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Short Communication

Exploring associations between perceived home and work neighborhood environments, diet behaviors, and obesity: Results from a survey of employed adults in Missouri

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ABSTRACT

Dietary behaviors are associated with obesity, and may be influenced by the environment. The objective of the current work was to investigate whether perceptions of built environment factors related to eating in the residential neighborhood will have different, independent associations with BMI and dietary behaviors than perceived built environment factors in the worksite neighborhood. In 2012–2013, a cross-sectional telephone-survey of Missouri adults (n = 2015) assessed perceptions of home and workplace built environment factors related to eating, dietary behaviors, and height and weight. Logistic regression models explored associations between perceived neighborhood built environment variables, diet, and obesity. The only variable associated with any of the outcomes explored in the fully adjusted models was the home neighborhood composite scale. None of the work environment variables were significantly associated with any of the health/behavior outcomes after adjustment. Few associations were found after adjustment for personal and job-related characteristics, and none were identified with the workplace neighborhood environment. While few home environment associations were found after adjustment, and none were identified with the perceived workplace neighborhood environment, the current study adds to the limited literature looking at associations between the perceived neighborhood around the workplace neighborhood and the perceived neighborhood around the home and dietary behaviors and obesity in adults. Future studies are needed to determine whether relationships between these environments and behavior exist, and if so, if they are causal and warrant intervention attempts.

1. Introduction

Obesity is a major public health threat (Ogden et al., 2015) with significant health consequences.(Borrell and Samuel, 2014) Dietary behaviors such as fruit and vegetable intake can help prevent chronic disease, (Dietary Guidelines Advisory Committee, 2015) and sugar-sweetened beverage intake drives increased calorie consumption and is associated with obesity. (Mozaffarian et al., 2011) Ecologic frameworks highlight the importance in influencing health behaviors of factors beyond the individual level, including inter-personal, community, and policy levels. These frameworks show that health behavior is influenced by multiple levels and that the levels interact. (Stokols et al., 2003; Sallis and Owen, 2015) While such frameworks suggest the environment may be important, including characteristics such as availability of supermarkets and access to fast food and restaurants, findings have been mixed. (Leal and Chaix, 2011; Moore et al., 2013; Jeffery et al., 2006)

Most research has focused on the home neighborhood environment and its relationship with obesity and dietary behaviors. (Leal and Chaix, 2011) The limited research exploring multiple environments (e.g., work and home) has demonstrated these environments likely differ, (Burgoine and Monsivais, 2013) and residential and work environments may be related to dietary each environment may be related to

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behaviors and/or obesity in different ways. (Moore et al., 2013; Thornton et al., 2013; Burgoine et al., 2013) This is important, given American workers spend, on average, 8.9 h per day at work.(US Bureau of Labor Statistics, 2015) In the work neighborhood environment, existing research has shown associations between objective measures of using spatial analysis techniques (e.g., mapping and databases of food outlets (Leal and Chaix, 2011; Jeffery et al., 2006; Thornton et al., 2013; Burgoine et al., 2013; Barrington et al., 2015)) and dietary behaviors. (Jeffery et al., 2006; Thornton et al., 2013; Zenk et al., 2011; Kerr et al., 2012). Yet few studies have investigated perceptions of the neighborhood and its association with obesity or dietary behaviors. (Moore et al., 2013) Perceptions of the environment are different from geographic factors, and capture only features participants are aware of or consider to be available. (Caspi et al., 2012)

The current study aims to investigate whether perceptions of built environment factors related to eating in the residential neighborhood will have different associations with BMI and dietary behaviors than perceived built environment factors in the worksite neighborhood.

2. Materials and methods

2.1. Design

The participants for this study were from the Supports at Home and Work for Maintaining Energy Balance (SHOW-ME) study. (Hoehner et al., 2013) SHOW-ME is a cross-sectional telephone-survey based study, developed to examine associations between environmental and policy influences of where participants live and work and energy balance behaviors and outcomes.

2.2. Sample

To represent a variety of Missouri cities, variation in the built environment, and representation by racial/ethnic minority and low-income populations, census tracts in four Missouri metropolitan areas (United States Census Bureau) (St. Louis area, Kansas City area, City of Springfield, and City of Columbia) were sampled. Census tracts were excluded from sampling if they had a population density less than the 10th percentile of the population density of study areas or >50% inhabitants aged 15–24 years. To achieve the desired sample, individuals were sampled using a multistage stratified sampling procedure. The seven strata included: metropolitan size (large vs. small), and within the large metropolitan size, walkability (low, moderate, and high),(Hoehner et al., 2013; Frank et al., 2010) and racial/ethnic minority (low vs. high) strata. Potential participants were contacted using list-assisted, targeted telephone random-digit-dialing with landline phone numbers. Data on cell phone use just before the start of the data collection period, (Blumberg and Luke, 2011a; Blumberg and Luke, 2011b) showed ~27.8% of US adults live in households that only have wireless phones. The percent in Missouri was lower (22.4%), but was higher for adults age 34 and younger, for racial and ethnic minorities, and for those living in poverty. Monitoring throughout data collection did not show deficits in participants in these age, race/ethnicity, or socio-economic categories. However, differences may have remained for other characteristics of wireless-only households that were not captured through standard demographics. The sample included the first eligible adult from each household; only one participant per household could participate. The response rate was 15%. Between April 2012 and April 2013, 2015 participants were recruited using three waves of data collection. To be included, participants were required the be: between the ages of 21 and 65 years; employed outside of the home at one primary location; employed for 20 or more hours per week at one site with at least five employees; not pregnant; and no physical limitation to prevent walking or bicycling in the past week. The study design was approved by the Human Research Protection Office of Washington University in St. Louis.

2.3. Measures

2.3.1. Survey development

Existing self-reported instruments with reliability and validity evidence served as the basis for the survey tool. (CHIS California Health Interview Survey, 2009; California Department of Public Health; Echeverria et al., 2004; Moore et al., 2009; Sallis et al., 2010; Centers for Disease Control and Prevention (CDC), 2011) The team also drew on input from a special Questionnaire Advisory Panel (including researchers from universities in the US and Australia and from the Centers for Disease Control and Prevention) who are experts in survey development, nutrition/food environment, PA, transportation, and worksite environmental intervention, was convened especially for this study. Test-retest assessment in a subsample found reliability coefficients ranged from 0.41 to 0.97, with 80% of items having reliability coefficients of >0.6. (Hoehner et al., 2013) Additional description of the survey instrument development and telephone interview procedures have been described previously. (Hoehner et al., 2013)

2.3.2. Main outcomes

2.3.2.1. Body Mass Index (BMI). BMI was calculated (kg/m^2) from self-reported height and weight, and was dichotomized at 30, based on the definition for obesity (Ogden et al., 2015).

2.3.2.2. Dietary intake. Measurement of fruit and vegetable intake was based on the 2011 Behavioral Risk Factor Surveillance Survey, (Centers for Disease Control and Prevention (CDC), 2011) using a reference period of the previous month. Daily totals for sugar-sweetened beverage consumption was computed by summing reported beverage consumption over the past seven days across several categories (non-diet soda, coffee and tea sweetened with caloric sweeteners, sports drinks, other-juice, Kool-aid). Participants could report the number of times per day, week, or month they consumed the given food item (e.g., individual items for sports drink, and soda), which were converted to continuous variables, servings per day. Frequency of fast food consumption in the previous week was measured using one item: "In the past 7 days, how many times did you eat fast food? Include fast food meals eaten at work, at home, or at fast-food restaurants, carryout or drive through." (CHIS California Health Interview Survey, 2009) Diet behaviors included eating fruits and vegetables (at least 3 times per day vs. fewer), drinking sugar-sweetened beverages (at least 1 time per day vs. <1), and eating fast food (at least two times per week vs. one or none). These variables were dichotomized based on the low prevalence of fruit and vegetable intake among U.S. adults, the contribution of sugar-sweetened beverages and fast-food to U.S. diets, as well as the distribution in the data.

2.3.3. Main exposures

2.3.3.1. Home neighborhood environment. Three items adapted from Echeverria et al. were used to assess the ease of purchasing fresh fruits and vegetables and the quality and selection of these items in the participant's neighborhood. (Echeverria et al., 2004) One item from the California Check for Health measure (California Department of Public Health) was adapted to assess whether "there are healthy restaurants, like salad, or sandwich shops, in" the respondent's neighborhood. An additional item was used to assess access to fast food, (Moore et al., 2009) which was reverse coded. Finally, one item, adapted from the Physical Activity Neighborhood Environment Scale (PANES) ("Many shops, stores, markets or other places to buy things I need are within easy walking distance of my home.") was used. (Sallis et al., 2010) Full item wording can be found in Table 1. All six items used a four-point scale; respondents could strongly disagree, disagree, agree, or strongly agree. A new variable was created as the average of these six variables. The Cronbach's alpha for this composite variable was 0.82.

Table 1
Demographic characteristics of Missouri employees completing SHOW-ME Survey in 2012–2013.

Characteristic	Categories	N	%
Gender	Male	628	32.2
	Female	1325	67.8
Weight status	Non-obese	1232	66.3
	Obese	625	33.7
Age	21–44	668	34.6
	45–54	642	32.2
	55–65	621	32.2
Race	White	1216	62.9
	Black/African American	586	30.3
	Other	131	6.8
Education	GED, HS, or less	427	21.9
	Some college or Associate Degree	496	25.4
	College graduate	624	32.0
	Graduate degree (Masters, PhD, MD, JD, etc)	402	20.6
Supervise others	Yes	710	36.5
	No	1234	63.5
Work schedule	Regular day schedule	1486	76.1
	Regular evening/night schedule	191	9.8
	Rotating/other schedule	275	14.1
Hours worked	<40 h/week	552	28.4
	40–49 h/week	1128	57.9
	≥50 h/week	267	13.7
Commute time	<15 min	619	31.8
	15–29 min	854	43.8
	≥30 min	476	24.4
Schedule flexibility	No flexibility	527	27.0
	Little/some flexibility	870	44.6
	A lot of/complete flexibility	552	28.3
Other job	Yes	181	9.3
	No	1771	90.7
Worksite size	0–49 employees	600	32.3
	50–199 employees	590	31.7
	200 or more employees	670	36.0
Home neighborhood environment			
It is easy to buy fresh fruits and vegetables in my neighborhood	Strongly disagree	76	3.9
	Disagree	250	12.8
	Agree	912	46.7
	Strongly agree	714	36.6
The fresh produce in my neighborhood is of high quality.	Strongly disagree	76	3.9
	Disagree	292	15.1
	Agree	1043	54.1
	Strongly agree	518	26.9
There is a large selection of fresh fruits and vegetables available in my neighborhood.	Strongly disagree	75	3.9
	Disagree	326	16.8
	Agree	974	50.2
	Strongly agree	565	29.1
There are healthy restaurants, like salad, or sandwich shops, in my neighborhood.	Strongly disagree	108	5.6
	Disagree	452	23.3
	Agree	1025	52.9
	Strongly agree	352	18.2
There are many opportunities to purchase fast food in my neighborhood.*	Strongly agree	42	2.2
	Agree	224	11.5
	Disagree	968	49.7
	Strongly disagree	712	36.6
Many shops, stores, markets or other places to buy things I need are within easy walking distance of my home.	Strongly disagree	176	9.0
	Disagree	590	30.3
	Agree	830	42.6
	Strongly agree	351	18.0
Work neighborhood environment			
There are healthy restaurants, like salad or sandwich shops, in the neighborhood surrounding my workplace.	Strongly disagree	162	8.4
	Disagree	385	20.0
	Agree	909	47.1
	Strongly agree	473	24.5
There are many opportunities to purchase fast food in the neighborhood surrounding my workplace.*	Strongly disagree	717	37.0
	Disagree	797	41.1
	Agree	308	15.9
	Strongly agree	117	6.0
Many shops, stores, markets or other places to buy things I need are within easy walking distance of my work.	Strongly disagree	278	14.3
	Disagree	663	34.1
	Agree	689	35.5
	Strongly agree	313	16.1

*Reverse coded.

2.3.3.2. Workplace neighborhood environment. Respondents were asked about the neighborhood around their workplace using three items, including one adapted from Moor 2009, asking about opportunities to purchase fast food. (Moore et al., 2009) A new item to assess availability of healthy restaurants was developed for this survey. The third item mirrors the item used to assess the home neighborhood environment regarding access to shops to buy things, adapted from PANES. (Sallis et al., 2010) Full item wording can be found in Table 1. These items use the same response options as those assessing the home neighborhood environment. A composite variable was developed by averaging these three variables; the Cronbach's alpha was 0.71.

2.3.4. Covariates and socio-demographic variables

We explored several characteristics as potential covariates, including race, age, gender, highest level of education completed. Characteristics of the participants' jobs were also considered as potential confounders, including whether they supervise others, the type of schedule they work (i.e., regular daytime schedule, regular night shift, rotating shift), how many hours they work per week, the amount of time they spend commuting, flexibility of work hours, whether they have another job, and the size of their employer.

2.4. Analysis

Logistic regression models explored the associations between neighborhood environment variables and diet and obesity; these were conducted with and without adjustment for demographic factors, and with the addition of potential confounding factors regarding their job. Each environment variable was tested separately followed by a model including a composite variable. Variables for adjustment were selected based on associations in bivariate analyses and those commonly used in the nutrition epidemiology literature. To be consistent, we included the same adjustment variables in all analyses.

3. Results

The sample was primarily female (68%) and white (63%), with one-third of participants obese (34%). The participants in this study were highly educated, with 53% having at least a college degree. Additional details about the study sample are shown in Table 1.

As shown in Table 2, the home neighborhood composite scale was negatively associated with the likelihood of being obese (aOR = 0.81, 95% CI: 0.68–0.96), and was the only neighborhood environment variable associated with any of the outcomes explored in the fully adjusted models. None of the work environment variables were significantly associated with any of the health/behavior outcomes after adjustment (Table 2). None of the work or home neighborhood environment variables was associated with sugar-sweetened beverage or fast food intake in the fully adjusted models.

4. Discussion

This study explored associations between perceptions of the built environment around both home and work, and dietary behaviors or obesity. Only the association, between obesity and the home neighborhood composite variable was significant in the fully adjusted model (though this should be viewed with caution given the large number of comparisons tests). There were no significant associations between perceptions of the environment and any of the outcomes explored, after adjustment. Our findings differ from previous studies using objective measures of access to the built environment, which have reported stronger associations with eating behaviors and obesity when the built environment was measured around the workplace, compared to when measured around the home environment. (Thornton et al., 2013; Burgoine et al., 2013; Barrington et al., 2015) These previous studies used objective data, based on the respondent's work address and databases of food outlet availability, (Burgoine and Monsivais, 2013; Thornton et al., 2013; Barrington et al., 2015) rather than the respondent's perception of his/her home and work neighborhoods. Studies that approach the question of how the built environment relates to dietary behaviors only in terms of objectively measured spatial

Table 2
Crude and adjusted[a,b] associations (ORs) between home and work neighborhood environments and fruit and vegetable intake (<3/3 +/d) fast food intake (±2×/week), sugar-sweetened beverage intake (<1/1 +/d), and obesity among Missouri working adults, 2012–2013.

	OR (95% CI)	A OR[a] (95% CI)	A OR[b] (95% CI)
Home neighborhood environment			
Fruit and vegetable intake			
Home neighborhood scale	1.15 (0.98–1.35)	1.11 (0.94–1.31)	1.11 (0.94–1.31)
Easy to buy	**1.13 (1.01–1.26)**	1.09 (0.97–1.22)	1.09 (0.97–1.23)
High quality produce	1.09 (0.97–1.23)	1.04 (0.92–1.18)	1.04 (0.92–1.18)
Large selection	1.08 (0.96–1.21)	1.04 (0.92–1.17)	1.03 (0.91–1.16)
Healthy restaurants	**1.21 (1.08–1.36)**	**1.14 (1.01–1.28)**	1.12 (0.99–1.27)
Fast food restaurants	1.01 (0.89–1.14)	1.02 (0.90–1.16)	1.04 (0.91–1.18)
Many shops, stores	0.94 (0.85–1.04)	1.00 (0.90–1.12)	1.00 (0.90–1.12)
Fast food intake			
Home neighborhood scale	0.87 (0.74–1.01)	0.92 (0.78–1.08)	0.94 (0.80–1.11)
Easy to buy	0.90 (0.80–1.01)	0.94 (0.84–1.06)	0.96 (0.85–1.08)
High quality produce	**0.88 (0.78–0.99)**	0.92 (0.81–1.04)	0.95 (0.84–1.08)
Large selection	0.89 (0.80–1.00)	0.93 (0.83–1.05)	0.96 (0.85–1.08)
Healthy restaurants	**0.86 (0.77–0.96)**	0.92 (0.82–1.04)	0.93 (0.82–1.05)
Fast food restaurants	1.08 (0.96–1.23)	1.07 (0.94–1.21)	1.07 (0.94–1.22)
Many shops, stores	0.95 (0.86–1.05)	0.92 (0.82–1.02)	0.92 (0.83–1.03)
Sugar-sweetened beverage intake			
Home neighborhood scale	0.89 (0.76–1.04)	0.98 (0.83–1.16)	0.93 (0.78–1.11)
Easy to buy	0.89 (0.80–1.00)	0.97 (0.86–1.10)	0.94 (0.83–1.07)
High quality produce	**0.84 (0.75–0.94)**	0.92 (0.81–1.05)	0.90 (0.79–1.03)
Large selection	**0.84 (0.75–0.94)**	0.91 (0.81–1.03)	0.89 (0.78–1.01)
Healthy restaurants	0.92 (0.82–1.03)	1.06 (0.94–1.20)	1.02 (0.90–1.16)
Fast food restaurants	1.09 (0.97–1.24)	1.11 (0.97–1.26)	1.06 (0.93–1.22)
Many shops, stores	1.09 (0.99–1.21)	1.02 (0.91–1.14)	1.01 (0.90–1.13)
Obesity			
Home neighborhood scale	**0.79 (0.66–0.93)**	**0.81 (0.68–0.96)**	**0.81 (0.68–0.96)**
Easy to buy	0.89 (0.79–1.00)	0.91 (0.81–1.03)	0.90 (0.79–1.02)
High quality produce	**0.85 (0.75–0.97)**	0.88 (0.77–1.00)	0.89 (0.78–1.01)
Large selection	**0.85 (0.75–0.96)**	**0.87 (0.77–0.99)**	0.88 (0.77–1.00)
Healthy restaurants	**0.85 (0.75–0.96)**	0.89 (0.79–1.01)	0.88 (0.77–1.00)
Fast food restaurants	1.07 (0.94–1.22)	1.07 (0.93–1.23)	1.06 (0.92–1.23)
Many shops, stores	0.93 (0.83–1.03)	0.90 (0.80–1.00)	0.89 (0.79–1.00)
Work neighborhood environment			
Fruit and Vegetable Intake			
Work Neighborhood Scale	1.00 (0.88–1.14)	1.04 (0.91–1.18)	1.03 (0.90–1.18)
Healthy restaurants	1.09 (0.98–1.20)	1.07 (0.96–1.19)	1.06 (0.95–1.19)
Fast food restaurants	0.98 (0.88–1.09)	1.00 (0.90–1.12)	1.00 (0.90–1.12)
Many shops, stores	0.95 (0.86–1.05)	1.00 (0.90–1.10)	0.99 (0.89–1.10)
Fast food intake			
Work neighborhood scale	1.10 (0.97–1.25)	1.08 (0.95–1.23)	1.07 (0.93–1.22)
Healthy restaurants	1.01 (0.91–1.12)	1.02 (0.92–1.13)	1.02 (0.91–1.13)
Fast food restaurants	**1.12 (1.01–1.25)**	1.10 (0.99–1.22)	1.09 (0.98–1.22)
Many shops, stores	1.05 (0.96–1.16)	1.02 (0.93–1.13)	1.02 (0.92–1.13)
Sugar-Sweetened beverage intake			
Work neighborhood scale	1.08 (0.95–1.23)	1.03 (0.90–1.18)	1.03 (0.89–1.18)
Healthy restaurants	0.95 (0.85–1.05)	0.98 (0.88–1.09)	0.98 (0.87–1.10)
Fast food restaurants	1.10 (1.00–1.23)	1.06 (0.95–1.19)	1.05 (0.94–1.18)
Many shops, stores	1.11 (1.01–1.22)	1.02 (0.92–1.14)	1.02 (0.92–1.14)
Obesity			
Work neighborhood scale	0.97 (0.85–1.12)	0.96 (0.84–1.11)	1.01 (0.87–1.17)
Healthy restaurants	0.98 (0.87–1.09)	0.98 (0.88–1.10)	1.01 (0.90–1.14)
Fast food restaurants	0.99 (0.90–1.12)	1.00 (0.89–1.11)	1.03 (0.91–1.15)
Many shops, stores	0.98 (0.88–1.08)	0.95 (0.86–1.06)	0.98 (0.87–1.09)

Bold indicates statistical significance ($p < 0.05$).
[a] Adjusted for race, age, gender, highest level of education completed.
[b] Adjusted for race, age, gender, highest level of education completed, supervise others, type of schedule, hours worked per week, time spent commuting, flexibility of job, another job, and size employer.

accessibility may overlook other important non-geographic factors in the environment (only capturing proximity); (Caspi et al., 2012) participants may not be aware of the food around them or may not be interested in the options available. They may also consider options that are geographically nearby, but difficult to access (e.g., require crossing a dangerous intersection, neighborhood crime/violence) not to be nearby options.

Socio ecological frameworks suggest that factors at multiple levels are related to behavior, therefore, the null findings in the current study may be the result of the sole focus only on the built environment, which, as the frameworks suggest, may be necessary but not sufficient to influence health behaviors and outcomes. (Stokols et al., 2003; Sallis and Owen, 2015) It would be interesting for future studies to explore interactions between the environments inside and outside the home and work environments including both physical characteristics as well as social and psychological characteristics. This could expand the understanding of what built environment features really matter in terms of food choice. Further, the current study explored only perceptions of work and home neighborhood environments it is possible that built environment factors in other places (e.g., locations along commuting routes) may be important; future studies could use alternate methods to uncover all the environmental exposures an individual experience. (Kestens et al., 2010)

Findings from this study yield few significant associations. Yet, this study remains important to furthering our understanding of how the perceived environment may be related to dietary behaviors both around home and the workplace. This is important for public health interventions and policies to inform workplace health and well-being, as there is a dearth of research in this area. The built environment around the workplace is likely much less malleable in an intervention context than other factors within the workplace setting, as it is unlikely most employers will be able to change the stores and restaurants around their business. Therefore a better understanding of the associations among the workplace neighborhood environment, nutrition behaviors, and obesity outcomes can help inform decision-making and allocation of resources toward the environment level interventions likely to have the most impact.

This study has limitations worth noting. (1) It is not possible to determine the direction of the association or causality from this cross-sectional study. The relationship between the perceived environment and behavior may suggest people's perception of the environment is shaped by their dietary preferences, rather than suggesting the environment shapes their diet. This is a particular concern given that the neighborhoods were assessed by self-report of perceptions. (Caspi et al., 2012) Future research incorporating objective and self-reported environmental data using longitudinal designs would offer stronger evidence. (2) Dietary behaviors and weight were also assessed by self-report; (Willett, 2012) self-reported weight is vulnerable to under-reporting. (Gorber et al., 2007) (3) There is potential for respondent bias as the response rate was low, 15%. (4) Generalizability of the findings is limited as all participants were from a single state and were from metropolitan areas such that rural populations were not represented. (5) Finally, despite the large sample size (2015), it is possible that the study was under-powered to detect weak associations of the magnitude observed.

4.1. Conclusions

The current study adds to the limited literature looking at associations between the perceived neighborhood around both the workplace and the home and dietary behaviors and obesity in adults. Few associations were found after adjustment, and none were identified with the perceived workplace neighborhood environment. Additional studies are needed to determine whether relationships between these environments and behavior exist, and if so, if they are causal and warrant intervention attempts.

Conflict of Interest

The authors declare there is no conflict of interest.

Abbreviations

(SHOW-ME) study Supports at Home and Work for Maintaining Energy Balance
(BMI) Body Mass Index
(PANES) Physical Activity Neighborhood Environment Scale

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