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Environmental Justice: Obesity, Physical Activity, and Healthy Eating

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Background: The term "environmental justice" refers to efforts to address the disproportionate exposure to and burden of harmful environmental conditions experienced by low-income and racial/ethnic minority populations. *Methods:* Based on computer and manual searches, this paper presents a review of articles in the published literature that discuss disparities in physical activity, dietary habits, and obesity among different populations. *Results:* This paper provides evidence that economically disadvantaged and racial/ethnic minority populations have substantial environmental challenges to overcome to become physically active, to acquire healthy dietary habits, and to maintain a healthy weight. For example, residents living in poorer areas have more environmental barriers to overcome to be physically active. *Conclusions:* We propose a research agenda to specifically address environmental justice with regard to improving physical activity, dietary habits, and weight patterns.

This paper focuses on the effects of the physical environment on the physical activity, dietary habits, and obesity patterns of disadvantaged populations. Specifically, the history and principles of environmental justice are presented. For different income levels and racial/ethnic groups, the scientific literature is reviewed for environmental influences on physical activity, dietary habits, and obesity.

The History of the Environmental Justice Movement

The emergence of the environmental justice movement began with protests from community residents. The local, grass-roots protests received national attention when veteran civil rights leaders and social justice advocates joined local mobilization efforts. For example, in 1982, a rural, predominantly African American community, Afton, NC, was chosen as a landfill site. Approximately 500 demonstrators were arrested protesting this siting decision. These protests attracted national attention.[1-2] In addition, empirical studies provided data that strengthened the claims of activists.

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A study by the US General Accounting Office in 1983 determined that, in the eight southeastern states comprising Environmental Protection Agency (EPA) Region IV, three of the four communities containing large commercial hazardous waste landfills were composed predominantly of African Americans and that in all four of the communities, at least one-fourth of the population was living below the poverty line.[3] This finding became the impetus for a study by the Commission for Racial Justice, United Church of Christ in 1987 that compared the demographic characteristics of ZIP code areas without waste treatment, storage, or disposal facilities to those of areas with such a facility. The study showed that the ZIP codes without a facility had 12.3% racial/ethnic minorities, ZIP codes with one facility had 24% racial/ethnic minorities, and ZIP codes with more than one facility or with one of the nation's five largest landfills had 38% racial/ethnic minorities.[4] The authors concluded that "…three out of every five Black and Hispanic Americans lived in communities with uncontrolled toxic waste sites" ([4] page 13). Since these early studies, several empirical studies have investigated environmental injustice claims.[5]

Definition of Environmental Justice

Environmental justice is concerned with fair treatment and meaningful involvement of all people (regardless of race, ethnicity, income, national origin, or educational level) in the development, implementation, and enforcement of environmental laws, regulations, and policies.[6] "Fair treatment," as defined by the EPA,[6] means that no population, due to policy or economic disempowerment, is forced to bear a disproportionate burden of the negative human-health impacts. These impacts include air and water pollution and other environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies.

The concept of environmental justice in the federal government was introduced at the 1990 National Minority Health Conference: Focus on Environmental Contamination. This conference sponsored by the Agency for Toxic Substances and Disease Registry was the first attempt by a federal agency to bring together a group of scientists who had evaluated various aspects of environmental justice.[6] The effort had been initiated several years before under the guidance of such experts as Robert Bullock and Beverly Wright along with United Church of Christ Commission for Racial Justice. The concept and goals of environmental justice gained wider acceptance when President Clinton in February 1994 signed Executive Order 12898 entitled "Federal Action to Address Environmental Justice in Minority Populations and Low-Income Populations." In response to the Executive Order and from the resulting Symposium on Health Research and Needs to Ensure Environmental Justice, the Institute of Medicine (IOM) was asked by the National Institute of Environmental Health Sciences to conduct a study that would provide an independent assessment of three issues:[6]

1. Specific medical and health issues associated with the concept of environmental justice (e.g., medical education, clinical practice and research, medical surveillance, and public health);

2. The roles of basic research and medicine in addressing these issues; and
3. Appropriate priorities for medical research that would facilitate improvement in the current situation.

The resulting Institute of Medicine report entitled "Toward Environmental Justice: Research, Education, and Health Policy Needs," outlined environmental justice issues (environmental equity, geographic equity, and social equity) and provided guiding principles for establishing environmental justice. Environmental equity refers to fairness in environmental decision-making and equal protection under the law for all populations. It involves the fair treatment and meaningful involvement of all people in the development, implementation, and enforcement of environmental laws, regulations, and policies. Geographic equity refers to the location and spatial configuration of communities and their proximity to environmental hazards and locally unwanted land use. Social equity refers to the role of sociological factors, such as race, culture, and political power in environmental decision-making.[6]

Environmental justice upholds norms and values, rules, regulations, and policy decisions required to establish healthy and sustainable communities where people can interact with the confidence that their environment is safe, nurturing, and productive.[6] Environmental justice is served when people can realize their highest potential, without experiencing sexism, racism, and class bias.[6] Environmental justice is supported by democratic decision-making and personal empowerment; freedom from violence, drugs, and poverty; and respect for cultural and biological diversity.[6] Public health perspectives most applicable to environmental justice are:

— Improving the science base

— Involving the affected populations

— Communicating findings to all stakeholders

The Institute of Medicine report stated that environmental justice can be achieved through three paradigms: assessment, policy development, and assurance. Assessment involves collecting and analyzing information to diagnose a community. This might involve conducting surveys to identify the health needs of a community, interpreting the findings, monitoring and forecasting changes, and evaluating outcomes. Policy development involves determining what the science base can and cannot offer. Assurance involves ensuring integrity throughout the process, recognizing community and indigenous knowledge, encouraging active community participation, and utilizing cross-cultural exchanges.

Fifty years ago the World Health Organization (WHO) defined health as "a state of complete physical, mental, and social well being and not merely the absence of disease or infirmity." The definition of environmental health includes references to the built environment, the natural environment, and the social environment.[6] Specifically, the environment can facilitate or hinder behaviors important to health. The term "environmental justice" refers to efforts to address the disproportionate exposure to and burden of harmful environmental conditions experienced by low-income and racial/ethnic minority populations.

Environmental Justice and Obesity

Significant disparities in sex, ethnicity, and socioeconomic status (SES) exist with respect to the prevalence of obesity and overweight and related co-morbidities in the US.[7] For example, the prevalence of obesity (BMI ≥ 30) for African American and Mexican American women is substantially higher than for non-Hispanic white women (49.7% and 39.7%, respectively, vs. 30.1%). African American women are also more likely to meet the criteria for extreme obesity (BMI ≥ 40) in the sample from the National Health and Nutrition Examination Survey.[8-9] The prevalence of overweight and obesity (BMI ≥ 25) in African American and Mexican American women age 20 and older is substantially higher than that of non-Hispanic white women in the same age group (> 70.0% vs. 57.2%, respectively). These disparities also occur among minority men; however, the magnitude of differences is much smaller.[8-9]

These disparities also are evident among children and adolescents.[7] For example, 18.5% of Mexican American and 23.2% of African American girls, 6 to 19 years old, had BMIs equal to or exceeding the 95th percentile compared to only 12.9% of non-Hispanic white girls. Disparities are even more dramatic when considering risk for being overweight (BMI ≥ 85th percentile), with African American and Mexican American girls demonstrating rates of 40.1% and 36.6% compared to 27.0% of non-Hispanic white girls. As noted earlier, for adults, smaller group differences exist between African American (31.0%) and non-Hispanic white (29.2%) men; however, Mexican American men ages 6 to 19 had a substantially greater prevalence of overweight (42.8%).[9]

Current evidence also clearly demonstrates a SES-related disparity in the incidence of obesity and type 2 diabetes, an important obesity-related morbidity.[10-11] Pareratakul and colleagues,[12] using data from the 1994-1996 Continuing Survey of Food Intakes by Individuals, found that individuals with less than a high school education or whose income was 130% or less than the Federal Poverty Guideline, both indices of SES, had higher rates of obesity than those with more education and a higher income average (23.0% vs. 16.5% for education and 23.0% vs. 16.6% for income, respectively).

In 2003, the Center for Research on Minority Health, in conjunction with the Institute of Medicine's Roundtable on the Environment Health and Medicine, held regional focus groups to assess community perspectives on health and the environment. One of those focus groups was held in the Kashmere Gardens neighborhood of Houston, an area with a high concentration of ethnic minority and underserved populations. Among the most common factors residents mentioned as deterring physical activity were the lack of sidewalks, open ditches, air and water pollution. When asked about the contribution of inactivity to obesity, a common response was "How can you expect anyone to exercise when there are no sidewalks and it is not safe to go from here to there?" From a community perspective, this qualitative study illustrates that there can be a connection between environmental justice and obesity.

Environmental Justice Disparities and Obesity

Booth and colleagues[13] reviewed the literature on the role of the built environment

and obesity in creating disparities in environmental justice and found consistently greater obesity risk was associated with low area or neighborhood SES. In one of the first studies to examine this issue, Ellaway et al.[14] evaluated the relationship between neighborhood material deprivation, an indicator of area SES, and obesity in four neighborhoods in the United Kingdom. Material deprivation was established as a composite of several factors, including housing tenure, car ownership, and weekly household income. The residents' actual weights and heights were assessed among 691 adults age 40 to 60 y. They found that neighborhood of residence was significantly associated with body-mass index (BMI), waist circumference, and prevalence of obesity. For example, the prevalence of obesity was nearly double in the most materially deprived neighborhood (29.2%) compared to that in the neighborhood with the least material deprivation (14.2%), even after controlling for a number of individual-level demographic and SES factors.

A study conducted in the Netherlands by van Lenthe and Mackenbach[15] demonstrated similar results. Individual-level data from a self-report questionnaire administered to 8,897 adult residents in 84 different neighborhoods (i.e., administrative units) were analyzed. An index of material deprivation aggregated at the neighborhood level was constructed for each neighborhood on the basis of: 1) the percentage of subjects with a primary-school or lower educational level; 2) the percentage of subjects who were unskilled (manual labor) workers; and 3) the percentage of subjects who were unemployed. They found that increasing levels of neighborhood deprivation were associated with increasing mean BMIs and prevalence of overweight, although the relationship was stronger for overweight women and older individuals than for men and younger individuals. Cubbin and associates[16] investigated the relationship between neighborhood material deprivation using the Townsend Deprivation Index and the frequency of risk factors for cardiovascular disease (CVD) among 25 to 64-y-old adults in the US. Both household interviews and on-site medical examinations were used to collect individual-level outcome data. These data were linked with US census tract data to evaluate racial/ethnic differences, controlling for individual SES. Overall, residing in a deprived area or neighborhood was associated with a higher probability of having an adverse CVD risk profile. While the risk profile varied by ethnic group and gender, even after adjusting for individual SES, neighborhood deprivation consistently exerted an independent effect on CVD risk factors. This study also demonstrated that a one-unit increase in the neighborhood deprivation index was associated with 0.18, 0.11, and 0.13 unit increases in BMI for African American, Mexican American, and non-Hispanic white women, although it was only significant for African American women. Even after controlling for individual education and income, African American women who lived in material-deprived neighborhoods were at a disproportionately higher risk for CVD.

Similar results have been demonstrated using children and adolescents. Kinra and associates[17] studied the relationship between neighborhood deprivation and the measured heights and weights of 20,973 children in the United Kingdom who were between 5 and 14 y old. The results demonstrated that girls and boys who lived in the most-deprived areas had rates of obesity (i.e., BMI of ≥ 98th percentile) that were 29% and 39% greater (respectively) than those of area girls and boys in the least-deprived referent areas.

Environmental Justice and Physical Activity Patterns

Physical inactivity contributes to many physical and mental health problems and is responsible for 200,000 deaths per year in the US.[18] Furthermore, the treatment of health conditions associated with physical inactivity (e.g., obesity) poses an economic cost of at least $117 billion each year.[19] Recent data from surveillance systems (Behavioral Risk Factor Surveillance System, 2000;[20-21] National Health Interview Survey, 2002;[22] National Health and Nutrition Examination Survey, 1999-2000[23]) and comprehensive national documents[24] indicate that persons from some racial/ethnic minority groups (e.g., African Americans and Hispanics) and people with lower incomes are less likely to get recommended levels of physical activity and, thus, experience disproportionately higher rates of chronic diseases associated with physical inactivity. For example, on the basis of the National Health Interview Survey, 1997,[24] the proportion of adults who engage in no leisure time physical activity by ethnic group is: 38%, non-Hispanic white; 46%, American Indian; 42%, Asian or Pacific Islander; 52%, African American; and 54% Hispanic or Latino. Also, people living in households in which the total annual income is less than $15,000 are more likely to be obese, to be diagnosed with diabetes or asthma, to live a sedentary lifestyle, and to be at risk for health problems related to lack of physical activity than people from households with annual incomes above $50,000.[20] A developing research area is the influence of the physical environment on physical activity and inactivity patterns. Specifically, crime, neighborhood disorder, the availability of recreational facilities, presence of sidewalks and bicycle lanes, nearby parks and playgrounds, street connectivity, and accessible and safe places to be physically active may differ by income level and race/ethnicity.

Environmental Justice, Physical Activity, and the Environment

Table 1 presents the methods and findings from twelve studies about the effects of racial/ethnic identity and socioeconomic factors on physical activity patterns. The following narrative briefly summarizes the information in Table 1.

Distribution of Physical Activity-Friendly Environments by Demographic Characteristics

Reports in the literature indicate that low-income and racial/ethnic minority populations have limited access to physical activity-friendly environments (i.e., including safe, affordable, well-maintained, and appealing environments) compared to other populations. After adjusting for age, sex, smoking status, body-mass index, and baseline physical activity score, those living in a poverty area showed a greater decrease in physical activity during a 10-y time period compared to those living in a non-poverty area.[25] In another study, higher median household income and lower poverty rates were associated with increasing levels of available activity-related settings.[26]

Table 1 Physical Activity and the Environment by Income Level and Racial/Ethnic Minorities

Study	Sample	Study design	Measures	Primary findings
Yen & Kaplan[25]	*N* = 1,737 in Alameda County, CA	Longitudinal population-based cohort; random stratified household sample of adult residents	Self administered questionnaires for physical activity, income, education, race/ethnicity, smoking status, BMI, alcohol consumption. Poverty areas were determined by federal criteria.	Independent of individual income, education, smoking status, BMI, and alcohol consumption, poverty area residence remained associated with decreases in physical activity.
Powell et al.[26]	A national sample was drawn from 209 communities in 2002 and 200 communities in 2003 with 8th, 10th, and 12th grade schools	Cross-sectional	Observational (drive/walk around) indicators of community level physical activity related spaces (i.e., sports areas, parks, playgrounds, public pools, beaches, and bike paths). SES data were obtained from 2000 Census and census block groups	Higher median household income and lower poverty rates were associated with increasing levels of available physical activity-related settings. Communities with higher proportions of racial/ethnic minority populations were associated with fewer physical activity settings.
Wilson et al.[27]	1,194 residents (age 18 to 96 y) of a US southeastern county; 10 low SES census tracts and 11 high SES census tracts	Cross-sectional	Respondents completed perceptions of environmental supports questionnaire. GIS measures were used to objectively assess environmental supports for physical activity. Physical activity was measured by 2001 BRFSS.	Respondents from low versus high socio-economic areas reported higher perceptions of neighborhood crime, unattended dogs, unpleasantness of neighborhoods, untrustworthy neighbors, and less access to public recreation facilities. GIS did not support differences in perceptions by SES with one exception-respondents from low versus high SES areas had substantially fewer trails. Having and using trails in one's community predicted sufficient physical activity for low—but not for high—SES respondents.

Study	Sample	Study design	Measures	Primary findings
Estabrooks et al.[28]	Small US city (population = 133,046); 32 census tracts; high-, medium-, low-SES categorized by % of unemployed individuals, per capita income, % of population below the poverty threshold	Cross-sectional	GIS generated a list of physical activity resources available within each census tract.	Low-, medium-, and high-SES neighborhoods did not differ in the number of pay-for-use facilities; however, low-SES and medium-SES neighborhoods had significantly fewer free-for-use resources than high-SES neighborhoods. Individuals from lower SES neighborhoods may have limited ability to control their physical activity because of inaccessible environments.
Brownson et al.[29]	1,269 adults age 18 y and older in 12 southeast Missouri counties	Cross-sectional, risk factor survey using a random digit dialing technique	Interviews included 9 sets of questions: 1) walking behavior 2) regular walking 3) access to trails 4) access to indoor exercise facilities 5) use of walking trails 6) change in exercise behavior due to walking trail use 7) perceptions of safety when using trails 8) how respondents found out about trails 9) aspects of trails most liked.	Persons with more education and earning higher incomes were more likely to have access to walking trails and to indoor places to exercise. Lower income groups and persons with high school education or less reported increased walking due to trail use compared to higher income persons and persons with a college education. Persons with higher incomes were more likely to use the trails than persons with lower incomes.

(continued)

Table 1 Physical Activity and the Environment by Income Level and Racial/Ethnic Minorities (*continued)*

Study	Sample	Study design	Measures	Primary findings
Boslaugh et al.[30]	1,073 blacks (47%) and non-Hispanics (53%), 18 to 65 y old, recruited from two public health centers and a work site in St. Louis, MO	Cross-sectional, multilevel design	Individual level – self administered pen and paper survey of neighborhood pleasantness and availability of physical activity. Neighborhood level – 5 census variables by ZIP code level: percentage African American, percentage living in same house 5 y ago, percentage using public transportation to get to work, percentage who walked or cycled to work, and median house value.	Blacks rated their neighborhoods lower than non-Hispanic whites on pleasantness and availability of physical activity. Higher individual incomes were associated with greater pleasantness and availability ratings.
Brownson et al.[31]	US adults	Cross-sectional risk factor survey using random-digit dialing technique. To obtain a representative sample of lower income individuals, ZIP codes in which 32% or more of residents were below the federal poverty level were over sampled.	The survey instrument (90 questions) was a combination of questions derived from the BRFSS, the National Health Interview Survey, and other recent surveys.	Women with higher incomes compared to women with lower incomes reported greater access to areas or equipment such as walking or jogging trails, parks, and treadmills. In contrast, among men, those with lower incomes reported greater access to physical activity areas or equipment than those with higher incomes. Women and men of lower incomes compared to those of higher incomes were more likely to report high crime rate, heavy traffic, unattended dogs, and foul air from cars and factories.

Study	Sample	Study design	Measures	Primary findings
Sallis et al.[32]	The sample was 2,053 residents from San Diego, CA. The mean number of years of education = 14.9; mean age = 47.8 y. Compared to the 1980 census data, affluent, educated non-Hispanic whites were over-represented in the sample.	A random sample of residents was surveyed regarding exercise habits and other variables. 385 exercise facilities were classified as either free or pay. Respondent's addresses and exercise facilities were located on a grid map and coded. The density of facilities around each respondent's home address was computed. Exercise facilities in San Diego were compiled from the telephone directory, local sports and exercise publications, and other available sources. Facilities were classified as free or pay.	A 7-page questionnaire about determinants (e.g., barriers and convenience) of physical activity was mailed to a random sample of adults from a commercial, cross-index directory of San Diego. Vigorous physical activity was assessed by the responses to the following question: "During a usual week, about how often do you do physical exercise in your free time, for at least **20 min** without stopping, **hard** enough to make your heart rate and breathing increase a large amount?" Responses to the question were scored as frequency per week. Subjects were classified as sedentary (no sessions of vigorous physical activity per week, $n = 938$) or exercisers (3 or more sessions per week, $n = 800$). The remaining 315 subjects were excluded from the analysis. Distances between each respondent's home and each catalogued exercise facility was computed as the sum of the differences between the coordinates. The mean number of facilities within 5 km units by 1 km increments of each respondent's home was computed.	After controlling for age, education, and income, respondents who reported engaging in three or more exercise sessions per week reported a statistically greater density of pay facilities near their homes than did those who reported no exercise sessions. In other words, an association between proximity of exercise facilities and frequency of exercise was found.

(continued)

Table 1 Physical Activity and the Environment by Income Level and Racial/Ethnic Minorities (*continued)*

Study	Sample	Study design	Measures	Primary findings
Rohm Young et al.[33]	The convenience sample was well-educated, urban African American women (n = 234) from Baltimore, MD. The age range was 20-50 y.	The study design was a cross-sectional survey.	The Women and Physical Activity Survey, an interview-administered instrument, consisted of demographic, personal, social, and physical environmental factors. The physical environmental factors were ratings of traffic, presence of sidewalks, street lighting at night, presence of unattended dogs, safety from crime, places from walking distance, and places to exercise. Physical activity level was determined by the BRFSS. The three physical activity groups were: 1) meeting recommendations; 2) insufficiently active; and 3) inactive.	Physical environmental factors were not associated with physical activity in this sample of African American women.
Sanderson et al.[34]	567 African American women in three rural counties	Cross-sectional	As part of the Women's Cardiovascular Health Network Project, telephone surveys were collected from African American women residing in three rural counties. The measures included physical activities per week and social, physical, and community correlates. The physical environmental factors were ratings of traffic, presence of sidewalks, street lighting at night, presence of unattended dogs, safety from crime, places within walking distance, and places to exercise.	There were no statistically significant associations among physical activity levels and physical environmental variables.

Study	Sample	Study design	Measures	Primary findings
Voorhees et al.[35]	The convenience sample was 285 Hispanic/Latina women, ages 20-55 y, living in northern Virginia.	The study was a community-based, cross-sectional design.	The face-to-face survey was administered in Spanish. The Women and Physical Activity Survey consisted of demographic, personal, social, and physical environmental factors. The physical environmental factors were ratings of traffic, presence of sidewalks, street lighting at night, presence of unattended dogs, safety from crime, places within walking distance, and places to exercise. Physical activity level was determined by the BRFSS. The three physical activity groups were: 1) meeting recommendations; 2) insufficiently active; and 3) inactive.	The physical environmental factors were not statistically significant correlates of physical activity among Hispanic/Latina women. Although not statistically significant, light traffic and safety from crime showed trends for positive relationships with meeting physical activity guidelines.

(continued)

Table 1 Physical Activity and the Environment by Income Level and Racial/Ethnic Minorities (*continued)*

Study	Sample	Study design	Measures	Primary findings
King et al.[36]	2,912 middle and older age women from four racial/ ethnic groups (blacks, non-Hispanic whites, Hispanics, American Indian- Alaskan natives) were included. Each group represented approximately one quarter of the sample. Approximately 58% of the women sampled reported a high school education or less, 60% reported household incomes < $35,000 per year.	The data were part of a large scale, cross-sectional survey of physical activity in women (United States Women's Determinants Study)	Self-report measures of physical activity engaged in during the past two weeks were collected (National Health Interview Survey and the BRFSS). The correlates were social demographics, health related - psychosocial, program-based, and environmental factors.	In logistic regression analyses for the four racial ethnic sub-groups, the significant environmental barriers were: non-Hispanic whites—presence of hills was associated with more physical activity; blacks—the presence of unattended dogs was associated with being more physically active, and frequently seeing others exercising in the neighborhood was positively related to physical activity; Hispanics—the presence of hills was associated with being more physically active; American Indians-Alaskan Natives—there were no significant environmental barriers.

Note. Published articles, from 1990 to 2005, were selected based on computer (e.g., PubMed) and manual searches (e.g., review of reference lists of selected articles). The key words for the computer searches were environment, physical activity or exercise, and income level or racial/ethnic minorities. The inclusion criteria were: 1) objective and/or subjective assessments of the environment for physical activity; 2) analyses by socio-demographic characteristics (i.e., income level and/or racial/ethnic identity); 3) assessment of physical activity; and 4) study populations with samples of 18 years of age and older. Unpublished studies were not included in this review.

Also, communities with higher proportions of racial/ethnic populations were associated with fewer physical activity settings.[26] Wilson et al.[27] reported two dissimilar findings. Respondents from low versus high socio-economic areas had substantially fewer walking or bicycling trails. In the same study, however, presence of sidewalks, recreation facilities, and crime did not differ by socio-economic areas.[27] In contrast, Estabrooks et al. [28] found that low-, medium-, and high-SES neighborhoods did not differ on the number of pay-for-use facilities; however, low-SES and medium-SES neighborhoods had significantly fewer free-for-use resources (i.e., walking paths,

parks, and playgrounds) than high-SES neighborhoods. Similarly, Brownson and colleagues[29] reported that people with more education and earning higher incomes were more likely to have access to walking trails and indoor exercise facilities.

In addition to income level, other demographic characteristics have been studied. In one study,[30] African Americans rated their neighborhoods lower with respect to pleasantness and availability of physical-activity resources than non-Hispanic whites rated their neighborhood, and individuals with higher incomes rated their neighborhoods higher with respect to these same factors than did individuals with lower incomes. In other research,[31] gender differences were reported. Women with higher incomes compared to women with lower incomes reported greater general and specific access to areas or equipment such as walking or jogging trails, parks, and treadmills. In contrast, in the same self-report telephone survey, among men, those with lower incomes reported greater access to specific physical activity areas such as neighborhood streets and parks than those with higher incomes.[31] On the other hand, higher income men reported greater general access to indoor or outdoor places to exercise than men with lower incomes.[31] Furthermore, in the same study, lack of time was a personal barrier for physical activity among those with higher incomes but not among respondents with lower incomes.[31]

Physical Activity and Environmental Correlates by Income Level and Racial/Ethnic Group

Sallis and colleagues[32] controlled for age, education, and income, found that vigorous-intensity physical activity was associated with proximal density of pay-exercise facilities. Three studies among African American[33-34] and Hispanic/Latina[35] women found that self reported perceived factors relevant to the physical environment were not statistically significant correlates of physical activity patterns. In contrast, King and coworkers[36] found that significant environmental variables of physical activity differed among non-Hispanic white, African American, Hispanic, and American Indian-Alaskan native populations. Another study[29] found that, among persons who reported having access to walking trails, people with low-incomes and those with only a high school education (or less) had significantly increased their walking as a result of trail use compared with people of higher incomes and those with a college education.

Few research studies have assessed changes in the physical environment and the concomitant effects on physical activity by sociodemographic groups. Two studies indicate that cultural factors can be used to promote physical activity related to environmental variables.[37-38] For example, locating destination amenities along a trail or a walking path (e.g., grocery stores/markets, restaurants, banks, drug stores, and churches) might promote walking and, thus, increase physical activity. Determining what amenities to locate on the trail or walkway would take into consideration cultural preferences, which would vary by sociodemographic factors.[37]

Summary of Environmental Justice and Physical Activity

"Deprivation amplification" is a pattern related to the features of the local environment.[39] This pattern is defined as, in places where people have fewer personal

resources, the local facilities that enable people to lead healthy lives are poorer compared to non-impoverished and non-socially deprived areas.[39] For example with physical activity, this pattern indicates that in places where people have limited resources (e.g., money, private transport, etc.), there are fewer safe, open green spaces where people can walk, jog, or take their children to play; children's playgrounds are less attractive; there are more perceived threats (e.g., litter, graffiti, youth gangs, assaults) in the environments.[39] Residents living in poorer areas are less likely to engage in physical activity. The limited research in this area supports the deprivation amplification hypothesis confirming that residents living in poorer areas have substantially more barriers to overcome to be physically active.

Although not definitive, these studies begin to demonstrate disproportionate access to health promoting, environmental features (i.e., sidewalks, parks, calm traffic, etc.) in low income and racial/ethnic minority communities and their contribution to the higher obesity rates in these communities. Such differences seem to parallel those of the environmental justice literature that documents the disproportionately greater number of toxic landfills found in low income and racial/ethnic minority communities and thus, violates the fair treatment principle necessary for environmental justice.

Environmental Justice and the Food Resources

Table 2 summarizes the studies that examined disparities in food resources, eating behaviors, and obesity.

Disparities in the Availability and Distribution of Food Resources by SES

Several studies have examined the relationship between SES and food availability and the types and density of food-providing institutions. For example, Horowitz and colleagues[40] examined the availability of and costs of diabetes-healthy foods in lower (East Harlem) and higher (Upper East Side) income areas of New York City. They surveyed a total of 324 stores to determine the availability of foods such as high-fiber breads, low-fat milk, and fresh fruits and green vegetables. Whereas the total density of stores per 100,000 residents was lower in the higher income area than the lower income area (62 per 100,000 vs. 143 per 100,000 in the lower income area), the disparity was due primarily to the number of small stores in the lower income area. However, the availability of medium- (OR = 3.0; 95% CI = 1.5 to 6.1) and large-sized (OR = 2.8; 95% CI = 1.4 to 5.8) food stores was substantially less in the lower income area when compared to the higher income area. In addition, when stores were classified in terms of desirability (those that offered at least one item from each of the food or beverage groups defined as being diabetes-healthy), the density of stores was reversed, with the higher-income area having a substantially higher density of desirable stores than the low-income area (36 per 100,000 vs. 26 per 100,000, respectively; OR = 3.2; 95% CI = 2.2 to 4.6).

Not surprisingly, the availability of larger and more desirable food stores influenced the availability of diabetes-healthy foods and beverages.[40] Stores in higher income areas were significantly more likely to offer low-carbohydrate or high-fiber bread (OR = 2.3; 95% CI = 1.7 to 3.2), low-fat or non-fat milk (OR = 1.9; 95% CI

Table 2a Environmental Disparities on Food Resource Availability and Distribution

Study	Sample	Study design	Primary findings
Horowitz et al.[40]	324 stores in high and low SES areas	Cross-sectional survey of the presence of a number of diabetes-healthy foods, such as high-fiber breads, low-fat milk, and fresh fruits and green vegetables	—Availability of medium- (OR = 3.0; 95% CI = 1.5-6.1) and large-sized (OR = 2.8; 95% CI = 1.4-5.8) food stores was substantially less in the lower income area when compared to the higher income area —58% of stores in higher income area stocked diabetes-healthy foods compared to only 18% of stores in the low-income area
Morland et al.[41]	221 census tracts with various levels of SES and ethnic composition as defined by the 1990 US Census that were the residential areas for participants in the ARIC study.	Cross-sectional survey of the distribution of food store and food service resources	—3 times as many supermarkets were found in the wealthier neighborhoods —There was a greater density of convenience stores, small grocery stores, and specialty food stores in the lower wealth neighborhoods —More black residents lived in lower SES neighborhoods than did white residents —4 times as many supermarkets were located in white neighborhoods than in black neighborhoods
Morland et al.[42]	10,623 participants from the ARIC study living in 208 census tracts	Cross-sectional survey of food resources and self-reported dietary intake of residents using a semi-quantitative food frequency questionnaire	Increasing numbers of supermarkets in census tracts was associated with increased fruit and vegetable consumption in both black and white Americans (a 32% and 11% increase for each additional supermarket, respectively), suggesting that the density of certain types of institutions would indeed influence health behaviors such as healthy food consumption
Block et al.[43]	155 fast-food restaurants within 156 census tracts	Cross-sectional survey of fast-food restaurant density by area SES and ethnic/racial composition	Predominantly black neighborhoods had 2.4 fast-food restaurants per square mile compared to 1.5 per square mile in neighborhoods with mostly white residents
Reidpath et al.[44]	267 postal districts in a large Australian city and 331 unique fast food outlets in the included postal districts	Cross-sectional survey of fast-food restaurant density by area SES	—Fast-food restaurant density was substantially higher in the lowest income category of postal districts —There was a dose-response monotonic relationship between fast-food outlet density and area SES across four income strata

Table 2b Environmental Disparities and Eating Behaviors

Study	Sample	Study design	Primary findings
Diez-Roux et al.[45]	13,095 adults participating in the baseline exam of the ARIC study	Cross-sectional study of four communities in the US evaluating the association between neighborhood SES and food consumption	Individuals living in poorer environments, regardless of race, consumed diets lower in fruits, vegetables, and fish and higher in meat than those living in wealthier neighborhoods, even after adjusting for individual income level
Lee and Cubbin[46]	8,165 youths and young adults ranging in age from 12 to 21 y who completed the YRBS and whose addresses could be geocoded and linked to 1990 Census neighborhood SES and racial composition	Cross-sectional survey evaluating the relationship between neighborhood SES and cardiovascular health behaviors including diet, smoking, and physical activity	—Youths living in areas characterized by low area SES had significantly poorer dietary habits than those in higher SES areas —Neighborhood SES was not a consistent predictor of physical activity or smoking
Shohaimi et al.[47]	22,562 women and men age 39-79 in the UK enrolled in the EPIC-Norfolk cohort	Cross-sectional survey assessing the relationship between area SES and fruit and vegetable intake using the Townsend Deprivation Index to obtain the area-SES	—Individual social class and educational level and residential area deprivation predicted fruit and vegetable consumption ($\beta = -26.5$; $P < 0.001$ for men, $\beta = -16.0$; $P = 0.005$ for women) —Men living in deprived areas were estimated to eat 27 g fewer of fruits and vegetables than men in non-deprived areas —Women living in deprived areas were estimated to eat 16 g less than their counterparts in non-deprived areas

Table 2c Environmental Disparities and Overweight and Obesity Risk

Study	Sample	Study design	Primary findings
Ellaway et al.[14]	691 40-60 y old adults who participated in face-to-face interviews living in the four neighborhoods stratified by SES	Cross-sectional survey evaluating the relationship between BMI and area level of material deprivation	Neighborhood of residence was significantly associated with BMI, waist circumference, and obesity prevalence with greater deprivation resulting in higher BMIs and waist circumferences
van Lenthe and Mackenbach[15]	8,897 adult residents in 84 different neighborhoods who were participating in an ongoing longitudinal cohort study (the Dutch GLOBE study)	A cross-sectional analysis of individual level variables such as BMI and the association with neighborhood level deprivation	—Increasing levels of neighborhood deprivation were associated with increasing mean BMIs and overweight prevalence —Neighborhood deprivation had a stronger relationship for women and older individuals who were overweight when compared to men and younger individuals
Cubbin et al.[16]	9,961 US adults age 25-64 y who completed the NHANES III assessment from 1988-1994	Cross-sectional evaluation of the relationship between neighborhood material deprivation and the frequency of cardiovascular disease risk behaviors such as physical inactivity and higher BMI	—Neighborhood deprivation consistently exerted an independent effect on CHD risk factors, even after adjusting for individual SES —A one-unit increase in the neighborhood deprivation index was associated with an 0.18, 0.11, and 0.13 unit increase in BMI for black, Mexican American, and white women, although it was only significant for black women
Kinra et al.[17]	20,973 children between the ages of 5 and 14 y in the UK	Cross-sectional evaluation of the relationship between neighborhood deprivation and BMI	Children living in the most deprived areas had rates of obesity that were 29% and 39% greater than those in the least deprived referent areas for boys and girls, respectively

Note. Published articles in peer-reviewed journals were identified using Medline, PsychInfo, and HealthSTAR. In addition, manual searches of relevant journal table of contents and reference sections from selected articles were conducted. Articles were selected for review if they evaluated the relationship between racial/ethnic composition or SES of an area and the distribution food resources, eating behavior, and/or obesity risk.

= 1.6 to 2.3), fresh fruits (OR = 1.2; 95% CI = 1.1 to 1.4), and fresh vegetables (OR = 1.3; 95% CI = 1.1 to 1.5) than the lower income areas. Prices for all items were substantially higher in the higher income area, regardless of the store type.

The distribution of food stores and food-services institutions (e.g., restaurants) was also studied by Morland and colleagues.[41] Information from the 1990 census was used to estimate neighborhood SES and individual-level variables such as racial category in 221 census tracts from sites enrolled in a population-based prospective study of cardiovascular disease (CVD) risk in the US. The addresses of food stores and food services were obtained from local health and state agriculture departments and were classified according to the 1997 North America Industrial Classification System (NAICS). Importantly, the researchers found three times as many supermarkets (e.g., which they defined as having the healthiest food options) and more full-service restaurants in the wealthier neighborhoods than in the lower- and medium-income neighborhoods, where there was a greater density of convenience stores, small grocery stores, specialty food stores, and fast-food restaurants.

Morland and colleagues[41] reported on the disparities in food resource distribution with respect to racial/ethnic minority groups. They found that more African Americans lived in lower SES neighborhoods than did non-Hispanic whites, that four times as many supermarkets were located in non-Hispanic white neighborhoods compared to African American neighborhoods, and that the ratio of supermarkets in predominantly non-Hispanic white neighborhoods compared with African American neighborhoods was 1:3,816/residents vs. 1:23,582/residents, respectively. Unfortunately, they did not collect data on individual-level health behaviors or obesity risk, so they could not examine any relationships between food resource distribution and health outcomes. A separate study by Morland[42] showed that an increase in the numbers of supermarkets in neighborhoods inhabited primarily by African Americans (32%) and those inhabited primarily by non-Hispanic white Americans (11%) was associated with increased consumption of fruits and vegetables in these communities, suggesting that the density of certain types of food resource institutions can influence health behaviors such as the consumption of healthy foods.

Block and colleagues[43] showed that the density of fast-food restaurants was greatest in neighborhoods where the population is predominantly African American. They mapped all fast-food restaurants in New Orleans, LA in 2001 and examined the density of these restaurants within a 0.5 and 1.0 mile buffer of the census tract boundaries in which they resided. They identified 155 fast-food restaurants within 156 census tracts that had at least 500 people, more than 2000 people per square mile, and less than 200 alcohol outlets per 1000 people (which was used as a proxy for commercial activity), thus ensuring some similarity across the analyzed census tracts. Multiple regression analyses produced a final model that accounted for 44% of the variation in the density of fast-food restaurants and demonstrated a significant positive relationship between the density of fast-food restaurant and percentage of African American residents ($\beta = 0.35$). Thus, neighborhoods in which 80% of the residents are African American had 2.4 fast-food restaurants/square mile, whereas neighborhoods in which 80% of the residents are non-Hispanic white had only 1.5 fast-food restaurants per/square mile.

Reidpath and associates[44] documented a relationship between area measures

of SES and the density of fast-food outlets, which provide primarily energy-dense foods. They examined 267 postal districts in a large Australian city and used an online telephone service directory and identified 331 unique fast-food outlets in those postal districts. The study showed that in the lowest SES area, the population per fast-food outlet was 5,641 persons, whereas in the highest SES strata, there were 14,256 individuals/fast-food outlet.[44] Thus, people living in poorer areas are much more likely to be exposed to the energy-dense foods typically served at fast-food outlets. Unfortunately, this study did not examine actual food consumption behaviors or actual obesity prevalence, so it is unknown if there would be any relationship between greater fast-food outlet density in low SES areas and actual differences in food consumption or obesity risk.

Environmental Justice and Dietary Habits

Several studies have attempted to evaluate the relationship between area SES and food consumption and have consistently found that living in lower income areas is associated with reduced consumption of fruits and vegetables and in diets lower in saturated fats from meats. In a study by Diez-Roux et al.,[45] it was demonstrated that individuals living in poorer neighborhoods, regardless of race/ethnicity, consumed diets lower in fruits, vegetables, and fish and higher in meat than those living in wealthier neighborhoods, even after adjusting for individual income level.

Lee and Cubbin[46] examined the relationship between neighborhood SES and risks to cardiovascular health (e.g., poor diet, smoking, and lack of physical activity) in adolescents and young adults. They used six items from the Youth Risk Behavior Survey that inquired about consumption of fruits and vegetables, hamburgers, hot dogs and sausage, French fries and potato chips, and cookies and doughnuts. Neighborhood SES was derived from census tract indicators, including family income, area poverty, education, housing value, crowding, and employment type (blue collar vs. white collar). Although neighborhood SES was not a consistent predictor of physical activity or smoking, it was predictive of poor dietary habits. Thus, youth living in areas characterized by low SES had substantially poorer dietary habits than those in higher SES areas.

Shohaimi et al.[47] examined the relationship between area SES and fruit and vegetable intake using data from a prospective cohort study of cancer determinants among 22,562 women and men age 39 to 79 in the United Kingdom. Fruit and vegetable intake was assessed using a 130 item food frequency questionnaire that catalogs 11 types of fruit and 26 types of vegetables. The Townsend Deprivation Index, a composite score used to determine material deprivation, was used to obtain the area SES measure and consists of census variables including lack of material resources, overcrowding, wealth, and income that are aggregated to the area level. Multivariate regression analyses revealed that individual social class and educational level and residential area deprivation (the Townsend Index) predicted fruit and vegetable consumption ($\beta = -26.5$; $P < 0.001$ for men, $\beta = -16.0$; $P = 0.005$ for women); thus, men living in deprived areas were estimated to eat 27 g less fruits and vegetables than men in non-deprived areas, while women living in deprived areas were estimated to eat 16 g less fruits and vegetables than women living in non-deprived areas.

Summary

The chain of evidence reviewed above suggests that poorer areas or neighborhoods or those with more racial/ethnic minority residents may be structurally different with regard to the density or availability of different types of food resources or food services. These foods are often less expensive but more energy dense than healthier options.[10] There were no data in these studies on relating this factor to concomitant health risks. In addition, evidence was presented that these same SES differences also are related to differences in certain health behaviors, particularly consumption of fruits and vegetables. The studies reviewed also demonstrated area SES differences in risk for overweight and obesity.

Although these findings provide preliminary evidence for the hypothesis that SES disparities in overweight and obesity are related to differences in environmental characteristics, most of the studies suffer from the epidemiologic "black box" problem[48] i.e., they do not identify the actual features of the environment that account for the relationship between the environment and health behaviors or obesity; therefore, it is impossible to determine which characteristics of the environment (e.g., density of food service outlets or physical activity resources) may be most important. The few studies that examined actual resource availability or density did not collect health risk information. Thus, future studies need to comprehensively evaluate health risk and the built environment in which participants reside. For example, one study reported that the relationship between overall health and body-mass index was in part mediated by a greater number of physical activity barriers for those in poor health, which led to a decrease in moderate-intensity physical activity.[49]

Recommendations for Future Research

This review presented research related to environmental justice and aspects of obesity, physical activity, and healthy eating. The following suggestions are recommendations for studies to further advance this research area.

1. Develop transdisciplinary collaborations and effective partnerships to advance public health, active living, and environmental justice goals.
2. Assess the prevalence of physical activity friendly and unfriendly environments (i.e., spatial equity) by sociodemographic characteristics. These studies can address environmental justice concerns related to low-income and racial/ethnic minority populations.
3. Assess the perceptions of the physical environment by sociodemographic characteristics. Perceptions compared to objective assessments of the physical environment can provide insights related to behavioral patterns.
4. Investigate the environmental correlates and determinants of physical activity and healthy eating among sociodemographically diverse population groups. Cultural and community variables may relate to different environmental correlates and determinants for low-income and racial/ethnic minority populations.
5. Analyze the process in which policies and ordinances are developed. Urban

planning policies and ordinances can have a broad impact on the built environment, physical activity, and healthy eating. An environmental justice issue is whether policy development includes representatives from all segments of the community. A central concern is whether low-income and racial/ethnic minority populations fully participate in policy development (i.e., procedural justice).

6. Analyze changes in economic development and income levels with trends in physical activity, healthy eating, and obesity rates. An overarching issue is equality and fairness related to jobs, economic development, housing opportunities, and decreasing income inequalities. Environmental justice, social inequalities, health disparities, spatial equity, and procedural equity are related. Perhaps, effective strategies and approaches dedicated to eliminating income and economic disparities may diminish the scope of environmental injustices and improve health outcomes.

Conclusions

Urban design, land use patterns, and transportation systems that promote walking and bicycling can create active and healthier communities.[50] In public health, there is a commitment to eliminating health disparities among low-income and racial/ethnic populations.[24] These groups have higher rates of obesity and lower rates of physical activity compared to higher income populations and non-Hispanic whites. Because Healthy People 2010 ranks physical inactivity as the leading health indicator, environmental justice and the physical environment must become a priority research area to address the epidemic of sedentary behavior, unhealthy eating patterns, and the high rates of obesity. In the absence of addressing environmental justice issues, the research agenda is incomplete and undermines the objectives of eliminating health disparities and improving the health of all communities. The unfair and disproportionate distribution of health promoting features among various communities and the consequent disease burden are comparable to the unfair and disproportionate distribution of hazardous waste landfills that sparked the environmental justice movement. These similarities are important concerns of social and environmental justice.

Prospective studies implementing the recommendations outlined earlier that include sufficient numbers of participants from different sociodemographic and racial/ethnic groups will lead to a greater understanding of environmental justice issues. Such research has the potential to provide insights to develop effective interventions to address disparities in physical activity, eating, and obesity patterns among populations of different income levels and different racial/ethnic backgrounds. From a community perspective, the objective is to create health promoting environments that facilitate making healthy choices for all segments of society. To accomplish this objective, energizing a grass-roots movement and ensuring a political will at the highest levels are needed to develop and enforce just urban policies for all community residents. It is a matter of fairness and environmental justice.

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