

## Social Environment and Physical activity: A review of concepts and evidence

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### Abstract

The rapidly growing and evolving literature on the social environment and its influence on health outcomes currently lacks a clear taxonomy of dimensions of the social environment and the differing mechanisms through which each influences health-related behavior. This paper identifies five dimensions of the social environment—social support and social networks, socioeconomic position and income inequality, racial discrimination, social cohesion and social capital, and neighborhood factors—and considers each in the context of physical activity to illustrate important differences between them. Increasing the specificity of terminology and methods in social environmental research on health will enable more systematic inquiry and accelerate the rate of scientific discovery in this important area.

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### Introduction

Links between environmental conditions and health-related behaviors have long been recognized in social and behavioral science models and theories (Bandura, 1986; McLeroy, Bibeau, Steckler, & Glanz, 1988), and generally supported by empirical evidence. Historically, much of this research focused on aspects of the physical environment. However, in 1976 Cassel suggested that other factors in our surroundings, “certain aspects of the social environment,” also had an impact on health (Cassel, 1976). The influence of social factors is now widely

recognized in health behavior research (Emmons, 2000) and formally recognized by federal health agencies as an important determinant of health (U.S. Department of Health and Human Services, 1996). Although there is no definition of “social environment” that is universally agreed upon by social scientists, the social environment in which individuals live influences behavior by “shaping norms, enforcing patterns of social control, providing or not providing environmental opportunities to engage in particular behaviors, reducing or producing stress, and placing constraints on individual choice” (Institute of Medicine, 2003).

Most health outcomes and behaviors are socially patterned or distributed in society, negatively impacting those that live in resource-deficient social and physical environments (Berkman & Kawachi, 2000a). Individuals that live in these environments

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are at increased risk of engaging in unhealthy behaviors, such as physical inactivity, often as a response to stressful and hazardous environments (Geronimus, 2000; King, 1997). Physical inactivity is a growing public health problem associated with increased risk for heart disease, diabetes, high blood pressure, obesity, and some cancers (U.S. Department of Health and Human Services, 1996). Several psychosocial, cognitive, and emotional factors have been identified that help to explain why some people are active and others are inactive (Sherwood & Jeffery, 2000). However, in addition to selected individual factors, the social, economic, political, and physical environments in which individuals live also play important roles in health outcomes and behaviors. There is broad agreement that effective public health approaches to promoting physical activity must address modifiable social environmental factors that can support behavior change (Schmid, Pratt, & Howze, 1995), and there have been increasing efforts to understand the relative influence of each on physical activity (Giles-Corti & Donovan, 2003). Greater attention to social environmental factors is a necessary next step in research on physical activity. It is a behavior that is inherently shaped by one's social environment in that most activity occurs within the bounds of families, communities, and neighborhoods (Li et al., 2005). Advising individuals to be more physically active without considering social norms for activity, resources and opportunities for engaging in physical activity, and environmental constraints such as crime, traffic or unpleasant surroundings, is unlikely to produce behavior change. Physical activity research has tended to focus on individual-level factors, partly due to the complexity of addressing social and structural determinants of health (Smedley, 2000); however, there is an increased emphasis on the role of social and physical environmental contexts as key modifiable determinants of physical activity.

Social cognitive theory (Bandura, 1986) and other social ecological and contextual models (McLeroy et al., 1988; Sorenson et al., 2003; Stokols, 1992) illustrate the interactive relationship between individuals and environments, and emphasize the need to address behavior at multiple levels of influence. A main premise of these theories and models is that environmental factors and individual factors simultaneously shape behavior. Social environmental characteristics can influence health and behavior directly or indirectly through mediating

mechanisms, and these mechanisms likely differ for distinct outcomes. For instance, having supportive social relationships can reduce the probability of individuals adopting unhealthy behaviors by minimizing the impact of daily stressors or stressful events (Berkman & Glass, 2000; Heaney & Israel, 1997). At the same time, social inequalities, such as the unequal distribution of income, can influence health via differential exposure to carcinogens and pathogens, decreased access to healthcare and health facilities, and increased exposure to stressful events (Adler, 2001).

In as much as different mechanisms have been proposed for different social environmental characteristics and health outcomes, the rapidly growing and evolving literature on social environmental characteristics and health currently lacks a taxonomy to help make these important distinctions. Consequently, what is meant by "social environment" can vary considerably from one study to the next, making it difficult to build and interpret a base of evidence. Toward this end, we sought to identify aspects of the social environment that were: (1) commonly studied or cited in the research literature, (2) empirically or theoretically associated with physical activity, and (3) amenable to change through structural or health promotion interventions. We identified three broad overarching categories that represent five social environmental dimensions. These dimensions are not intended to be exhaustive, but represent the most commonly studied "social determinants" or "social factors" cited in the research literature. Broadly, they include: *interpersonal relationships* (e.g., social support and social networks), *social inequalities* (e.g. socioeconomic position and income inequality, racial discrimination), and *neighborhood and community characteristics* (e.g., social cohesion and social capital, neighborhood factors) (Berkman & Kawachi, 2000b; Brennan, Baker, Haire-Joshu, & Brownson, 2003; Faresjo, 1992; Institute of Medicine, 2001; Kaplan, 1999; Stokols, 1992; Yen & Syme, 1999). We readily acknowledge that these dimensions at times overlap and operate at multiple levels; however, this highlights the interconnectedness among many of these dimensions and their shared influence on behavior. Next, we discuss the pathways through which these dimensions may influence physical activity. To date, there have been many proposed hypotheses put forth for how social environmental characteristics influence health and behavior (see Table 1). This paper will illuminate

Table 1  
Social environment dimensions, descriptions and key elements, and mechanisms by which they influence behavior

Dimension	Description/key elements	Mechanism
Social support and social networks	The presence and nature of interpersonal relationships and interactions; extent to which one is interconnected and embedded in a community; interpersonal level characteristic	Enables or constrains the adoption of health-promoting behaviors; provides access to resources and material goods; provides individual and community coping responses; buffers negative health outcomes; and restricts contact to infectious diseases
Socioeconomic position (SEP) and Income Inequality (II)	<i>SEP</i> : Reflects one's social standing in society; commonly measured using educational attainment, occupation, and individual income <i>II</i> : Reflects the unequal distribution of income; signifies the gap between the rich and poor	<i>SEP</i> : Increases biological stress and subsequently adverse health; reduces accumulation of and access to material resources that can protect against stress. <i>II</i> : Creates less socially cohesive communities through disinvestments in social capital; reduces social spending on programs and services; and increases psychosocial conditions (e.g., frustration, social comparison)
Racial discrimination	Interpersonal or institutional bias that results in psychological harm; limits opportunities for advancement	Produces economic and social deprivation; increases exposure to harmful substances; and creates psychological trauma. Inadequate healthcare and targeting of harmful substances to marginalized groups is also a byproduct of racial discrimination
Neighborhood factors	Also described as neighborhood deprivation; represents independent environmental factors of "place" rather than the aggregation of individuals living in an area	Exposure to harmful elements of the physical environment (e.g., water quality), availability of health, social, and community support services, community reputation and other historical and cultural features
Social cohesion and social capital	Extent of connectedness and solidarity among groups; shared resources that allow people to act together; area or community-level characteristic	Ability to enforce and/or reinforce group or social norms for positive health behaviors; provision of tangible support (e.g., transportation)

mechanisms specific to physical activity, allowing us to better understand how social environmental factors exert their effects on activity behavior. Following this, we discuss conceptual and methodological challenges posed when investigating environmental effects. We conclude with suggested research and intervention opportunities for social epidemiologists and intervention researchers interested in physical activity.

### Interpersonal relationships

Social interactions and interpersonal relationships are an important aspect of the social environment, such that "the degree to which an individual is interconnected and embedded in a community—is vital to an individual's health and well-being..." (Berkman & Glass, 2000). Social support and social networks are two common indicators of interpersonal relationships, respectively describing their com-

position and structure (Berkman & Glass, 2000; Heaney & Israel, 1997).

### Social support and social networks

Social support has been broadly defined as resources provided by other persons (Cohen & Syme, 1985), and social networks refer to the collective structure of social relationships that surround an individual, and provide information on how an individual is integrated with others (Institute of Medicine, 2001). The Task Force on Community Preventive Service's recent review of physical activity interventions found strong evidence that social support interventions increase physical activity levels and that "buddy systems," walking groups, and exercise contracts with another person can increase time spent engaging in physical activity and frequency of exercise (Kahn et al., 2002). Studies have also shown that having a spouse

and/or supportive family and friends are positively associated with increased physical activity (Eyler et al., 1999; Sallis, Hovell, & Hofstetter, 1992; Sternfeld, Ainsworth, & Quesenberry, 1999). Fewer studies have been published empirically linking social networks and physical activity. Reported findings show that select social network characteristics such as number of individuals in the network, frequency of contact, and network homogeneity are positively associated with energy expenditure and exercise adherence (Gillett, 1988; Spanier & Allison, 2001), but additional studies exploring these social network characteristics are needed.

#### *Mechanisms through which social support and social networks may influence physical activity*

Interpersonal relationships may influence physical activity by providing social support and establishing social norms that constrain or enable health-promoting behaviors (Berkman, 2000; Heaney & Israel, 1997). For example, engaging in physical activity with others can help to establish positive social norms for physical activity among an individual's social network. Observing the physical activity behavior of others can also help individuals learn about physical activity, in addition to receiving positive feedback about the benefits of physical activity (Stahl et al., 2001). Through social networks individuals form a sense of attachment and connectedness to one another providing access to resources and material goods that support physical activity (e.g., provision of child care services). Also, social network membership, be it among individuals or organizations, provides coping resources that can promote physical activity participation such as access to physical activity trainers, assistance with starting a physical activity program, or political lobbying for improvement of existing physical activity facilities and resources, such as parks and sidewalks.

#### **Social Inequality**

It is well established that the health status of individuals and communities tends to improve with increasing social and economic status (Institute of Medicine, 2003; Lynch & Kaplan, 2000). From the landmark Whitehall studies which found health gradients based on occupational class (Marmot, Shipley, & Rose, 1984) to current health disparities research, social and health scientists have sought to

understand how social inequalities, or the unequal distribution of resources based on social status, influences health. This section examines three dimensions of social inequality: socioeconomic position, income inequality, and racial discrimination.

#### *Socioeconomic position and income inequality*

Socioeconomic position (SEP) reflects one's place in the social hierarchy and is associated with differential access to social and material resources (Williams & Collins, 2002). Common indicators of SEP include individual income, educational attainment, and occupational or job status (Adler & Newman, 2002; Lynch & Kaplan, 2000). The unequal distribution of income in society, or income inequality is defined as the "proportion of aggregated household income held by households whose income is below a specified centile on the distribution of household income" (i.e., 90th percentile) (Kaplan, Pamuk, Lynch, Cohen, & Balfour, 1996). It has been suggested that health outcomes depend not on absolute income such as poverty, but rather on equality or how resources are distributed in society (Auerbach & Krimgold, 2001).

Not only are individuals at the highest levels of income, education, and job classifications more likely to engage in healthy behaviors (e.g., reduced tobacco use, physical activity engagement proper diet) than those of lower job status and incomes (Lindstrom, Hanson, Wirfalt, & Ostergren, 2001; Lynch, Kaplan, & Salonen, 1997), they also tend to adopt more health-promoting behaviors and reduce riskier behaviors at a faster rate than the poor (Institute of Medicine, 2003). Most research has found a positive relationship between SEP and physical activity (Ford et al., 1991; Giles-Corti & Donovan, 2002; Jeffery, French, Forster, & Spry, 1991). Lower SEP individuals are more likely to report engaging in job-related physical activity and walking compared to higher SEP individuals who are more likely to report engaging in leisure-time physical activity and sport-related activity (Ford et al., 1991). A more limited but growing evidence base suggests a similar relationship between income inequality and health behaviors such as cigarette smoking and physical activity (Kaplan et al., 1996; Osler et al., 2002). Unequal distribution of physical activity resources (e.g., walking trails) in rich and poor neighborhoods is likely to influence opportunities for physical activity (Gorden-Larsen, Nelson, Page, & Popkin, 2006).

### *Mechanism through which SEP and income inequality may influence physical activity*

Though the mechanisms through which socio-economic position and income inequality influence health outcomes are not well understood, several studies have explored their relationship to physical activity. One common hypothesis centers around access to health care (Adler, Boyce, Chesney, Folkman, & Syme, 1993; Baum, Garofalo, & Yali, 1999). Research suggests that poverty reduces access to health care resources, which in turn results in poor health. By extension, those in poorer health are then less likely to be physically active than those in good health. However, access to health care explains only part of the difference in health status among various SEP groups (Adler, 2001; Wilkinson, 1999). A growing body of research is now exploring the role of biological stress as a potential pathway to negative health status (Auerbach & Krimgold, 2001; Kawachi, Subramanian, & Almeida-Fiho, 2002). Exemplifying stress as depression or living and working in stressful environments may also influence uptake of physical activity. Access to resources (Lynch, Smith, Kaplan, & House, 2000), such as physical activity facilities, and alternately, the differential possession of material resources that allow individuals to respond to adverse conditions have been proposed as potential mechanisms. For example, people with greater disposable incomes can obtain social and material resources (e.g., gym memberships) that maintain physical activity even in adverse weather conditions.

Proposed mechanisms through which *income inequality* may influence health and behavior, and physical activity specifically, include underinvestment in human capital, erosion of social capital, and psychological factors such as social comparisons. Income inequality is often marked by differential investment in social services (e.g., improvements in the built environment such as sidewalk maintenance), trust between neighbors, and tangible resources (e.g., availability of physical activity facilities). Urban neighborhoods, marked with reduced social spending on public parks, experienced a rise in the deterioration of these facilities and their subsequent use for illicit drug activity (Kelly, 1997). Furthermore, comparing one's social status to that of others may result in personal frustration and stress (Wilkinson, 2001), which may also lead to reduced physical activity. Much of the work in this area has examined the relationship

between income inequality and health at the level of states and cities; additional research is needed that looks at smaller social areas such as neighborhoods.

### *Racial discrimination*

Racial discrimination has emerged as an important determinant of racial/ethnic disparities in health (Gee, 2002; James, 2003). It is manifested in differential treatment that may be interpersonal, institutionalized, or both. Interpersonal discrimination refers to personally perceived bias that occurs between individuals whereas institutionalized discrimination refers to discriminatory policies or practices of organizations that result in differential access to resources and societal opportunities (Karlsen & Nazroo, 2002; Krieger, 2000), the latter of which has resulted in the economic and social deprivation of ethnic minorities (Nazroo, 2003; Williams, 1999).

The experience of racial discrimination can result in emotional distress that places individuals at greater risk for cardiovascular disease, and poor mental and physical health states (Williams, Neighbors, & Jackson, 2003). A recent review has documented the relationship between interpersonal racial discrimination and health behaviors (Williams et al., 2003), specifically cigarette smoking and alcohol use; people who experience racial discrimination are at increased risk of these behaviors (Guthrie, Young, Williams, Boyd, & Kintner, 2002; Landrine & Klonoff, 2000). We found no studies that have examined the relationship between interpersonal racial discrimination and physical activity. Much of the research on the effects of racial discrimination has been explored in terms of perceptions of interpersonal bias; however, institutional racism that is inherent in social structures persists. Historically, institutional racial discrimination has restricted access of some population subgroups to certain types of physical activity and activity venues such as golf courses and swimming pools. While such practices are today illegal, racial discrimination that is experienced through residential segregation may still influence the availability or pleasantness of physical activity resources such as access to parks and facilities. A recent study (Boslaugh, Luke, Brownson, Naleid, & Kreuter, 2004) found that African Americans living in segregated areas rated their neighborhoods as less pleasant for physical activity and having fewer

physical activity facilities compared to African Americans living in more diverse, less segregated areas. Though some facilities (i.e., athletic fields, tennis courts) do exist in segregated communities, there are often more facilities available in affluent neighborhoods (King et al., 1995; Macintyre, MacIver, & Sooman, 1993).

#### *Mechanism through which racial discrimination may influence physical activity*

Krieger (2000) identifies these potential mechanisms, among others, through which racial discrimination influences health: economic and social deprivation, increased exposure to toxic substances and hazardous conditions, and targeted marketing of legal and illegal drugs and substances. Each of these pathways undermines the adoption and maintenance of healthful behaviors. Economic and social deprivation reduces the ability of local governments to invest in health-promoting products and services such as parks (Ross & Mirowsky, 2001). Individuals that live in environments with hazardous conditions (e.g., high crime and neighborhood disorder) are also less likely to engage in physical activity (Seefeldt, Malina, & Clark, 2002), and the targeted marketing of legal and illegal drugs and substances in racially segregated neighborhoods influences unhealthy behaviors such as substance abuse and potentially physical inactivity.

#### **Neighborhood and Community Characteristics**

Macintyre, Ellaway, and Cummins (2002) asked, “Should we be focusing on places or people?,” raising the question of whether “place” has an independent effect on health. Researchers are trying to answer this question in community and neighborhood studies that control for individual-level factors that place people at risk for adverse health (Cohen et al., 2000; Pickett & Pearl, 2001; Sloggett & Joshi, 1994). This is a broad category representing many characteristics; however, the purpose of this paper is to introduce key concepts. Characteristics of the place in which one lives, such as social cohesion and social capital, and factors like neighborhood socioeconomic position are core social environmental factors that encapsulate neighborhood and community factors and that influence a myriad of health-related behaviors (Diez Roux, 2001; Macintyre & Ellaway, 2003).

#### *Social cohesion and social capital*

Research has shown that cohesive and socially integrated societies tend to experience better health outcomes (e.g., lower mortality rates and greater life expectancy) compared to less well-off societies (Wilkinson, 1996). Social cohesion, which is the “extent of connectedness and solidarity among groups in society” (Kawachi & Berkman, 2000), combined with the willingness to intervene for the common good, comprise a measure of collective efficacy (Sampson, Raudenbush, & Earls, 1997). Neighborhoods and communities that have shared beliefs and shared expectations for collective action are more able to mount collective responses to local problems such as public safety issues (Sampson et al., 1997). A related concept, social capital, is the “resources available to individuals and to society through social relationships” (Institute of Medicine, 2003; Kawachi et al., 2002), specifically social networks, norms of reciprocity, and trust that encourage people to act together to attain shared goals (Kreuter & Lezin, 2002; Putnam, 1996). Social capital may be a measure of the strength of social cohesion, such that socially cohesive societies are rich in social capital (Berkman, 2000; Institute of Medicine, 2003).

In the last six years alone, there has been a great deal of attention given to this notion of the social environment of neighborhoods, specifically on social capital research and scholarship. Several review articles have been written, each summarizing definitions from sociology, economics, political science, and public health (Berkman, 2000; Cattell, 2001; Edmondson, 2003; Hawe & Shiell, 2000; Kawachi & Berkman, 2000; Kreuter & Lezin, 2002; Kunitz, 2004; Portes, 1998; Shortt, 2004). Social capital, social cohesion, and collective efficacy appear to influence a broad spectrum of health-related behaviors ranging from criminal activity (Kennedy, Kawachi, Prothrow-Stith, Lochner, & Gupta, 1998; Sampson et al., 1997) and political participation (Putnam, 1993) to teenage pregnancy (Gold, Kennedy, Connell, & Kawachi, 2002). More recently, empirical evidence has been found for a relationship with physical activity. Lindstrom, Hanson, and Ostergren (2001) have conducted two studies on social capital and physical activity in Sweden. Both studies found a significant negative association between social participation (a dimension of social capital) and low leisure-time physical activity.

### *Mechanism by which social cohesion and social capital may influence physical activity*

According to Berkman and Kawachi (2000), communities with an abundance of social capital may be better able to reinforce positive social norms for health behaviors (e.g., physical activity) as well as enforce ordinances and laws restricting certain behaviors such as the selling illegal drugs or engaging in other illicit behaviors around parks, thus increasing a sense of safety in areas where individuals are likely to engage in physical activity. In addition, cohesive and trusting neighborhoods can influence behavior by appreciating shared collective goals, such as reduced neighborhood crime (Ross & Jang, 2000). Residents being actively involved in monitoring crime can help create safer environments for both youth and adults to engage in physical activity. Lastly, social capital may influence health through psychosocial processes like social support (Berkman & Kawachi, 2000b; Institute of Medicine, 2003). Neighbors that trust one another are more likely to provide help and support in time of need. Instrumental support, such as money to purchase appropriate walking shoes, could influence access to health-promoting services.

### *Neighborhood factors*

In the 1980s, sociologist William Julius Wilson argued that social and environmental factors, as well as lack of institutions and resources in neighborhoods contributed to poverty (Gephart, 1997; Wilson, 1987). Studies show that the social composition of areas can have a significant effect on health, even after controlling for individual-level factors such as income (Browning & Cagney, 2002; Diez Roux, 2001; Macintyre & Ellaway, 2003). Characteristics such as neighborhood socioeconomic position or deprivation, home ownership, presence or lack of neighborhood resources (i.e., grocery stores), and perception of crime (Kawachi & Berkman, 2003), are commonly measured neighborhood factors. Neighborhood factors are frequently assessed using area-level measures such as census tract variables or census tract variables aggregated to form an index such as the Townsend and Carstairs Index (e.g., percent unemployed, no access to car, and households not owner occupied) (Morris & Carstairs, 1991; Townsend, Phillimore, & Beattie, 1988).

Much of the research on the influence of neighborhoods on physical activity has focused on

the impact of the physical environment (e.g., traffic, sidewalks, facilities) on encouraging or limiting physical activity (Humpel, Owen, & Leslie, 2002; Huston, Evenson, Bors, & Gizlice, 2003; Saelens, Sallis, Black, & Chen, 2003). Fewer studies have evaluated social aspects of neighborhoods to determine if the neighborhood in which one lives has an independent effect on physical activity, controlling for the individuals who live there (Ross, 2000). Cubbin, Hadden, and Winkleby (2001) explored the independent contribution of neighborhood deprivation in understanding physical activity. Using the Townsend Index and controlling for individual SES, the authors found a positive association between neighborhood deprivation and physical inactivity among men and women of different racial/ethnic groups. Using a similar index of neighborhood deprivation, Sundquist, Malstrom, and Johansson (1999) found that individuals living in deprived areas were more likely to be physically inactive than those living affluent areas.

### *Mechanism through which neighborhood effects may influence physical activity*

Researchers are still trying to identify the mechanisms by which neighborhood factors influence health. Macintyre et al. (1993, 2002) identify several potential mechanisms that are applicable to physical activity. Features of the physical environment, such as poor air quality (e.g., smog) may inhibit physical activity. Likewise, the availability and accessibility of health and municipal services such as recreational facilities also limits opportunities for physical activity. Community support services, such as reduced daily school physical education or limited trash pick-up also serve as barriers to physical activity. Lastly, sociocultural neighborhood features such as social and cultural norms for physical activity may influence activity behavior. Although these mechanisms include physical attributes of neighborhoods, they also include social, cultural, and historical characteristics that are integral, yet often overlooked in neighborhood studies.

### **Challenges and advancements in measuring social environmental characteristics**

Recent papers have explored the measurement of environmental factors and their associations with physical activity (Baker, Brennan, Brownson, & Housemann, 2000; Cheadle et al., 1991). To discuss

all of the methodological challenges related to measuring each of the social environmental dimensions described would be beyond the scope of this paper; however, a brief discussion of measurement and methodological issues and advancements with respect to measuring social environmental factors is warranted.

The study of the influence of social environmental factors on health is currently limited by the use of area-level measures that are simply aggregates of individual responses. Macintyre et al. (1993) has suggested that future studies of community and neighborhood characteristics look directly at features of both the social and physical environments that might influence health, in addition to assessing individual-level factors. More recently, physical activity studies are directly examining features of neighborhoods themselves, such as presence or lack of resources (e.g., fitness facilities), elevated lead levels in playground soil, and transportation services—factors that are central to both the social and physical environments and amenable to change (Macintyre et al., 1993; Yen & Kaplan, 1999). Others have also suggested the need to include more objective or unobtrusive environmental measures such as environmental audits to objectively measure physical environmental characteristics (e.g., number of sidewalk segments) (Hoehner, Brennan Ramirez, Elliott, Handy, & Brownson, 2005). This is less prevalent for the measurement of social environmental factors. For example, Baker et al. (2000) suggest counting the number of community walking clubs or the number of schools that allow school facilities to be used outside of school hours as important social environmental indicators of physical activity. Cheadle et al. (1991) suggest other measures that can be applicable to influencing social norms such as counting the number of media reports dealing with physical activity. The use of Geographic Information Systems (GIS), global positioning system (GPS), and geocoding are also increasingly being used in studies assessing the relationship between environmental factors and physical activity (Porter, Kirtland, Neet, Williams, & Ainsworth, 2004). These tools have the ability to link individuals with their geographic location enabling researchers to merge social environmental features such as crime data and social supports (e.g., number of houses of worship) with physical activity data (Porter et al., 2004), and display the spatial distributions of activity behavior (Cromley, 2003).

Social environmental characteristics can be measured at the interpersonal level, ecological level, or both. For example, racial discrimination has both individual (i.e. perceived discrimination) and group-level (e.g., institutional discrimination) units of analysis. Very often social environmental characteristics consist of individuals/units at a lower level nested within spatial units at a higher level (e.g., individuals nested within neighborhoods). Multi-level methods are specifically geared toward the statistical analysis of data that have nested structures and sources of variability at multiple levels (Diez Roux, 2002; Subramanian, Jones, & Duncan, 2003; Subramanian, 2004). A fundamental application of multilevel methods is disentangling the different sources of variations in the outcome. The variation can be due to environmental, area or ecological effects, or compositional; that is, certain types of people who are more likely to be in poor health due to their individual characteristics happen to be clustered in certain places. As applied to physical activity research, the use of multilevel statistical modeling applications allows researchers to tease apart some of the environmental and compositional influences on physical activity by incorporating both individual and social environmental factors into multilevel models.

Qualitative methodologies are also integral to identifying associations between social environmental correlates and physical activity. The use of focus groups, in-depth interviews, and observation studies allows for a deeper understanding of the reasons why people are inactive and can help in targeting interventions for specific groups. Qualitative methods can be used to help researchers develop and strengthen conceptual frameworks explaining the relationship between social environmental factors and physical activity (Masse, Dassa, Gauvin, Giles-Corti, & Motl, 2002). Triangulation from multiple data sources, both qualitative and quantitative, allows for further understanding of factors that influence physical activity (Masse et al., 2002).

## Conclusion

Research has shown that many health behaviors are determined by not only individual-level factors, but also social environmental characteristics (Emmons, 2000; Sorensen et al., 2003). Yet, few physical activity studies address the social environment in which people live, limiting our understanding of its impact (Emmons, 2000). Though influence of



individual-level factors on physical activity is well-studied, research on social environmental influences is understudied but growing. To help organize and advance scientific inquiry about the social environment and physical activity, this paper has identified five modifiable dimensions of the social environment (e.g., *social support and social networks; socioeconomic position and income inequality; racial discrimination; social cohesion and social capital; and neighborhood factors*), specified and summarized the mechanisms by which they influence physical activity, and highlighted new methodological and analytic techniques that can benefit this area of research.

This paper has important implications for future studies. First, it offers greater specificity to the terminology and categorization of social environmental factors. Standardization of this sort is essential to improving the precision of measurement and specificity of hypotheses. Second, this paper identifies specific mechanisms through which each dimension of the social environment may influence physical activity. These mechanisms, described as intermediate outcomes or mediators, are the ways through which the social environment exerts its influence. Different dimensions work through different mechanisms, and decisions about programs and policies to promote physical activity should be made on the basis of this understanding. For example, interventions that seek to increase access to physical activity facilities could focus on racial discrimination, which influences physical activity through residential segregation, or focus on income inequality, which operates through reduced social spending on public health programs. Third, this paper identified specific gaps in the literature with respect to the role of the social environment on physical activity. Some dimensions, such as SEP have a longer history of inquiry; others such as racial discrimination are still emerging. Furthermore, little is known about the relative importance of these five dimensions of the social environment on physical activity or the dynamic relationships between them. The next step in fully understanding these relationships is to develop both theoretical and causal models explicating their shared influence on physical activity.

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