the urban heat sink, absorption of heat that can increase the temperature in cities by several degrees. The urban infrastructure is also part of the physical environment and determines how a city provides water, disposes of garbage and provides energy (Melosi, 2000). As this expensive infrastructure ages in a period of declining municipal resources, breakdowns may increase, causing health problems related to water, sewage, or disposal of solid waste (Garrett, 2001). Depending on their construction, city structures like bridges and skyscrapers may be vulnerable to natural or human-made disasters, as the September 11, 2001 terrorist attacks on New York City demonstrated.

In the first half of the twentieth century, air pollution in the US increased steadily as industrialization progressed, industries and homes used coal for power and heat, and automobiles proliferated. Cities had the worst pollution (McNeill, 2000). In the second half of the century, however, and especially in the last 25 years, many forms of pollution decreased as coal was phased

out, manufacturing plants moved to the suburbs or abroad, lead was banned from gasoline, and the automobile industry was forced to build cleaner cars. Despite these advances, however, as late as the mid-1990s, researchers estimated that urban air pollution contributed to 30,000–60,000 deaths per year in the US (Dockery et al., 1993; Samet, Dominici, Currenro, Coursac, & Zeger, 2000). Many developing world nations face growing urban pollution as they industrialize.

Other threats to health include hazardous waste landfills, often located in or near urban areas, which may be associated with risks of low birth weight, birth defects, and cancers (Vrijheid, 2000). Noise exposure, a common urban problem, may contribute to hearing impairment, hypertension, and ischemic heart disease (Passchier-Vermeer & Passchier, 2000).

The social environment

The social environment describes the structure and characteristics of relationships among people within a community. Components of the social environment include social networks, social capital, segregation, and the social support that interpersonal interactions provide. Comprehensive definitions of many of these factors are given elsewhere (see Berkman & Kawachi, 2000). A city's social environment can both support or damage health through a variety of pathways (Leviton, Snell, & McGinnis, 2000; Freudenberg, 2000a; Geronimus, 2000). For example, social norms in densely populated urban areas can support individual or group behaviors that affect health (e.g. smoking, diet, exercise, sexual behavior) (King et al., 2003). Social supports can buffer the impact of daily stressors, and provide access to goods and services that influence health (e.g., housing, food, informal health care). (Berkman, Glass, Brissette, & Seeman, 2000).

Many cities are characterized by substantial racial/ethnic diversity. This diversity has the potential both to enhance health (e.g. broaden social support) and to damage it (e.g., a breakdown in traditional values on drug or sexual behavior). Overall racial diversity may simply mask increased racial segregation that has been associated with poor health outcomes (Acevedo-Garcia, Lochner, Osypuk, & Subramanian, 2003; Williams, 1999). Between 1980 and 2000, segregation of African-Americans in the US declined, but levels were still highest for Blacks and several measures of the segregation of Hispanics and Asians increased (Iceland, Weinberg, & Steinmetz, 2002).

Ultimately, the variety of social settings available within cities also can positively influence the well-being of many city residents. The individual who may be regarded as deviant in a homogeneous community can find others with similar characteristics in a more diverse setting.

Health and social services

Cities are characterized by a rich array of health and social services (Casey, Thiede Call, & Klingner, 2001; Felt-Lisk, McHugh, & Howell, 2002). Even the poorest urban neighborhood often has dozens of social agencies, each with a distinct mission and service package. Many of the inner city health successes of the last two decades, including, reductions in HIV transmission, teen pregnancy rates, TB control, and new cases of childhood lead poisoning, have depended in part on the efforts of these groups (Freudenberg et al., 2000).

On the other hand, low-income urban residents continue to face significant obstacles in finding health care. First, low-income people, Blacks and Latinos, over-represented in urban areas, are more likely to lack health insurance coverage (Williams & Rucker, 2000). In turn, uninsured persons face barriers to care, receive poorer quality care, and are more likely to use emergency systems (Merzel, 2000). Recent immigrants, homeless people, inmates released from jail or prison, all disproportionately represented in urban areas, also face specific obstacles in obtaining health care. In turn, these populations put a burden on health systems not adequately funded or prepared to care for them.

Social services for disadvantaged or marginalized populations are often susceptible to changing municipal fiscal realities with the resultant decrease in service frequently coinciding with times of greater need in the urban population (Felt-Lisk et al., 2002). In the past few years, for example, the decline in the national economy and tax revenues has forced many cities and states to reduce services at the very time unemployment, homelessness, and hunger are increasing (National League of Cities, 2003).

Many cities are characterized by sharp disparities in wealth between relatively proximate neighborhoods (Wilkinson, 1997). These disparities are often associated with disparities in quality of care (Andrulis, 2000). The presence of well-equipped, lucrative, practice opportunities in the same city decrease the likelihood that service providers will work in lower paid, public service clinics, particularly when these latter services face limited resources and wavering political commitment.

Public health interventions and research

Although interventions are at the center of our interest as public health researchers (and in column 3 in the center of the framework presented in Fig. 1), only after considering the range of factors that influence urban living conditions can we profitably turn our attention to how public health interventions may shape health in cities. It should be noted that organized public health intervenes both to change urban living conditions (column 4) and to modify municipal level determinants of health (column 2).

Public health interventions have used various strategies to promote health and prevent disease among urban populations (Freudenberg, 2000b). These include strategies to modify individuals, usually by education to change risk behavior, to alter social environments by providing increased social support, enhancing social networks, or changing social norms, to change physical environments by improving housing, regulating pollution, or promoting new approaches to urban planning, and to modify health and social services by increasing access, offering enhanced services, training providers, or improving the quality of care. A recent review of published reports on health interventions designed to reduce selected health problems in US cities found that the first and last strategies, changing individuals and health care services, were the most frequently used methods and that few interventions intervened on more than one or two levels (Freudenberg et al., 2000). The framework we propose here (Fig. 1) suggests that interventions to improve health are more likely to be effective if they recognize and address the range of determinants of urban living conditions.

Finally, we note that both *health and non-health outcomes* (column 5) represent the endpoint of public health attention. Including non-health outcomes allows interventionists and researchers to specify the broader contributions of public health. Improving housing in low-income urban neighborhoods, for example, may lead not only to less lead poisoning but also to increased neighborhood stability, reduced crime, and improved economic development, allowing planners, policy makers and residents to have a more accurate and comprehensive picture of the costs and benefits of various solutions.

Using the framework

The framework we propose makes two principal contributions to our thinking about key issues in the health of urban populations. In discussing how factors such as global trends and municipal factors affect the social and physical environments that proximally define the urban context, this framework places the health of urban populations within the larger regional, national, and global context. This framework then illustrates how the health of urban populations, rather than being only a product of local forces (such as, for example, the built physical environment), inevitably reflects larger processes. In recognizing that there are multiple determinants of the health of urban populations, our framework adds to the growing study of population health as a distinct field that incorporates considerations ranging from the broader economic context to individual behavior and genetics as potential determinants of the health of populations (Kindig & Stoddart, 2003). In so

doing, this framework suggests that some influences on urban health may have broad applicability around the world. For example, the framework suggests that policy makers in both developed and developing nations need to consider the health impact of policies designed either to promote, or discourage, suburbanization.

Second, the framework we propose allows the researcher or practitioner to narrow the focus to specific areas or to broaden the focus toward more general perspectives. For example, we can consider the question of how mass transit systems affect health. Our framework allows one level of analysis relating to the congestion and confinement of people in subways where the risk of air-borne transmission of infectious diseases, dispersion of bio-terror agents, commission of violent crime, or emission of debilitating noise can affect people across racial, ethnic, income and neighborhood boundaries. This approach considers the health effects of unique urban features. Alternatively, investigators could work on another level, examining municipal determinants (e.g., how the mass transit system is managed and financed, local incentives and penalties for automobile use), and national trends (e.g., declining federal support for cities and mass transit). Each level of analysis suggests directions for intervention to improve health.

A second example examines how food affects the health of urban populations. Food availability depends on international distribution systems, tariffs, and trade routes. Global trends in liberalization or restriction of trade then affect movement of food between countries and markets. Within cities, efficacy of food inspection mechanisms depends to a large extent on municipal policies and resources made available for regular food inspections. In turn, food intake has been shown to differ between neighborhoods within cities (Diez-Roux et al., 1999). Therefore, factors at multiple levels all ultimately affect food choices in cities and contribute to health or disease. Researchers studying the issue of how food affects health in urban areas can consider global and national levels, municipal levels, and inter-neighborhood variability, as they are related to the risk for heart disease, cancer, obesity, or chronic hunger within cities. Findings can guide national or state food policies, municipal-level interventions, or community campaigns.

By providing researchers with a framework that outlines a set of variables that may influence the health of urban populations, we hope to facilitate discussion toward achieving a more consistent body of literature that can guide research and practice. By including variables of interest to epidemiologists, clinicians, political scientists, sociologists, anthropologists, geographers, urban planners and architects, to name a few, the model suggests the potential for synthesizing findings across relevant disciplines. Finally, by proposing that cities influence health by exposing their residents to a set of conditions that can be compared in different time

frames and places, the model points towards a more unified and useable guide to intervention.

Conclusions

In this paper we have focused on the US experience as the source of most of our observations about the determinants of health in cities. While we think that there is much to be gained by considering the US experience, it is worth emphasizing that the relative importance of characteristics of the urban environment that may affect health may vary substantially in different cities and in different parts of the world. For example, in many rapidly growing urban areas, the provision of safe water and sanitation is likely to account for a greater proportion of the morbidity and mortality in a specific city than are all the other factors identified here. As cities become more established, an aging physical infrastructure and strains on health and social services can both influence health behaviors and access to resources. Many of these international differences of necessity are substantially simplified in the framework. Different enduring structures, for example, can make for critical differences in the substance and style of municipal governance, with implications for public health practice, characteristics of cities, and health. In addition, the course of urbanization in different cities worldwide may have different implications for health. A newly urbanizing city is likely to be under different, and probably more substantial, strains than is a long-established urban area. Therefore, when applying the proposed framework to a consideration of how cities may affect health it is important for the public health researcher or practitioner to consider both place, i.e., the particulars of a given city, and time, i.e., the trajectory of urbanization in a particular city. There are no simple solutions that can summarize the relations between the different factors that can affect health in different countries. Rather, specific investigations and interventions would benefit from a systematic assessment of relevant local and temporal contexts, which the framework proposed here can guide, in order to inform intervention efforts in a given urban area. We hope that this paper stimulates the development of other frameworks that may better reflect how the urban context shapes health across countries and continents.

We conclude with a few observations. First, cities continue to grow and a majority of people in both developed and developing nations will be living in urban areas throughout the 21st century (United Nations Populations Division, 2002). Second, although some estimates of the prevalence of various health conditions suggest that the burden of disease in cities is greater than that in non-urban areas, this has not always been the

case historically and is certainly not a consistent observation across cities and diseases today (Judd et al., 2002). Similarly, although academic discourse often assumes that cities have a deleterious effect on health, there are also many positive and health-enhancing aspects of cities and the urban context. Third, in order to understand urban health we must shift our focus of inquiry away from disease outcomes toward urban exposures, namely, the characteristics of the urban context that influence health and well-being in cities. Fourth, the study of urban health must acknowledge the reality of complexity. There are no simple solutions, no magic bullets for the multidimensional health problems facing cities today. This complexity can itself cause or exacerbate problems, where a response to one part of a problem can precipitate an accident or disastrous unintended consequences (Perrow, 1999). Approaches that recognize the importance of studying interactions at multiple levels are a useful tool for the study of urban health (Diez-Roux, 2000; Vlahov & Galea, 2003). Fifth, many disciplines need to contribute to the study of cities. New methodologies in epidemiology, geography, and the quantitative social sciences, insights from anthropologists, psychologists and historians, and the technical contributions of engineers, architects, and urban planners are among the strands that will contribute to a science of urban health.

In this paper we have argued that enduring structures, global and national trends, municipal determinants and the urban living conditions within different communities interact to create unique patterns of health and disease. While urban health research to date has focused on describing the health-related characteristics of various urban populations and comparing them to non-urban ones, this necessary task is not sufficient. We hope that the framework presented here provides a basis for developing an agenda for scholarship and interventions toward improved health in cities.

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