

11-6-2014

Home and Workplace Built Environment Supports for Physical Activity

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Recommended Citation

Adlakha, Deepti; Hipp, J. Aaron; Marx, Christine M.; Lin, Yang; Tabak, Rachel; Dodson, Elizabeth A.; and Brownson, Ross C., "Home and Workplace Built Environment Supports for Physical Activity" (2014). *Brown School Faculty Publications*. Paper 17.
http://openscholarship.wustl.edu/brown_facpubs/17

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Final version available at: <http://www.ajpmonline.org/article/S0749-3797%2814%2900490-5/fulltext>

Citation: Adlakha, D., Hipp, A. J., Marx, C., Yang, L., Tabak, R., Dodson, E. A., & Brownson, R. C. Home and Workplace Built Environment Supports for Physical Activity. *American Journal of Preventive Medicine*. doi: 10.1016/j.amepre.2014.08.023

Home and Workplace Built Environment Supports for Physical Activity

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Final version available at: <http://www.ajpmonline.org/article/S0749-3797%2814%2900490-5/fulltext>

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Background: Physical inactivity has been associated with obesity and related chronic diseases. Understanding built environment (BE) influences on specific domains of physical activity (PA) around homes and workplaces is important for public health efforts and interventions to increase population PA.

Purpose: To examine the association of home and workplace BE features with PA occurring across specific life domains (work, leisure, and travel).

Methods: Between 2012 and 2013, telephone interviews were conducted with participants in four Missouri metropolitan areas. Questions included sociodemographic characteristics, home and workplace supports for PA, and dietary behaviors. Data analysis was conducted in 2013; logistic regression was used to examine associations between BE features and domain-specific PA.

Results: In home neighborhoods, seven of 12 BE features (availability of fruits and vegetables, presence of shops and stores, bike facilities, recreation facilities, crime rate, seeing others active, and interesting things) were associated with leisure PA. The global average score of home neighborhood BE features was associated with greater odds of travel PA (AOR=1.99, 95% CI=1.46, 2.72), leisure PA (AOR=1.84, 95% CI=1.44, 2.34), and total PA (AOR=1.41, 95% CI=1.04, 1.92). Associations between workplace neighborhoods' BE features and workplace PA were small, but in the expected direction.

Conclusions: This study offers empirical evidence on BE supports for domain-specific PA. Findings suggest that diverse, attractive, and walkable neighborhoods around workplaces support walking, bicycling, and use of public transit. Public health practitioners, researchers, and

worksite leaders could benefit by utilizing worksite domains and measures from this study for future BE assessments.

Introduction

Physical inactivity is a primary modifiable risk factor for obesity and related chronic diseases.¹ Evidence shows a steep rise in rates of physical inactivity among urban populations.² Fewer than 50% of adults and 40% of youth meet U.S. physical activity (PA) guidelines, with the built environment (BE) identified as a reason for limited PA.³⁻⁶

Elements of home neighborhood BE (e.g., streets, sidewalks) have been widely investigated.⁷ However, their impact on specific domains of everyday life in which PA occurs (e.g., at work, while travelling) needs exploration. Because adults spend about half of their waking hours at workplaces,⁸ the influence of workplace neighborhoods is potentially important. This study examines relationships between home and workplace BE features, domain-specific PA (work, travel, leisure), and total PA.

Methods

In 2012–2013, telephone interviews (N=2,015) were conducted with employed adults residing in four Missouri metropolitan areas: St. Louis, Kansas City, Springfield, and Columbia. Eligibility criteria included: (1) ability to speak English or Spanish; (2) age 21–65 years; (3) employed in at least one occupation (20 hours/week) at a single worksite; and (4) worksite has \geq five employees. Exclusion criteria included: (1) presence of medical condition that interferes with ability to walk;

(2) pregnancy; and (3) self-employment. Given lack of consensus on what defines a unique neighborhood,⁹ census tracts were used as the primary definition. Two samples were drawn: a (1) representative sample, with oversampling of census tracts in small metropolitan areas; and (2) high-density/minority sample drawn from census tracts with high population density and high minority population (% African American, % Hispanic). Detailed study design, participant recruitment, and sociodemographic characteristics (Appendix Table 1) have been described in supplementary text and related studies.^{10, 11} The IRBs of Washington University in St. Louis and University of Missouri-Columbia approved study procedures.

Twelve items from the Physical Activity Neighborhood Environment Survey (PANES)¹² (Table 1) were used to measure BE features around homes and workplaces. Items were identical across both neighborhoods. Reliability of items has been previously established, with reliability coefficients above 0.60.¹⁰ Four-point Likert scale response options ranging from 1 (strongly agree) to 4 (strongly disagree) were combined as “agree” (*strongly agree, agree*) and “disagree” (*disagree, strongly disagree*). A global average score for home and workplace neighborhood BE features was constructed using Likert scale responses from all 12 items.

In 2013, a series of multiple logistic regressions were used to identify BE predictors of meeting CDC-recommended levels (≥ 150 minutes/week) for work, travel, leisure, and total PA (dichotomous outcomes) using SPSS, version 21 (IBM Corp., Armonk NY). Pairwise interactions between PANES items and interactions between home and workplace global average

scores were tested. Physical activity was measured with the International Physical Activity Questionnaire (IPAQ).¹³ Models were adjusted for age, sex, race, education, and income. Descriptive statistics (Appendix Tables 2–4) and details on data analysis are provided in the supplementary text.

Results

In home neighborhoods, seven of 12 BE features (availability of fruits and vegetables, presence of shops and stores, bike facilities, recreation facilities, crime rate, seeing others active, and interesting things to look at) were associated with leisure PA (Table 1). Six home neighborhood BE features significantly predicted travel PA. Except for crime, no clear associations of individual home neighborhood BE features with workplace PA or total PA were observed. The global average score of home neighborhood BE features predicted significant increases in adjusted odds of engagement in travel PA (AOR=1.99, 95% CI=1.46, 2.72), leisure PA (AOR=1.84, 95% CI=1.44, 2.34), and total PA (AOR=1.41, 95% CI=1.04, 1.92).

A smaller number of associations between workplace neighborhood BE features and workplace PA were significant. Three of 12 workplace neighborhood BE features (bike facilities, interesting things to look at, and crime rate) significantly predicted workplace PA (Table 2). Although other workplace BE features were not significant, overall adjusted odds of engagement in workplace PA were in the expected direction. Certain BE features in workplace neighborhoods (e.g.,

healthy restaurants, bicycle and recreation facilities) significantly supported travel and leisure PA. Bike facilities and presence of interesting things in workplace neighborhoods were significantly associated with PA across all domains. Sidewalks and walkable access to transit were significantly associated with total PA around workplaces.

Similar to home neighborhoods, global average score of workplace BE features was associated with travel PA (AOR=2.13, 95% CI=1.62, 2.80), leisure PA (AOR=1.34, 95% CI=1.09, 1.64), and total PA (AOR=1.30, 95% CI=1.00, 1.68). However, the association between global average score of workplace neighborhood supports with workplace PA was weak and insignificant (AOR=1.01, 95% CI=0.82, 1.25). No significant interactions (pairwise, global average scores) were found between home and workplace BE features.

Discussion

This study is among the first to examine associations between home and workplace BE features (individual, global average) and PA domains around homes and workplaces. Previous studies have demonstrated significant associations between individual BE features and total PA,¹⁴⁻¹⁶ predominantly in home neighborhoods.

The presence of physically active people and interesting things around homes improved odds of leisure and travel PA. Three BE features around workplaces (presence of shops and stores, bicycle facilities, and recreation facilities) were associated with travel PA, implying higher

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engagement in active travel. Bicycling facilities around workplaces increased odds of engagement in travel PA. Interesting things around workplaces resulted in a greater likelihood of engagement in PA across all domains. Around workplaces, public transit access and presence of sidewalks were significantly associated with total PA, while healthy restaurants promoted leisure and travel PA. These associations imply diverse, attractive, and walkable workplace neighborhoods can serve as incentives for walking, bicycling, and active commuting. Cumulatively, BE features predicted increased odds of travel, leisure, and total PA around homes and workplaces, providing additional evidence of BE supports for specific PA domains.

Crime is a frequently cited barrier to PA.¹⁷ However, its association with PA was inconsistent in this analysis. Previous studies have yielded similar inconclusive results acknowledging that the impact of perceived safety from crime on walking in residential neighborhoods needs careful examination.^{14, 17} This may relate to the complexity of measuring crime (e.g., time of occurrence, people's perceptions, and coping mechanisms influence PA differently).¹⁴

The cross-sectional study design limits causal inference.¹⁸ Certain census tracts were oversampled to increase variability by race/ethnicity and walkability, but this was not adjusted for in statistical models. Self-reported PA and neighborhood measures are subject to bias (e.g., social desirability of PA; physically active people may notice more neighborhood destinations). Another limitation of this study and PA literature in general is a lack of consensus on measuring workplace PA (e.g., lack of tested items, inadequate details on types of workplace PA).^{19, 20} The

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IPAQ measure of workplace PA is meant to capture only work-related PA.^{21, 22} However, without a clear description of workplace PA, study participants could be reporting time spent in PA during work hours (e.g., walking or bicycling to a restaurant during lunch) as workplace, leisure, or travel PA.

Data on BE characteristics to support PA across specific domains (work, travel, and leisure) provide information to guide design decisions for healthy living around homes and workplaces.^{23, 24} Addition of key worksite domains can guide the development of objective measures of worksite PA to explore combined effects of BE around homes and workplaces. Additional research is needed to advance measurement and evaluation of workplace PA.

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

Acknowledgements

This work was supported by the NCI Centers for Transdisciplinary Research on Energetics and Cancer (TREC) (Washington University in St. Louis, U54 CA155496). The opinions or assertions contained herein are the private ones of the authors and are not considered as official or reflecting the views of the National Institutes of Health.

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Table 1. Home neighborhood predictors of meeting CDC recommended levels of work, travel, leisure, and total PA

Variable	Work PA^a (aOR ^b , 95% CI ^c)	Travel PA (aOR, 95% CI)	Leisure PA (aOR, 95% CI)	Total PA (aOR, 95% CI)
Large selection of fresh fruits and vegetables	1.06 (0.84-1.35)	1.27 (0.94-1.72)	1.33* (1.05-1.68)	1.23 (0.92-1.63)
Opportunities to purchase fast food	0.77 (0.58-1.02)	1.20 (0.85-1.70)	0.92 (0.70-1.21)	0.77 (0.55-1.09)
Presence of healthy restaurants	0.99 (0.80-1.22)	1.28 (0.98-1.68)	1.12 (0.91-1.39)	1.10 (0.84-1.43)
10-15 minute walk to a transit stop	0.89 (0.70-1.13)	1.06 (0.78-1.45)	1.01 (0.80-1.28)	0.90 (0.66-1.22)
Sidewalks on most streets	0.94 (0.72-1.23)	1.61* (1.11-2.34)	1.23 (0.95-1.59)	1.01 (0.73-1.40)
Shops, stores, or markets	1.08 (0.89-1.32)	1.33* (1.03-1.71)	1.22* (1.01-1.48)	1.16 (0.91-1.49)
Facilities to bicycle	0.90 (0.71-1.09)	1.31* (1.02-1.67)	1.27* (1.05-1.53)	1.09 (0.86-1.39)
Recreation facilities	1.06 (0.84-1.34)	1.46* (1.08-1.97)	1.27* (1.02-1.59)	1.27 (0.96-1.67)
Crime rate makes it unsafe to walk	0.80* (0.64-0.98)	0.99 (0.76-1.27)	1.25* (1.02-1.54)	1.05 (0.81-1.36)
Traffic makes it difficult to walk	0.80 (0.63-1.03)	0.94 (0.70-1.25)	1.23 (0.97-1.56)	1.04 (0.73-1.41)
See people being physically active	1.03 (0.82-1.30)	1.51* (1.13-2.03)	1.59* (1.27-2.00)	1.24 (0.94-1.64)
Interesting things to look at	0.95 (0.77-1.17)	1.31* (1.01-1.70)	1.68* (1.37-2.07)	1.18 (0.92-1.53)
Global Average	0.91 (0.71-1.16)	1.99* (1.46-2.72)	1.84* (1.44-2.34)	1.41* (1.04-1.92)
Home Neighborhood Score				

*denotes statistical significance at p<0.05

^a Physical Activity

^b Adjusted Odds Ratios; adjusted for age (continuous), and sex, race, education, income (all categorical).

^c Confidence Interval

n range: 1784-1862

Table 2. Workplace neighborhood predictors of meeting CDC recommended levels of work, travel, leisure, and total PA

Variable	Work PA^a (aOR ^b , 95% CI ^c)	Travel PA (aOR, 95% CI)	Leisure PA (aOR, 95% CI)	Total PA (aOR, 95% CI)
Large selection of fresh fruits and vegetables	1.16 (0.95-1.43)	1.22 (0.95-1.57)	1.23* (1.01-1.50)	1.08 (0.84-1.39)
Opportunities to purchase fast food	0.87 (0.69-1.10)	0.85 (0.63-1.15)	1.01 (0.81-1.27)	1.17 (0.86-1.58)
Presence of healthy restaurants	0.98 (0.79-1.22)	1.53* (1.16-2.02)	1.26* (1.02-1.55)	1.05 (0.83-1.38)
10-15 minute walk to a transit stop	1.21 (0.94-1.56)	1.34 (0.96-1.87)	1.27 (0.99-1.62)	1.36* (1.01-1.84)
Sidewalks on most streets	1.10 (0.88-1.38)	1.30 (0.97-1.74)	1.21 (0.97-1.51)	1.38* (1.05-1.81)
Shops, stores, or markets	1.05 (0.86-1.27)	1.51* (1.19-1.93)	1.14 (0.94-1.38)	1.16 (0.92-1.48)
Facilities to bicycle	1.29* (1.06-1.57)	1.63* (1.28-2.07)	1.33* (1.10-1.61)	1.54* (1.20-1.98)
Recreation facilities	1.15 (0.94-1.40)	1.60* (1.25-2.05)	1.25* (1.03-1.51)	1.20 (0.94-1.53)
Crime rate makes it unsafe to walk	0.76* (0.60-0.96)	1.06 (0.80-1.40)	1.19 (0.96-1.49)	0.92 (0.69-1.22)
Traffic makes it difficult to walk	0.90 (0.74-1.10)	1.15 (0.91-1.47)	1.16 (0.96-1.41)	1.02 (0.80-1.31)
See people being physically active	1.14 (0.94-1.40)	1.44* (1.21-1.86)	1.22* (1.01-1.49)	1.18 (0.92-1.51)
Interesting things to look at	1.22* (1.00-1.59)	1.90* (1.47-2.45)	1.21* (1.00-1.46)	1.33* (1.05-1.70)
Global Average Workplace Neighborhood Score	1.01 (0.82-1.25)	2.13* (1.62-2.80)	1.34* (1.09-1.64)	1.30* (1.00-1.68)

*denotes statistical significance at p<0.05

^a Physical Activity

^b Adjusted Odds Ratios; adjusted for age (continuous), and sex, race, education, income (all categorical).

^c Confidence Interval

n range: 1708-1864

Appendix

Methods

Study Design and Participant Recruitment

Participants were from the Worksite Policies and Neighborhood Influence on Obesity and Cancer Risk study, which is a cross-sectional study designed to understand the environmental and worksite policy influences on employees' obesity status. Study size was determined by calculating statistical power for varying anticipated effect sizes ($r = 0.3$ (medium) - 0.5 (large)) and sample sizes ($n = 500$ to 2000), as recommended for studies of this nature.^{25, 26} Participants were recruited using list-assisted telephone random-digit-dialing methods and a total of 2015 participants completed a self-report survey over the telephone.

Survey Development

The telephone survey instrument developed for this study was based on existing self-reported and environmental assessment instruments, and input from a special Questionnaire Advisory Panel (QAP) that included six external researchers and two practitioners with expertise in survey development, nutrition/food environment, physical activity, transportation, and worksite environmental intervention. The survey was edited following their review. Next, volunteers who were representative of the participant population were recruited by telephone from a research registry for cognitive response testing of the survey. Twelve participants consented and participated in telephone interviews with two trained project staff (mean administration time, 53 minutes; range, 37-66 minutes). Cognitive response testing findings led to changes in the interviewer script and instructions to enhance participants' understanding of question intent.

Physical Activity Assessment

Selected questions from the International Physical Activity Questionnaire (IPAQ)¹³ were administered as part of the telephone survey to collect participants' self-reported physical activity, specifically the frequency and duration of occupational and leisure-time physical activities. The IPAQ has been extensively tested internationally for reliability (Spearman's rho clustered ~0.8) and validated with objective measures (median rho ~0.3), which are comparable to most other self-reported validation studies.²⁷

Data Analysis

A series of 26 multiple logistic regressions were conducted using Statistical Package for the Social Sciences (SPSS) version 21 to identify BE predictors of meeting CDC recommended levels (≥ 150 minutes/ week) for work, travel, leisure-time, and total PA (dichotomous outcomes). One multiple logistic regression for each of the 12 items in the Physical Activity Neighborhood Environment Survey (PANES) in the home neighborhood and one for each of the 12 PANES items in the work neighborhood was conducted. Two multiple logistic regressions tested global average neighborhood scores (obtained from PANES) for both home and workplace neighborhoods. In addition, we also used logistic regression with an interaction term and 95% confidence interval to test pairwise interactions between PANES items as well as interaction between global average neighborhood scores for both home and workplace neighborhoods. SPSS removes missing values in a list wise manner, leaving only cases with all variable data in the final regression model. All models were adjusted for individual covariates such as age, sex, race, education, and income. Among these control variables, age was treated as a continuous variable

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and the other variables (sex, race, education, and income) were categorical variables. Each variable used in this analysis had a response rate greater than 93.5%. Age, sex, race, education, income, and items from PANES were compared for participants missing and not missing the PA outcome variables using independent samples t-tests. There were no significant differences between these groups.

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Appendix Table 1. Descriptive statistics of sample population

Variable	n	%	Mean	Median	SD
Age (continuous)	1995	-	48.15	49.00	18.37
Sex	2013	99.90	0.32	0.00	0.47
Female	1361	67.50			
Male	652	32.40			
Race	2015	100.00	1.46	1.00	0.64
White	1250	62.00			
African American	601	29.80			
Other	164	8.10			
Education	2008	99.70	2.51	3.00	1.05
Grade school or high school	447	22.20			
College or associate degree	513	25.50			
College graduate	634	31.50			
Graduate degree	414	20.50			
Income	1886	93.60	1.79	2.00	0.41
\$0K-\$29,000	391	19.40			
\$>29,000-\$75000	1495	74.20			

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Citation: Adlakha, D., Hipp, A. J., Marx, C., Yang, L., Tabak, R., Dodson, E. A., & Brownson, R. C. Home and Workplace Built Environment Supports for Physical Activity. *American Journal of Preventive Medicine*. doi: 10.1016/j.amepre.2014.08.023

Appendix Table 2. Descriptive statistics of sample population meeting and those not meeting CDC recommended levels of work, travel, leisure, and total PA

Variable	n	%
Work PA	1950	100.0
Meeting CDC guidelines	990	50.8
Not meeting CDC guidelines	960	49.2
Travel PA	1995	100.0
Meeting CDC guidelines	386	19.3
Not meeting CDC guidelines	1609	80.7
Leisure PA	1990	100.0
Meeting CDC guidelines	951	47.8
Not meeting CDC guidelines	1039	52.2
Total PA	1922	100.0
Meeting CDC guidelines	1556	81.0
Not meeting CDC guidelines	366	19.0

Appendix Table 3. Descriptive statistics of home neighborhood healthy eating and physical activity features

Variable	n	%
Large selection of fresh fruits and vegetables	1998	100.0
Agree	1584	79.3
Disagree	414	20.7
Opportunities to purchase fast food	2006	100.0
Agree	271	13.5
Disagree	1735	86.5
Presence of healthy restaurants	1997	100.0
Agree	1416	70.9
Disagree	581	29.1
10-15 minute walk to a transit stop	1970	100.0
Agree	1554	78.9
Disagree	416	21.1
Sidewalks on most streets	2011	100.0
Agree	1691	84.1
Disagree	320	15.9
Shops, stores, or markets	2007	100.0
Agree	1220	60.8
Disagree	787	39.2
Facilities to bicycle	2001	100.0
Agree	1156	57.8
Disagree	845	42.2
Recreation facilities	2007	100.0
Agree	1545	77.0
Disagree	462	23.0
Crime rate makes it unsafe to walk	1966	100.0
Agree	1260	64.1
Disagree	706	35.9
Traffic makes it difficult to walk	2003	100.0
Agree	1587	79.2
Disagree	416	20.8
See people being physically active	2006	100.0
Agree	1534	76.5
Disagree	472	23.5
Interesting things to look at	1995	100.0
Agree	1302	65.3
Disagree	693	34.7

Appendix Table 4. Descriptive statistics of workplace neighborhood healthy eating and physical activity features

Variable	n	%
Large selection of fresh fruits and vegetables	2014	100.0
Agree	845	42.0
Disagree	1169	58.0
Opportunities to purchase fast food	2000	100.0
Agree	436	21.8
Disagree	1564	78.2
Presence of healthy restaurants	1989	100.0
Agree	1425	71.6
Disagree	564	28.4
10-15 minute walk to a transit stop	1945	100.0
Agree	1583	81.4
Disagree	362	18.6
Sidewalks on most streets	1999	100.0
Agree	1528	76.4
Disagree	471	23.6
Shops, stores, or markets	2004	100.0
Agree	1035	51.6
Disagree	969	48.4
Facilities to bicycle	1958	100.0
Agree	934	47.7
Disagree	1024	52.3
Recreation facilities	1940	100.0
Agree	1067	55.0
Disagree	873	45.0
Crime rate makes it unsafe to walk	1923	100.0
Agree	1448	75.3
Disagree	475	24.7
Traffic makes it difficult to walk	1988	100.0
Agree	1142	57.4
Disagree	846	42.6
See people being physically active	1987	100.0
Agree	1221	61.4
Disagree	766	38.6
Interesting things to look at	1984	100.0
Agree	1151	58.0
Disagree	833	42.0