

# Neighborhoods and Cardiovascular Risk: Beyond Individual-Level Risk Factors

*Ana V. Diez Roux, MD, PhD, Kiarri Kershaw, MPH,  
and Lynda Lisabeth, PhD, MPH*

## Corresponding author

Ana V. Diez Roux, MD, PhD  
Department of Epidemiology, 109 South Observatory,  
3671 SPH Tower, Ann Arbor, MI 48103, USA.  
E-mail: adiezrou@umich.edu

**Current Cardiovascular Risk Reports** 2008, 2:175–180  
Current Medicine Group LLC ISSN 1932-9520  
Copyright © 2008 by Current Medicine Group LLC

Efforts to prevent and treat cardiovascular disease have traditionally focused on individual-level risk factors. However, recent work has highlighted the role of residential environments in shaping the distribution of cardiovascular outcomes and risk factors. Living in disadvantaged neighborhoods has been associated with greater cardiovascular disease risk even after accounting for personal measures of socioeconomic status. Current research efforts focus on identifying the specific features of the physical and social environments of neighborhoods that are most relevant. Physical environments include the walking and recreational environments (features of urban design and availability of recreational resources) and the local food environment (availability of healthy foods and advertising). Physical features of neighborhoods have been shown to be related to health behaviors and other cardiovascular risk factors. Features of the social environment (such as social norms, neighborhood sources of stress, and social cohesion) have been less well studied. Additional work is needed to identify the most effective neighborhood-level interventions to improve cardiovascular health.

## Introduction

Over the past few decades, cardiovascular disease epidemiology has largely focused on identifying individual-level characteristics associated with increased risk of cardiovascular disease. Using epidemiologic approaches such as cross-sectional, case-control, and cohort studies, researchers have identified the now well-established cardiovascular risk factors of smoking, physical inactivity, low-density lipoprotein and high-density lipoprotein cholesterol, hypertension, diabetes, and obesity. In parallel to this focus on

individual-level behaviors and biologic characteristics as predictors of disease, cardiovascular epidemiology has a long tradition of focusing on the macro level—societal or environmental factors that shape the distribution of cardiovascular risk across individuals and populations [1]. In recent years, due in part to the development of geographic information systems and statistical techniques such as multilevel analysis [2], interest has grown in understanding how features of environments, particularly residential environments or neighborhoods, affect the cardiovascular risk of individuals [3]. If these environmental factors prove to be important, strategies to prevent cardiovascular disease may need to focus not only on changing individual behaviors or treating risk factors but also on modifying the environments that facilitate the development and maintenance of cardiovascular risk factors. In addition, because of the strong residential segregation by race/ethnicity and socioeconomic status, these environmental features may be important contributors to large and persistent socioeconomic and racial/ethnic differences in cardiovascular risk.

## Neighborhood Socioeconomic Characteristics and Cardiovascular Outcomes

Early work on neighborhoods and cardiovascular disease focused on the associations between neighborhood socioeconomic characteristics and cardiovascular risk. Several measures of the socioeconomic composition of neighborhoods, often summarized into indices of disadvantage or deprivation, were used as proxies for the more specific features of neighborhood physical and social environments that might be causally related to cardiovascular disease. In secondary data analyses of cross-sectional or longitudinal data, researchers linked national census data to individual-level confounder and outcome data. Census-defined areas such as block groups or census tracts in the United States or analogous areas in other countries were used as proxies of neighborhoods. In these studies, great effort went into statistically controlling for personal measures of socioeconomic position to estimate effects of neighborhood characteristics over and above the known effects of individual-level socioeconomic characteristics such as personal income or education.

Overall, these studies have demonstrated that living in disadvantaged or deprived neighborhoods is associated with a greater coronary heart disease prevalence [4,5], incidence [6–8,9•], and mortality [10–12] even after statistical controls for individual-level measures of income, education, and occupation. For example, in one US study, hazard ratios for coronary events in the most disadvantaged group of neighborhoods as compared with the most advantaged group—adjusted for age, study site, and personal socioeconomic indicators—were 1.7 among whites (95% CI, 1.3–2.3) and 1.4 among blacks (95% CI, 0.9–2.0) [6]. Although the impact of neighborhoods on case fatality after myocardial infarction has been less commonly investigated and existing work is limited by the inability to fully control for individual-level measures of socioeconomic position, evidence suggests that persons with a myocardial infarction who live in disadvantaged neighborhoods have poorer survival than those who live in more advantaged neighborhoods [9•,13,14]. For example, in the Worcester Heart Attack Study, patients with acute myocardial infarction living in the most deprived fifth of census tracts had a 30% higher death rate after infarction than those living in the wealthiest census tracts (RR = 1.30; 95% CI, 1.08–1.56) [14]. Although less frequently investigated than coronary heart disease, stroke also has been shown to be patterned by neighborhood socioeconomic characteristics: living in disadvantaged areas has been associated with greater incidence of stroke [15,16,17•,18], with at least one study showing that these associations persist after adjustment for individual-level socioeconomic status [17•].

### Mechanisms Generating Differences Across Neighborhoods in Cardiovascular Outcomes

Many mechanisms could contribute to the increased cardiovascular disease prevalence, incidence, and mortality in disadvantaged neighborhoods [3]. Identification of the specific mechanisms through which neighborhood environments may affect cardiovascular disease outcomes will strengthen conclusions regarding causal effects of neighborhood environments on the development and prognosis of cardiovascular disease. Perhaps most importantly, understanding the mechanisms will point to specific interventions on neighborhood environments that may help prevent cardiovascular disease or improve the prognosis of patients with cardiovascular disease.

Although results have not always been consistent across studies, a number of investigations have shown that living in a disadvantaged neighborhood is associated with greater prevalence of established cardiovascular disease risk factors, including greater probability of smoking, worse diets, less physically active lifestyles, more hypertension, more diabetes, and greater body mass index [4,5,19–24,25•,26•]. There is also evidence that differences in cardiovascular risk across neighborhoods are not

fully accounted for by established cardiovascular risk factors [6,17•], suggesting that factors such as psychosocial characteristics, which have been hypothesized to play a role in causing cardiovascular disease [27], or exposures such as air pollution, which have been recently linked to cardiovascular events [28], could also be involved.

Although studies of neighborhood socioeconomic characteristics and cardiovascular outcomes or risk factors have been important in highlighting the presence of differences in cardiovascular risk across neighborhoods, they are limited in their ability to allow firm causal inferences to be made regarding the presence of neighborhood effects. Their limitations stem largely from the use of measures of socioeconomic composition as proxies for the more specific physical and social features of neighborhoods that may impact cardiovascular risk. The use of these measures creates methodologic challenges related to the ability of these studies to adequately control for the known effects of individual-level measures of socioeconomic position, even when individual-level data are available [29••]. In addition, it does not allow identification of the specific features of neighborhoods that are relevant and that would hence need intervention to reduce the cardiovascular risks of residents. For these reasons, the focus of research has recently shifted from the study of the cardiovascular effects of neighborhood socioeconomic composition to an understanding of the specific features of neighborhoods or residential areas that may be relevant to cardiovascular disease. These features, which may ultimately affect cardiovascular risk through their effects on established risk factors or other mechanisms, can be broadly classified into characteristics of the physical environment and characteristics of the social environment.

### Physical Environment of the Neighborhood

Two features of the physical environment that have received increasing attention as contributors to neighborhood differences in cardiovascular risk include neighborhood features related to physical activity (the walking and recreational environments; also called the built environment) and diet (sometimes referred to as the local food environment).

The built environment comprises features of neighborhoods that may affect the extent to which residents are physically active in their daily lives and participate in recreational physical activity. A large body of work increasingly done by interdisciplinary teams including physicians, epidemiologists, and urban planners has begun to characterize these features and investigate their relation to the physical activity levels of residents. Features of built environments hypothesized to be related to walking include the presence of mixed land use (eg, commercial and residential uses), the density and attractiveness of destinations, street connectivity, and the presence of sidewalks. Features related to recreational uses include the density and quality of parks and recreational facilities [30••]. A growing body of work

has shown that residents of neighborhoods with a mixture of uses, with more destinations and greater connectivity, are more likely to walk and hence be physically active as part of their routine daily activities [31,32]. The density of recreational resources (an indicator of availability and at least in part access to these resources) also has been shown to be related to the physical activity of residents [33•].

The local food environment encompasses features of neighborhoods such as the availability and relative cost of healthy foods, the presence of unhealthy food options (such as fast foods), and food advertising [34••]. Studies have shown that the availability of healthy foods varies substantially across neighborhoods, with healthy foods often being less available in poor and minority neighborhoods than in wealthy and white neighborhoods [35•]. Early work in this area used the presence of supermarkets as a crude measure of the availability of healthy foods because supermarkets in the United States often offer a broader variety of healthy foods. Surveys of stores using validated instruments also have shown that healthy food availability varies across neighborhoods even within similar types of stores [36]. The availability of healthy food is associated with greater consumption of healthy foods by residents [37] and with a lower prevalence of diet-related cardiovascular risk factors, including hypertension and obesity [38•,39,40]. The availability of fast foods varies substantially across neighborhoods [41], and evidence suggests that consumption of fast food is associated with adverse changes in body weight and insulin resistance [42•]. Research also has demonstrated that advertising for tobacco and alcohol is more common in poor and minority neighborhood than in wealthy and white neighborhoods [43].

A third feature of physical environments investigated in relation to cardiovascular disease is exposure to air pollution, particularly particulate matter and other traffic-related exposures. Studies have begun to investigate small-scale variations in a variety of air pollution exposures potentially linked to cardiovascular disease. Although results are not conclusive, exposure to particulate matter and traffic-related emissions, which may vary across relatively small-scale neighborhoods, may be linked to cardiovascular outcomes [44•].

### Social Environment of the Neighborhood

Features of the social environment that have been hypothesized to contribute to neighborhood differences in cardiovascular outcomes include social norms, neighborhood sources of stress, and features of the social connections within neighborhoods such as social cohesion.

Social norms regarding cardiovascular-related behaviors may arise or be reinforced at least in part within the context of neighborhoods. Neighborhood social norms may affect the behavior of residents by providing

incentives or disincentives to adopt or maintain certain behaviors. However, research remains rare on the impact of neighborhood-based social norms and the extent to which norms actually exert their effects in the context of neighborhoods as opposed to other social contexts.

Features of neighborhoods may serve as acute or chronic stressors and affect cardiovascular risk indirectly, through their impact on coping behaviors such as diet, or directly, through their effects on the hypothalamic-pituitary-adrenal axis or the sympathetic nervous system. There is scant information on what the most relevant stress-generating features of neighborhoods might be or on the way in which these features should be measured in empiric investigations. The most common domains investigated as potential neighborhood stressors in relation to a variety of health outcomes include neighborhood problems, neighborhood disorder, violence and safety, and physical ambient characteristics [45]. Neighborhood problems are generally assessed by asking residents to report on the extent to which they perceive various issues as a problem in their neighborhood (eg, violence, noise, traffic, litter, air quality, vandalism, drug use, and presence and quality of resources and services). "Neighborhood disorder" refers to conditions and activities in the neighborhood that indicate a breakdown of social order. Scales to measure neighborhood disorder typically assess neighborhood markers of social incivility, disruption, and physical decay. Violence and perceived safety are among the most common neighborhood sources of stress investigated in empiric studies. Violence and safety are measured using crime data or questionnaires. Physical ambient characteristics such as noise, crowding, housing characteristics, and proximity to environmental toxins also have been hypothesized to be sources of stress that vary across neighborhoods. These ambient characteristics are usually measured using census data or by linking residence data to other data sources such as noise measurements or proximity to airports or environmental toxins.

Empiric documentations of the cardiovascular effects of neighborhood stressors remain limited. Although the role of neighborhood stressors is often hypothesized, only a handful of studies has investigated the effects of neighborhood stressors on cardiovascular outcomes. For example, Sundquist et al. [46•] assessed the relationship between neighborhood violent crime and incidence of coronary heart disease in Sweden. After adjustment for individual-level socioeconomic stressors and demographic variables and neighborhood-level unemployment, women and men in the highest two quintiles of neighborhood violent crime had significantly higher odds of coronary heart disease than those in the lowest quintile. In another example, an index of neighborhood psychosocial hazards was associated with greater obesity, even after adjustment for a comprehensive list of individual-level characteristics [47].

The related constructs of social cohesion, social capital, and collective efficacy constitute a third dimension of the social environment postulated to contribute to neighborhood differences in cardiovascular risk. Social cohesion and social capital are broadly defined as features of social organization, including social trust, civic participation, and norms of reciprocity that facilitate cooperation for mutual benefit [48]. These constructs are distinct from social support or social networks assessed at the individual level because they characterize the community as a whole and are presumed to affect everyone regardless of individual characteristics. Collective efficacy is defined as the willingness of community members to look out for each other and intervene when trouble arises. Social cohesion, social capital, and collective efficacy may affect cardiovascular risk by reinforcing social norms related to health behaviors, by allowing residents to effect improvements in the physical environments, and by buffering adverse effects of neighborhood stressors. Limited research has examined the relationship between neighborhood social cohesion, social capital, or collective efficacy and cardiovascular outcomes. For example, low electoral participation (as an indicator of low social capital) was associated with higher coronary heart disease incidence in Sweden after controlling for individual-level characteristics [49]. Greater neighborhood collective efficacy (as assessed by a standardized scale combining social cohesion and informal social control) was linked to lower body mass index even after controlling for neighborhood deprivation [50].

Investigations of the effects of neighborhood social environments on cardiovascular disease are especially challenging because of issues related to measuring the social environment. Social environments are even more complex than physical environments in this regard. Another key challenge is isolating the effects of neighborhood social environments from the effects of neighborhood physical environments (such as access to healthy food or availability of safe places to exercise).

### Conclusions

Growing evidence suggests that residential environments affect cardiovascular risk through their influence on established risk factors such as health behaviors or through the biologic consequences of exposure to sources of chronic stress. An important consideration in interpreting existing research is that neighborhood constructs are grossly misspecified because of the reliance on crude geographic proxies for neighborhoods (usually administrative areas) with little attention to the spatial scale most relevant to the process being studied and limitations in the neighborhood-level measures. Hence, neighborhood effects are likely to be underestimated compared with the effects of individual-level variables, for which measurement strategies are much better developed.

Considerable uncertainty remains concerning what constitutes the most relevant aspects of residential environments. There is also little information on which neighborhood-level interventions may be most promising in terms of improving cardiovascular risk. Current research priorities focus on improving the measurement of specific attributes of neighborhoods and examining their effects in longitudinal settings (ie, on incident disease or on changes in cardiovascular risk over time). Better measurement of these factors and the study of their longitudinal effects may help identify the most promising interventions to test in future studies. Given the logistical and methodologic challenges of randomized trials in the study of neighborhood effects, researchers must take advantage of natural or quasi-experiments to evaluate how specific changes in neighborhood environments affect cardiovascular risk.

A clear implication of neighborhood effects on cardiovascular disease is that efforts to prevent the disease and prolong the life of patients with cardiovascular disease may benefit from approaches that add environmental interventions to existing individual-based strategies. Interdisciplinary collaborations among physicians, epidemiologists, urban planners, economists, and sociologists will be necessary to identify and implement the most effective neighborhood-level interventions.

### Disclosures

No potential conflicts of interest relevant to this article were reported.

### References and Recommended Reading

Papers of particular interest, published recently, have been highlighted as:

- Of importance
  - Of major importance
1. Rose G: Sick individuals and sick populations. *Int J Epidemiol* 1985, 14:32-38.
  2. Diez Roux AV: Multilevel analysis in public health research. *Annu Rev Public Health* 2000, 21:171-192.
  3. Diez Roux AV: Residential environments and cardiovascular risk. *J Urban Health* 2003, 80:569-589.
  4. Diez-Roux AV, Nieto FJ, Muntaner C, et al.: Neighborhood environments and coronary heart disease: a multilevel analysis. *Am J Epidemiol* 1997, 146:48-63.
  5. Lawlor DA, Davey Smith G, Patel R, Ebrahim S: Life-course socioeconomic position, area deprivation, and coronary heart disease: findings from the British Women's Heart and Health Study. *Am J Public Health* 2005, 95:91-97.
  6. Diez Roux AV, Merkin SS, Arnett D, et al.: Neighborhood of residence and incidence of coronary heart disease. *N Engl J Med* 2001, 345:99-106.
  7. Sundquist K, Malmstrom M, Johansson SE: Neighbourhood deprivation and incidence of coronary heart disease: a multilevel study of 2.6 million women and men in Sweden. *J Epidemiol Community Health* 2004, 58:71-77.
  8. Sundquist K, Winkleby M, Ahlen H, Johansson SE: Neighborhood socioeconomic environment and incidence of coronary heart disease: a follow-up study of 25,319 women and men in Sweden. *Am J Epidemiol* 2004, 159:655-662.

9. Winkleby M, Sundquist K, Cubbin C: Inequities in CHD incidence and case fatality by neighborhood deprivation. *Am J Prev Med* 2007, 32:97-106.
- A recent study of neighborhood deprivation in relation to incident coronary heart disease and case fatality after myocardial infarction.
10. Chaix B, Rosvall M, Merlo J: Recent increase of neighborhood socioeconomic effects on ischemic heart disease mortality: a multilevel survival analysis of two large Swedish cohorts. *Am J Epidemiol* 2007, 165:22-26.
11. Borrell LN, Diez Roux AV, Rose K, et al.: Neighbourhood characteristics and mortality in the Atherosclerosis Risk in Communities Study. *Int J Epidemiol* 2004, 33:398-407.
12. Diez Roux AV, Borrell LN, Haan M, et al.: Neighbourhood environments and mortality in an elderly cohort: results from the cardiovascular health study. *J Epidemiol Community Health* 2004, 58:917-923.
13. Tyden P, Hansen O, Engstrom G, et al.: Myocardial infarction in an urban population: worse long term prognosis for patients from less affluent residential areas. *J Epidemiol Community Health* 2002, 56:785-790.
14. Tonne C, Schwartz J, Mittleman M, et al.: Long-term survival after acute myocardial infarction is lower in more deprived neighborhoods. *Circulation* 2005, 111:3063-3070.
15. Kleindorfer DO, Lindsell C, Broderick J, et al.: Impact of socioeconomic status on stroke incidence: a population-based study. *Ann Neurol* 2006, 60:480-484.
16. Lisabeth LD, Diez Roux AV, Escobar JD, et al.: Neighborhood environment and risk of ischemic stroke: the brain attack surveillance in Corpus Christi (BASIC) Project. *Am J Epidemiol* 2007, 165:279-287.
17. Brown P, Guy M, Broad J: Individual socio-economic status, community socio-economic status and stroke in New Zealand: a case control study. *Soc Sci Med* 2005, 61:1174-1188.
- A study of neighborhood socioeconomic status and stroke.
18. Thrift AG, Dewey HM, Sturm JW, et al.: Greater incidence of both fatal and nonfatal strokes in disadvantaged areas: the Northeast Melbourne Stroke Incidence Study. *Stroke* 2006, 37:877-882.
19. Diez-Roux AV, Nieto FJ, Caulfield L, et al.: Neighbourhood differences in diet: the Atherosclerosis Risk in Communities (ARIC) Study. *J Epidemiol Community Health* 1999, 53:55-63.
20. Diez Roux AV, Merkin SS, Hannan P, et al.: Area characteristics, individual-level socioeconomic indicators, and smoking in young adults: the coronary artery disease risk development in young adults study. *Am J Epidemiol* 2003, 157:315-326.
21. Cubbin C, Hadden WC, Winkleby MA: Neighborhood context and cardiovascular disease risk factors: the contribution of material deprivation. *Ethn Dis* 2001, 11:687-700.
22. Sundquist J, Malmstrom M, Johansson SE: Cardiovascular risk factors and the neighbourhood environment: a multilevel analysis. *Int J Epidemiol* 1999, 28:841-845.
23. Cubbin C, Sundquist K, Ahlen H, et al.: Neighborhood deprivation and cardiovascular disease risk factors: protective and harmful effects. *Scand J Public Health* 2006, 34:228-237.
24. Cozier YC, Palmer JR, Horton NJ, et al.: Relation between neighborhood median housing value and hypertension risk among black women in the United States. *Am J Public Health* 2007, 97:718-724.
25. Auchincloss AH, Diez Roux AV, Brown DG, et al.: Association of insulin resistance with distance to wealthy areas: the multi-ethnic study of atherosclerosis. *Am J Epidemiol* 2007, 165:389-397.
- A study of neighborhoods and cardiovascular risk factors that uses innovative spatial analysis methods.
26. Do DP, Dubowitz T, Bird CE, et al.: Neighborhood context and ethnicity differences in body mass index: a multilevel analysis using the NHANES III survey (1988-1994). *Econ Hum Biol* 2007, 5:179-203.
- A recent paper on neighborhoods and body mass index.
27. Everson-Rose SA, Lewis TT: Psychosocial factors and cardiovascular diseases. *Annu Rev Public Health* 2005, 26:469-500.
28. Miller KA, Siscovick DS, Sheppard L, et al.: Long-term exposure to air pollution and incidence of cardiovascular events in women. *N Engl J Med* 2007, 356:447-458.
29. Diez Roux AV: Neighborhoods and health: where are we and where do we go from here? *Rev Epidemiol Sante Publique* 2007, 55:13-21.
- A review of conceptual and methodologic challenges in estimating neighborhood health effects.
30. Papas MA, Alberg AJ, Ewing R, et al.: The built environment and obesity. *Epidemiol Rev* 2007, 29:129-143.
- A review of evidence regarding the relationship of the built environment to diet, physical activity, and obesity.
31. Frank LD, Schmid TL, Sallis JF, et al.: Linking objectively measured physical activity with objectively measured urban form: findings from SMARTRAQ. *Am J Prev Med* 2005, 28(2 Suppl 2):117-125.
32. Owen N, Humpel N, Leslie E, et al.: Understanding environmental influences on walking; review and research agenda. *Am J Prev Med* 2004, 27:67-76.
33. Diez Roux AV, Evenson KR, McGinn AP, et al.: Availability of recreational resources and physical activity in adults. *Am J Public Health* 2007, 97:493-499.
- A study that uses geographic information systems to investigate associations between availability of recreational resources and physical activity.
34. Story M, Kaphingst KM, Robinson-O'Brien R, Glanz K: Creating healthy food and eating environments: policy and environmental approaches. *Annu Rev Public Health* 2008, 29:253-272.
- A recent review of the environment and diet.
35. Moore LV, Diez Roux AV: Associations of neighborhood characteristics with the location and type of food stores. *Am J Public Health* 2006, 96:325-331.
- A study of differences across neighborhoods in the availability of healthy foods.
36. Glanz K, Sallis JF, Saelens BE, Frank LD: Nutrition Environment Measures Survey in stores (NEMS-S): development and evaluation. *Am J Prev Med* 2007, 32:282-289.
37. Morland K, Wing S, Diez Roux A: The contextual effect of the local food environment on residents' diets: the atherosclerosis risk in communities study. *Am J Public Health* 2002, 92:1761-1767.
38. Mujahid M, Diez Roux AV, Cooper R, et al.: Cross-sectional associations of neighborhood characteristics and hypertension (The Multi-Ethnic Study of Atherosclerosis). *Epidemiology* (in press).
- A study that uses innovative measures to characterize neighborhoods and investigate how neighborhood characteristics affect hypertension.
39. Morland K, Diez Roux AV, Wing S: Supermarkets, other food stores, and obesity: the atherosclerosis risk in communities study. *Am J Prev Med* 2006, 30:333-339.
40. Lopez RP: Neighborhood risk factors for obesity. *Obesity (Silver Spring)* 2007, 15:2111-2119.
41. Block JP, Scribner RA, DeSalvo KB: Fast food, race/ethnicity, and income: a geographic analysis. *Am J Prev Med* 2004, 27:211-217.
42. Pereira MA, Kartashov AI, Ebbeling CB, et al.: Fast-food habits, weight gain, and insulin resistance (the CARDIA study): 15-year prospective analysis. *Lancet* 2005, 365:36-42.
- A study of the prospective association between fast food consumption and weight gain.
43. Hackbarth DP, Silvestri B, Cospser W: Tobacco and alcohol billboards in 50 Chicago neighborhoods: market segmentation to sell dangerous products to the poor. *J Public Health Policy* 1995, 16:213-230.
44. Hoffmann B, Moebus S, Mohlenkamp S, et al.: Residential exposure to traffic is associated with coronary atherosclerosis. *Circulation* 2007, 116:489-496.
- A study of traffic-related exposures and subclinical atherosclerosis.

45. Diez Roux A: Neighborhood stress. In *Encyclopedia of Stress*, edn 2. Edited by Fink G. Boston: Academic Press; 2007.
  46. Sundquist K, Theobald H, Yang M, et al.: Neighborhood violent crime and unemployment increase the risk of coronary heart disease: a multilevel study in an urban setting. *Soc Sci Med* 2006, 62:2061-2071.
- A study of the social environment and coronary heart disease.
47. Glass TA, Rasmussen MD, Schwartz BS: Neighborhoods and obesity in older adults: the Baltimore Memory Study. *Am J Prev Med* 2006, 31:455-463.
  48. Kawachi I, Berkman L: Social cohesion, social capital, and health. In: *Social Epidemiology*. Edited by Berkman L, Kawachi I. New York: Oxford University Press; 2000:174-190.
  49. Sundquist J, Johansson SE, Yang M, Sundquist K: Low linking social capital as a predictor of coronary heart disease in Sweden: a cohort study of 2.8 million people. *Soc Sci Med* 2006, 62:954-963.
  50. Cohen DA, Finch BK, Bower A, Sastry N: Collective efficacy and obesity: the potential influence of social factors on health. *Soc Sci Med* 2006, 62:769-778.