Published in final edited form as:
Am J Prev Med. 2009 April ; 36(4 Suppl): S86–S92. doi:10.1016/j.amepre.2009.01.002.

Measuring Physical Activity Environments:

A Brief History

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Abstract

Physical activity is usually done in specific types of places, referred to as physical activity environments. These often include parks, trails, fitness centers, schools, and streets. In recent years, scientific interest has increased notably in measuring physical activity environments. The present paper provides an historical overview of the contributions of the health, planning, and leisure studies fields to the development of contemporary measures. The emphasis is on attributes of the built environment that can be affected by policies to contribute to the promotion of physical activity. Researchers from health fields assessed a wide variety of built environment variables expected to be related to recreational physical activity. Settings of interest were schools, workplaces, and recreation facilities, and most early measures used direct observation methods with demonstrated inter-observer reliability. Investigators from the city planning field evaluated aspects of community design expected to be related to people's ability to walk from homes to destinations. GIS was used to assess walkability defined by the 3Ds of residential density, land-use diversity, and pedestrian-oriented designs. Evaluating measures for reliability or validity was rarely done in the planning-related fields. Researchers in the leisure studies and recreation fields studied mainly people's use of leisure time rather than physical characteristics of parks and other recreation facilities. Although few measures of physical activity environments were developed, measures of aesthetic qualities are available. Each of these fields made unique contributions to the contemporary methods used to assess physical activity environments.

Introduction

Human behaviors vary in their dependence on specific places. Physical activity is arguably on the more place-dependent end of the spectrum. Some places are physical activity–friendly by nature or design, such as playgrounds, health clubs, open spaces, stairs, sidewalks, and trails. Other places are designed for sedentary behaviors, such as movie theaters, classrooms, offices, and elevators. Places also can be designed in such a way that physical activity is unsafe or unattractive, such as interstate highways, streets without sidewalks or protected pedestrian crossings, crime-infested parks, and locked stairwells.

Given the close connection between built environments and physical activity, one might expect a long history of incorporating built environmental measures in physical activity research. In fact, very few studies of physical environments and physical activity were

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No financial disclosures were reported by the author of this paper.

conducted until the mid-1990s, at least in health-related fields. The primary reason for this neglect of physical environments was probably reliance by researchers on the dominant models and theories of behavior, which emphasized psychological and social influences on behaviors but did not specifically incorporate physical environmental influences.

Increasing use of ecologic models of behavior in the 1990s by physical activity investigators made it clear that important categories of influences had been neglected. Ecologic models are distinguished by their emphasis on multiple levels of influence on behaviors, including individual (biological, psychological); social/cultural; organizational; community; physical environment; and policy.[1] Ecologic models directed investigators to consider physical environment and policy influences, and physical activity–specific ecologic models made it clear that specific physical environmental variables of relevance to physical activity had to be conceptualized and measured before they could be examined in studies.[2] Thus, the history of physical environment measures for use in physical activity research is brief.

Purpose and Approach

This paper traces recent historical trends in multiple research fields that provided the foundation for the current state of measurement of physical activity environments, which are places where people are, or can be, physically active. Physical activity environments are a subset of broadly defined physical environments, which encompass built and natural environments. The built environment includes all buildings, spaces, and objects that are created or modified by people. It includes homes, schools, workplaces, parks and recreation areas, greenways, transportation systems, and motor vehicles. The built environment is shaped by land-use and transportation planning and policies. These built environments and the policies that govern them influence opportunities for physical activity for recreation, transportation, occupation, and household/yard work purposes.[3] Natural environments include places where people can be physically active, such as open space, as well as aspects of nature that could alter physical activity patterns, such as climate, weather, vegetation, and topography. Measurement of built environments is the primary focus of the present paper, because a substantial literature on these topics has been developed, there are clear policy options for altering many built environment characteristics, and multiple disciplines have important contributions to make to measurement. Another useful concept is behavior setting, which is the physical and social context of the place where physical activity is done.[4]

The social environment can include interactions among individuals, families, and small groups, as well as broader factors that could affect large groups or entire communities, such as culture, norms, and indicators of social disorder such as graffiti and trash. However, only selected social environment variables are considered in this review that may be related to willingness to use a specific setting for physical activity and have been studied in relation to physical activity. Policies result from a social process, and they can affect built environments, but policy measures are not considered in the present review.

This paper presents an overview of the history of contributions of three broadly-defined fields of study to the measurement of physical activity environments. The Year 2000 marks the approximate time of an increase in attention to measurement of physical activity environments, so the review focuses on measures developed and/or published before 2000, although some exceptions are made so that notable measures or trends can be included. A nonsystematic review of the scientific literature was conducted to identify quantitative measurement methods developed between 1980 and 2000 that were precursors of recently-developed measures. Measures and papers were identified through examination of personal files and reference lists, and experts in each of the relevant disciplines were consulted. The present paper builds on a previous review.[5]

The three broadly-defined fields represented are health, including public health, exercise science, and behavioral sciences; city planning, including travel behavior and urban design; and parks, recreation, and leisure sciences. Table 1 summarizes key historical contributions of each field to environmental measurement. These fields were chosen because they developed measures of the built environment of direct relevance to physical activity. Each section identifies the settings and outcome behaviors of most interest to the field, summarizes key conceptual contributions of each field, describes general approaches to measurement of built environments, presents examples of early environmental measures of relevance to physical activity research, and summarizes the contributions of each field to contemporary approaches to measuring physical activity environments.

Measuring Physical Activity Environments in the Health Fields

Settings and Behaviors of Interest

Behavioral researchers in public health, exercise science, psychology, and sociology have been working to explain variation in physical activity and to conduct interventions. Before 2000, the behaviors of interest were almost exclusively recreational physical activity, and the settings studied were mainly parks, trails, open spaces, private recreation facilities, and schools where people could engage in active recreation. Research was usually guided by theories that emphasized psychosocial factors.[1] However, the operant learning model of B.F. Skinner[6] provided conceptual and methodologic background for physical environmental measurement. Skinner's basic model was Environment → Behavior. Although his primary emphasis was on rewards and punishments delivered by people (or programmed machines), physical environment characteristics such as cues and barriers also were studied. Skinner's work led to the development of systematic observation and coding methods for environments and behaviors that formed the foundation for many recently created physical environmental measures.[7]

Observational Measures

Two approaches are covered in this section: directly observing physical activity behavior in specific settings (e.g., stairways, schools), and coding attributes of physical activity environments. To our knowledge**,** the earliest example of the former was counting people who chose between adjacent stairs or escalators in a Philadelphia train station.[8]

Direct observation has been used most often to study children's physical activity in a variety of settings.[7] FATS (Fargo Activity Timesampling Survey) began a tradition of colorful acronyms for instruments and assessed physical activity along with location and interactions with others.[9] Behaviors of Eating and Activity: Child Health Evaluation System (BEACHES)[10] and Children's Activity Rating Scale (CARS)[11] expanded the assessment to include access to and watching of television, social prompts to be active or sedentary, and presence of active toys. Extensive training was required to achieve high inter-observer agreement. Reliabilities were high, and data were collected using either paper forms or hand-held computers.

Similar observation methods were used for the System for Observing Fitness Instruction Time (SOFIT),[12] which assessed physical activity, teacher behavior, and lesson context during school physical education classes. Although SOFIT assessed only the social environment, SOPLAY (System for Observing Play and Leisure Activity in Youth) [13] assessed characteristics of free play settings such as playgrounds and fields. Physical environmental variables included type of location; size of play space; presence of permanent improvements (e.g., basketball hoops, playground markings); presence of equipment such as balls; presence of supervision; and weather. These social and physical environment variables

explained substantial variance in youth physical activity during unstructured times at school.[14]

Advantages of these observational measures included reliable objective measures and integration of physical and social environment with physical activity measures. Disadvantages included the costs of training and data collection as well as the limited detail of environmental measures, perhaps reflecting the lack of conceptualization at the time of development.

Another observational measure, called the Checklist for Health Environments at Work (CHEW), was developed to assess workplace environment attributes.[15] This measure assessed three scales of physical activity environments: the building itself, the grounds around the building, and the surrounding neighborhood. Worksite physical attributes included the presence of exercise equipment and showers, attractiveness of stairs, and bicycle parking. Information environment was operationalized as posters encouraging physical activity and notices about sports or activity opportunities. Attributes on the grounds and surrounding neighborhood included distance to parking, walking or cycling trails, and access to health clubs. Inter-observer reliability was high.

Measuring Access to Recreation Facilities

There was substantial interest in understanding access to recreation facilities, which is a distinct measurement question from characteristics of those recreation facilities. According to a 2002 review,[16] a modest number of studies produced consistent findings that proximity to community recreational facilities with favorable aesthetics was related to adults' recreational physical activity. Studies included in the review used a variety of self-reported and objective measures of access to recreation facilities. One study used a manual mapping technique to assess the density of recreation facilities around survey respondents' homes.[17] About 400 free (e.g., parks, schools) and pay (e.g., aerobics clubs, health clubs, YMCA/YWCAs) facilities were identified through telephone books and local magazines. Locations of facilities and the addresses of respondents were marked on a printed street map marked with 1-kilometer grid lines. Coordinates were entered into the computer and used to calculate the number of recreation facilities within 1 to 5 kilometers of homes. Although objectively measured proximity to facilities was associated with frequency of exercise, perceived "convenience" to facilities was not, suggesting the value of objective environmental measures. Current GIS software, which allows the manipulation and display of spatial data, now supports much more sophisticated measures of proximity. All spatial data, whether collected through census, observation, or self-report can be integrated within a GIS. Any attribute can be examined in relation to any other attribute, and summary variables can be created to be exported to statistical analysis software. GIS can be used to create variables to describe large areas like cities or census tracts, but the ability to characterize small areas, such as within a 1-km radius of residences, makes it a particularly useful technique for physical activity research.

Giles-Corti and colleagues [18] were notable for their early use of GIS by health researchers studying physical activity. They examined access to formal (e.g., health clubs, tennis court) and informal (e.g., streets, public open spaces) recreation facilities for each survey respondent. Locations of recreation facilities and respondent addresses, along with the street network were integrated in a GIS, and distance from homes to facilities was based on the street network. Exercisers tended to use facilities that were near their homes.

Self-Reported Measures

A self-report survey of physical activity environments was not published by health researchers until 1997.[19] The physical activity environment was conceptualized as homes, neighborhoods, and frequently traveled routes, and three scales were developed. First, home exercise equipment was assessed by a 16-item checklist that included aerobic equipment, weights, and sports equipment. Second, an 8-item checklist of neighborhood characteristics assessed factors likely to influence recreational physical activity. Items included sidewalks, traffic, unattended dogs, enjoyable scenery, and crime. Additional items assessed perceptions of safety and category of land use. Third, an 18-item checklist assessed facilities for recreational physical activity (e.g., health spa, park, dance studio) near home or work or on a frequently traveled route. The scales had moderate to high test–retest reliabilities, but evidence of construct validity was mixed.[19]

A Transdisciplinary Trend

An early example of a physical activity environmental measure developed by health researchers but informed by the city planning field was the neighborhood observation or audit instrument created by Pikora and colleagues.[20] SPACES (Systematic Pedestrian and Cycling Environmental Scan) was based on an explicit model of environmental influences on walking and cycling in neighborhoods, with main factors of function, safety, aesthetics, and destinations. Street segments (between two intersections) were walked by trained observers who coded specific attributes of buildings, roadways, sidewalks/footpaths, intersections, aesthetics, and maintenance. Overall attractiveness for walking and cycling was rated by coders. Variables were relevant for physical activity for recreation and transportation purposes. Observations were combined in GIS with land-use data and traffic information. Inter- and intra-observer reliabilities were generally high.

Contributions from Health Fields

Reliance on direct observation instead of self-reports began a tradition of high-quality objective measurement in this field. During the early years, health researchers maintained a focus on built and social environmental attributes relevant only to recreational physical activity. Development of measures tailored to specific behavior settings (e.g., schools, worksites, homes, communities) allowed the development of evidence that characteristics of all these settings were related to physical activity. Measures from the health field were usually characterized by a systematic development process with documentation of psychometric properties. The SPACES instrument signaled an important trend of combining concepts from the health and planning fields.

Measuring Physical Activity–Related Environments in the City Planning Field

Settings and Behaviors of Interest

Travel behavior and urban design researchers from the field of city planning have been studying since at least the 1980s how land use, design of communities, and design of transportation systems are related to travel behavior, with goals of reducing traffic congestion and air-quality impacts of development while enhancing quality of life. Consistent with the profession’s responsibility for built environments, planners have developed models and theories of built environments. Of special relevance to physical activity, planners created conceptualizations of community design such as walkability, or the ability of people to walk to nearby destinations. In contrast to health researchers, planners tended to study a small number of built environment variables. Cervero and Kockelman[21] introduced the 3Ds: residential density, land-use diversity, and pedestrian-oriented designs.

Also in contrast to health professionals who were mainly interested in recreational physical activity, planners studied walking and cycling for transportation, mainly as an alternative to driving.[22]

Objective Measures of Walkability

Early studies of active transportation often used a combination of mostly objective measures. Residential density is readily available from census data in many countries. Land-use diversity (i.e., mixed use) can be coded from field visits. For example, some investigators coded the types and locations of nonresidential land uses in targeted neighborhoods, with a focus on retail shops.[21,23] Indicators of pedestrian-oriented design were rarely available in existing databases, so these detailed measures were often assessed by field observations. Kitamura and colleagues[23] assessed such characteristics as street width, block size, presence of sidewalks and bike lanes, speed limits, and public transit service, although these variables were summarized/averaged for each neighborhood.

Sometimes, variables of interest were available in a digital form in GIS. Frank and Pivo[24] used a database providing categories of use for each parcel of land to develop a mixed use index. Handy[25] was one of the first to measure distances from homes to destinations using the street network, which should reflect actual distances for walkers and cyclists.

Self-Reported Measures of Walkability

It is reasonable to expect residents to provide relatively accurate reports of attributes of their neighborhood. Cervero[26] used items from the American Housing Survey that asked residents about the presence of commercial buildings within 300 feet of their homes as an indicator of mixed use. Handy[27] assessed more subjective evaluations of neighborhood environments, such as comfort, convenience, and attractiveness.

Contributions from the City Planning Field

Because of their expertise in built environments, city planners developed sophisticated concepts and measures of areas ranging in size from the immediate vicinity of homes to neighborhoods, cities, and regions. The introduction of GIS into physical activity research has been revolutionary in that GIS data can be used in the assessment of micro-environments around each participant’s home. However, early measures from the planning field were rarely described in enough detail in Methods sections to allow replication, and evaluations of reliability and validity were generally absent.

Measuring Physical Activity–Related Environments in the Leisure Studies Field

Settings and Behaviors of Interest

Leisure studies is a young scientific field that grew out of the parks and recreation profession. Leisure studies has been guided mainly by a social–psychological approach to understanding how people use their leisure time.[28] Physical activity is just one category of behaviors in which people can participate in leisure time, with others including socializing and relaxing. Although people’s use of parks and other recreation facilities was of substantial interest, relatively little attention was paid to studying physical characteristics of recreation environments. Thus, few quantitative measures of recreation facility characteristics were developed that were of direct relevance to physical activity research.

A dominant concept in leisure studies was constraints to leisure, which can cover both actual access to recreation opportunities and perceived access and cost. Numerous measures of leisure constraints have proven to be useful in explaining leisure behaviors.[29]

Leisure researchers conceptualized three categories of environmental characteristics.[28] Biophysical attributes included proximity to populations as well as quantity and quality of vegetation. The social environment of recreation facilities included crowding, conflicts between users (e.g., walkers versus cyclists, adolescents versus seniors), and incivilities such as trash and graffiti. Managerial characteristics included programs offered, fees, and rules. Few quantitative measures were developed for these environmental attributes, except for managerial characteristics.

Perceptions of Aesthetics and Landscape Quality

Leisure researchers have made unique contributions to measuring the aesthetics of built and natural environments, especially the quality of landscapes. The relevance for attracting people to be physically active in outdoor settings is clear. Landscape quality is defined broadly as containing basic amenities, a sense of place, spiritual connections, and other dimensions. As recounted by Terry[30] in a review, the two main measurement approaches are expert ratings and public perceptions. In the expert-driven approach, ratings are made of formal elements believed to create perceptions of quality, including line, form, color, variety, unity, and harmony. However, measures based on this approach have shown low reliability across raters; low variability across landscapes suggests limited ability to discriminate.

The public-perception approach requires untrained raters to make judgments of quality based on photographs of landscapes, and responses can be choices, rankings, or ratings. Biophysical characteristics can be varied in the photographs, so principles of aesthetic perception can be derived. The perceptual measures have both good test–retest reliability and discriminative validity. Many variations of this type of measure are available for use in physical activity studies.[30]

Contributions from the Leisure Studies Field

Leisure studies investigators developed useful concepts of biophysical characteristics of recreation facilities, social environments in these facilities, incivilities, managerial characteristics, and aesthetics. Although few quantitative measures of these factors are available for use in physical activity research, useful measures of aesthetic perceptions are available.

Comment

Three research traditions have approached physical activity environmental measurement from very different perspectives, and this history has produced a diversity of concepts, methods, and specific measures. Reliable and valid measures were developed using objective methods and self-reports. The early work summarized here provides the foundation for truly transdisciplinary approaches to measurement by teams collaborating across disciplinary boundaries that grew dramatically during the 2000s. Other papers [31,32] in this supplement to the *American Journal of Preventive Medicine* demonstrate how dramatically the state of measurement has progressed. There are now measures of numerous settings with well-documented reliability based on observation, self-report, and GIS methods. There has been an explosion in the breadth and depth of built and social environmental attributes assessed by contemporary measures, which demonstrates extensive development of conceptual models that has been informed by many disciplines. Each

research tradition has contributed in important ways to the current state of the measurement science, and continuing collaborations are expected to lead to accelerating advances.

All fields involved in the measurement of physical activity environments are likely to benefit from the strengths of the other disciplines. Public health and behavioral science bring strong quantitative approaches to measurement development and evaluation. The planning and transportation fields bring concepts and measures for built environments at the community level. The leisure studies and recreation fields bring rich knowledge of recreation environments that are critical settings for physical activity, as well as a strong tradition of assessing aesthetics. Engaging additional disciplines in physical activity research is likely to produce further benefits. For example, architects can bring knowledge of buildings where people spend most of their time; landscape architects can bring assessments of outdoor spaces; geographers can enhance application of GIS; and criminologists can add measures of crime, safety, and security. All these disciplines are needed to assemble the entire mosaic, and no single discipline can supply all the pieces.

Acknowledgments

This work was supported by The Robert Wood Johnson Foundation (Active Living Research), and National Institutes of Health Grants HL67350, HL077141, ES014240, and HL083454.

References

1. Sallis, JF.; Owen, N.; Fisher, EB. Ecological models of health behavior. In: Glanz, K.; Rimer, BK.; Viswanath, K., editors. Health behavior and health education: theory, research, and practice. 4. San Francisco: Jossey-Bass; 2008. p. 465-86.
2. Sallis JF, Cervero RB, Ascher W, Henderson KA, Kraft MK, Kerr J. An ecological approach to creating more physically active communities. Ann Rev Public Health 2006;27:297–322. [PubMed: 16533119]
3. National Institute of Environmental Health Sciences. Request for applications: obesity and the built environment, RFA number: RFA-ES-04-003. Bethesda MD: NIH; 2004.
4. Wicker, AW. An introduction to ecological psychology. Monterey CA: Brooks/Cole; 1979.
5. Bauman, A.; Sallis, JF.; Owen, N. Environmental and policy measurement in physical activity research. In: Welk, GJ., editor. Physical activity assessments for health-related research. Champaign IL: Human Kinetics; 2002. p. 241-51.
6. Skinner, BF. Science and human behavior. New York: Macmillan; 1953.
7. McKenzie, TL. Use of direct observation to assess physical activity. In: Welk, GJ., editor. Physical activity assessments for health-related research. Champaign IL: Human Kinetics; 2002. p. 179-96.
8. Brownell KD, Stunkard AJ, Albaum JM. Evaluation and modification of exercise patterns in the natural environment. Am J Psychiat 1980;137:1540–5. [PubMed: 7435710]
9. Klesges RC, Coates TJ, Moldenhauer-Klesges LM, et al. The FATS: an observational system for assessing physical activity in children and associated parent behavior. Behav Assess 1984;6:333–45.
10. McKenzie TL, Sallis JF, Nader PR, et al. BEACHES: an observational system for assessing children's eating and physical activity behaviors and associated events. J Appl Behav Analysis 1991;24:141–51.
11. Puhl J, Greaves K, Hoyt M, Baranowski T. Children's activity rating scale (CARS): description and evaluation. Res Quart Exerc Sport 1990;61:26–36.
12. McKenzie TL, Sallis JF, Nader PR. SOFIT: system for observing fitness instruction time. J Teach Phys Educ 1991;11:195–205.
13. McKenzie TL, Marshall SJ, Sallis JF, Conway TL. Leisure-time physical activity in school environments: an observational study using SOPLAY. Prev Med 2000;30:70–7. [PubMed: 10642462]

14. Sallis JF, Conway TL, Prochaska JJ, McKenzie TL, Marshall SP, Brown M. The association of school environments with youth physical activity. Am J Public Health 2001;91:618–20. [PubMed: 11291375]
15. Oldenburg B, Sallis JF, Harris D, Owen N. Checklist of health promotion environments at worksites (CHEW): development and measurement characteristics. Am J Health Promot 2002;16:288–99. [PubMed: 12053440]
16. Humpel N, Owen N, Leslie E. Environmental factors associated with adults' participation in physical activity: a review. Am J Prev Med 2002;22:188–99. [PubMed: 11897464]
17. Sallis JF, Hovell MF, Hofstetter CR, et al. Distance between homes and exercise facilities related to the frequency of exercise among San Diego residents. Public Health Rep 1990;105:179–85. [PubMed: 2108465]
18. Giles-Corti, Donovan RJ. The relative influence of individual, social, and physical environment determinants of physical activity. Soc Sci Med 2002;54:1793–1812. [PubMed: 12113436]
19. Sallis JF, Johnson MF, Calfas KJ, Caparosa S, Nichols J. Assessing perceived physical environment variables that may influence physical activity. Res Quart Exerc Sport 1997;68:345–51.
20. Pikora T, Bull F, Jamrozik K, Knuiman M, Giles-Corti B, Donovan R. Developing a reliable audit instrument to measure the physical environment for physical activity. Am J Prev Med 2002;23:187–94. [PubMed: 12350451]
21. Cervero R, Kockelman KM. Travel demand and the 3Ds: density, diversity, and design. Transport Res-D 1997;2:199–219.
22. Frank, LD.; Engelke, PO.; Schmid, TL. Health and community design: the impact of the built environment on physical activity. Washington: Island; 2003.
23. Kitamura R, Mokhtarian PL, Laidet L. A micro-analysis of land use and travel in five neighborhoods in the San Francisco Bay area. Transport 1997;24:125–58.
24. Frank LD, Pivo G. Impacts of mixed use and density on utilization of three modes of travel: single-occupant vehicle, transit, and walking. Transport Res Rec 1994;1466:44–52.
25. Handy S. Understanding the link between urban form and nonwork travel behavior. J Planning Educ Res 1996;15:183–98.
26. Cervero R. Mixed land-uses and commuting: evidence from the American Housing Survey. Transport Res-A 1996;30:361–77.
27. Handy SL. Urban form and pedestrian choices: study of Austin neighborhoods. Transport Res Rec 1996;1552:135–44.
28. Godbey GC, Caldwell LL, Floyd M, Payne L. Contributions of leisure studies and recreation and park management research to the active living agenda. Am J Prev Med 2005;28(2):S2:150–8.
29. Jackson EL. Leisure constraints: a survey of past research. Leisure Sci 1988;10:203–5.
30. Terry D. Whither scenic beauty? Visual landscape quality assessment in the 21st century. Landscape Urban Plan 2001;54:267–81.
31. Brownson RC, Hoehner C, Day K, Forsyth A, Sallis JF. Measuring the built environment for physical activity: state of the science. Am J Prev Med 2009;36(4S):XXX–XXX.
32. Lytle LA. Measuring the food environment: state of the science. Am J Prev Med 2009;36(4S):XXX–XXX.

Table 1

Historical contributions of various disciplines to contemporary measures of physical activity environments

Domain	Health, behavioral science, exercise science fields	City planning, transportation, urban design, geography fields	Leisure studies, parks, and recreation fields
Settings of interest	Recreation facilities, schools, worksites	Design of communities	Parks and recreation facilities
Physical activity behaviors of interest	Recreational or leisure time physical activity	Walking and cycling for transportation	Recreational or leisure time physical activity
Key concepts	Physical activity in specific settings, social environment, access to recreation facilities, home equipment, neighborhood attributes (function, safety, aesthetics, and destinations)	Walkability, often defined by 3Ds of residential density, land-use diversity, and pedestrian-oriented design	Constraints to leisure; biophysical, social, managerial aspects of recreation environments
Measurement approaches	Direct observation, self-report	Integration of data within GIS, self- report	Ratings of aesthetics
Key contributions	Measures of numerous social and built environment attributes; measured several types of settings; psychometric evaluation of measures; multiple measurement methods	GIS methods, walkability and other land-use concepts	Conceptualization of recreation environment characteristics, measurement of aesthetics