Residential Proximity And Its Impact On College Students' Body Mass Index

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ABSTRACT

Objective. The purpose of this study was to examine if environmental accessibility to healthy resources was associated with college students' corresponding health behaviors and body mass index (BMI). This study looked at college students' proximity and distance to environmental influence, such as fitness centers and fast food restaurants in relation to their physical activity (PA), fruit and vegetable consumption (FVC), and BMI. Methods. A sample of 156 college students from a mid-western university completed the cross-sectional survey on proximity to campus-related environmental resources. Student addresses were used to calculate accessibility to healthy environmental resources, including proximity to the university recreational facility and local grocery store. Physical activity was calculated into metabolic equivalents (METs) and dietary behavior included measures of daily fruit and vegetable consumption and weekly fast food meals. Analysis. Linear regression was used to estimate differences in participants' multiple health behavior and BMI based on proximity to certain environmental resources.

Results. Of the 156 students who participated in the current study, 79% were female and 87% were White, Non-Hispanic, with a mean age of 20.13±1.91. No associations between behaviors and BMI were detected. Proximity to the campus recreational facility significantly predicted lower BMI (p=0.01); and distance to the community grocery store was associated with increased BMI (p=0.01). Conclusion. Findings suggested associations between proximity to environmental resources and participants' BMI; however, this influence occurred outside the measured health behaviors. Longitudinal examinations are needed to determine the potential impact of resource proximity on changes in participants' health behavior and BMI overtime.

Keywords: Physical Activity; Fruits and Vegetable Consumption; Body Mass Index; Community Design

REVIEW OF LITERATURE

The Center for Disease Control and Prevention reports more than one-third of US adults are obese. Not only is the obesity epidemic on the rise amongst adults, it has become a serious and costly concern that significantly impacts Americans' physical and mental health (CDC, 2014). In the US, rapidly changing diets and reduced physical activity has contributed to the obesity epidemic and the increased rates of chronic disease (Popkin, 2003). Obesity is not an individual problem; it has become a population-level issue that requires effective long-term strategies and prevention techniques (WHO, 2000).

Certain environmental factors significantly impact adults' physical inactivity and related health-risk behaviors (Reed & Phillips, 2005). Many college-aged adults are reported overweight or obese, placing them at risk for common chronic illnesses such as hypertension, diabetes and cardiovascular disease (Ferrara, 2009).

One of the most critical periods in a young adult's life is the transition from high school to college (Ferrara, 2009). Major lifestyle changes occur, the "freshman 15", which is a term representative of weight gain during the transition to the independent life of an American college student (Ferrara, 2009). College students are more exposed to lifestyle changes than regular adults, such as eating habits, living environment, daily physical activity routines, and increased alcohol consumption (Racette &Deusinger, 2005). Some studies suggest possible weight gain occurs during this life period due to surrounding obesogenic environments, including buffet style dining halls and decreased energy expenditure opportunities (Levitsky & Halbmaier, 2004). "The American College Health

Association found that only 5.7% of college students reported eating 5 or more daily servings of fruits and vegetables and 21.8% reported eating 3 or more fatty food items per day (ACHA, 2007). Cafeteria settings provide students with unlimited food options and portion sizes, and unhealthy food choices are readily available for students on campus (Levitsky, Halbmaier, & Mrdjenovic 2004). In addition, The National College Health Risk Behavior Survey found that college students are rarely participating in moderate physical activity (20%) or vigorous physical activity (30%) on a regular basis (Douglas, Collins, Kann, Gold, Clayton, Ross &Kolbe, 1997).

Strong evidence suggests environmental factors present barriers to college students' weight management, such as time constraints, food accessibility, and access to on-campus physical activity opportunities (Greaney, Less, White, Dayton, Riebe, Blissmer, Shoff, & Greene, 2009). Greaney et al., reported that environmental- level barriers made it difficult to prepare nutritious meals due to the college meal plan. Students' financial situation also hindered their use of on-campus recreational resources, such as added facility and/or recreational fees (Greaney, et al., 2009). College students also report the quality of their campus recreational center was overlooked and the center was typically overcrowded (Greaney, et al., 2009).

The built environment is modified by humans, including homes, schools, workplaces, accessibility to resources, and leisure (Sridhar, Pasala & Rao, 2010). For college students the built environment has become a culture of risky behavior (Reed, & Phillips, 2005). In 2005, the National Research Council concluded that there is a prominent link between the built environment and physical activity (Transportation Research Board, 2005). Sprawling college campuses with large enrollments come with poor accessibility to healthy resources, requiring transportation-related support (Lee, Ewing & Sesso, 2010). Reed & Phillips (2005) found it was more likely for first year and second year college students to participate in physical activity due to on-campus residency and optimal proximity to exercise facilities. Upper classmen tend to have more of an inconvenience due to off campus housing and their proximity from such resources (Reed & Phillips, 2005). Currently, there is a lack of research particularly investigating whether proximity to fitness facilities is a contributing environmental factor to sedentary college students (Reed & Phillips, 2005).

PURPOSE

The US has experienced a dramatic rise in the prevalence of obesity (Ogden, Carroll, Kit & Flegal, 2012). Evidence suggests regular physical activity (PA) and fruit and vegetable consumption (FVC) aids in preventing obesity and related illnesses (Grundy, Blackburn, Higgins, Lauer, Perri, & Ryan, 1993; U.S. Department of Health and Human Services, 2010). Many published studies have indicated that specifically college students are the most at risk for unhealthy behaviors and a lack of physical activity due to sociocultural and physical environmental influences (Reed, & Phillips, 2005). Researchers suggest there are associations between the physical environment and individuals' obesity-related behaviors and weight status (Nelson, Gordon-Larsen , North, & Adair, 2006). Given high sustainability of the built environment, obesity-related promotional efforts have been strongly encouraged to target individuals' access to resources within their surrounding physical environment (Minkler, Vásquez, Tajik, & Petersen, 2008). The current research objective was to determine how greater accessibility to supportive environmental resources contributes to college students' multiple health behavior and body mass index (BMI). The objective of greater accessibility was measured by college student's distance to supportive environmental resources. The greater accessibility specifically examined associations between the proximity and distance of healthy environmental resources and participating college students' PA, FVC, and BMI.

METHODS

Research Methodology & Analytical Procedures

Although, there are many studies done on how the built environment affects physical activity in the field of urban planning, we rarely see studies done on college students and how environmental resources on campus influence their health behavior and body mass index (BMI). In order to address this gap in regards to University students, the proposed study consists of a web-based survey assessing University students' proximity and distance to healthy environmental resources and how this may or may not affect their PA, FVCM and BMI.

Study Design

A cross-sectional study design was used in this study. Samples were taken from college students at a Mid-Western University. All student responses were anonymous as data was collected via web-based survey. There are many advantages to online-based data collection such as low-cost, anonymous responses, and convenience for students. The cross-sectional study design examined associations between resource proximity measures, multiple health behavior, and BMI.

Participants and Recruitment

Participants consisted of undergraduate college students attending a mid-western university (≈15, 000 enrolled, onsite undergraduates) in a small town (≈22, 000 non-student community members). Students were recruited through health courses, and tend to be in a variety of majors and years in school. In order to be eligible to participate individuals needed to be currently enrolled in classes at Miami University. The web-based survey took approximately 10 to 15 minutes to complete, resulting in a 20% response rate. The online survey included questions relative to health and health behavior. Informed consent was obtained from all participants prior to conducting the interview, and participation was voluntary and students were able to opt out at any time.

Data Collection

The web-based survey assessed individual's proximity to environmental resources on campus, as well as their physical activity and perceived health. In addition to these elements the survey examined participants moderate to vigorous exercise and examined student's nutrition intake. Participants self-reported demographics (age, gender, ethnicity, and university address), height/weight (calculated as BMI), and perceived health ("*How would you describe your general health using the following scale: 1=poor, 2=fair, 3=good, 4=very good, 5=excellent*)?" Proximity to the university recreational facility and community grocery store was determined from participants' self-reported addresses and calculated as miles from their residences to each resource.

Participants' moderate to vigorous PA (MVPA) was assessed using the Godin Leisure-Time Exercise Questionnaire (GLTEQ) (Godin, & Shepherd, 1985), and then weighted by its associated metabolic equivalent (MET) value: (Vigorous/strenuous × 9) and (Moderate × 5). Previous research has deemed the GLTEQ highly reliable and valid (Jacobs, Ainsworth, Hartman, & Leon, 1993). Daily FVC was assessed with the National Health and Nutrition Examination Survey single item instrument (National Center for Health Statistics (NCHS), 2007), which has been validated extensively (Prochaska, & Sallis, 2007). Participants also reported their weekly fast food dining frequency ("*How many times per week did you eat at the following fast-food restaurant: McDonalds, Arby's, Taco Bell, and/or Wendy's*?).

Analysis

Linear regression models were used to estimate differences in participants' health behavior and BMI based on proximity to supportive environmental resources on a college campus. Reported models were adjusted for age, gender, ethnicity, and perceived health. Data analyses were performed using PASW Statistics 21.0 (2012, Chicago IL).

RESULTS

College student participants (n = 156) were mostly female (79%) and White, Non-Hispanic (87%), with a mean age of 20.13±1.91. On average, participants had a BMI of 22.65±3.97 and reported their health as *good* to *very good* (M=3.63±0.75). Mean comparisons by demographic subgroups are summarized in Table 1. Outside of significant covariate relationships, no associations between participants' health behaviors and BMI were revealed. Outcomes of linear regression analysis models are provided in Table 2. Distance to the closest recreational facility significantly predicted participants' lower BMI (β=-0.342, p=0.011), and proximity to the local grocery store was related to higher BMI (β=. 346, p=0.011).

DISCUSSION

In a sample of college students attending a mid-western university, we found no differences in health behavior by proximity to supportive environmental influences. The lack of association to participants' FVC is similar to inconsistencies reported in previous research. Higher FVC has been reported among individuals with greater accessibility to supermarkets and other food outlets offering healthy options (Morland K, Wing S, Diez Roux A, 2002 & Rose D, Richards R., 2004). However, null associations have also been reported (Morland et al., & Pearson , Russell, Campbell, & Barker, 2004; Ollberding, Nigg, Geller, Horwath, Motl, & Dishman, 2012). Relative to physical activity, current outcomes are contrary to a plethora of previous research. In a summary of 13 review articles summarized by Bauman and Bull (Bauman, & Bull, 2007), 11 of the reviews reported a consistent positive relationship between adults' activity levels and proximity to supportive environmental resources Additional studies are needed to clarify the null associations found here, with consideration of variations based on potential differences in campus and community characteristics.

Unlike health behavior, associations between participants' BMI and proximity to environmental resources were uncovered. Among current participants, greater proximity to the university exercise facility was associated with decreased BMI, supporting similar examinations of the built environment (Nelson et. al., 2006). Also, participants' increased BMI was associated with increased proximity to the community grocery store, which is inconsistent with previous reports of null associations (Block, Christakis, & O'malley, 2011). The lack of association between participants' health behavior and related environmental resources is interesting, suggesting the presence of unmeasured factors linking environment accessibility to differences in BMI. The current cross-sectional approach cannot decipher between reasons for participants' choice of residence location and influences of the built environmental; for instance, did individuals prioritize proximity to certain university/community resources when selecting their campus residency? Longitudinal examinations are needed to determine the potential impact of resource proximity on changes in participants' health behavior and BMI overtime.

Limitations

The sample was predominantly White, non-Hispanic and female, limiting generalizations to other distinct subgroups. Results are also limited to the specific college campus environment and surrounding community examined; similar campus targeted examinations are warranted. Finally, the cross sectional study design prevents causal inferences and cannot account for the potential bias of participants self-selecting their residence location in the effort to support their current habitual behaviors.

Significance

Previous reports examining environmental proximity to certain health-related resources have been inconsistent across various populations and contexts. Within the current sample, college-students' attending a mid-western university with closer proximity to the student exercise facility had a lower BMI. This supports previous evidence suggesting close proximity to exercise facilities on campus is a factor on frequency and attendance (Nelson et. al., 2006 &). College students living farther from the university exercise facilities reported a higher BMI, which may reflect perceived inconvenience, travel problems, and proximity.

Results also showed students' living closer to the community grocery store reported a higher BMI than those living farther away. Current results imply that proximity to healthy opportunities within the built environment impact students' reported BMI.

Although extensive research has been applied to the built environment, there remains limited evidence specific to characteristics of college campuses in relation to students' obesity-related behaviors and weight status. Coupled with similar campus-specific examinations, current outcomes provide groundwork toward evidence-based promotional efforts that target university environments to facilitate a healthy lifestyle among attending students.

Recommendations for Further Research

The university environment has a significant impact on attending students' obesity-related behaviors; hence, it is critical to thoroughly understand certain impacts of the built environment (Reed, & Phillips, 2005).Healthy food options and frequent opportunities for physical activity should be affordable and highly accessible to all students. Additional understanding is needed regarding the differences between rural and urban campuses; is there a relationship with specific environmental barriers that impact students' lifestyle behaviors. Future investigations should aim to determine the most salient environmental factors in relationship to students' self-efficacy and their perceptions related to exercise and nutrition.

AUTHOR BIOGRAPHIES

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Table 1. Descriptive statistics and mean fruit and vegetable intake for eligible study participants

		BMI		MVPA (minutes/week)		FVC (servings/day)		Fast Food (meals/week)	
	n (%)	**Mean (SD)**	***p***	**Mean (SD)**	***p***	**Mean (SD)**	***p***	**Mean (SD)**	***p***
Total	156	22.65 (3.97)		195.03 (112.26)		4.80 (2.28)		.42 (.79)	
Gender									
Male	32 (21%)	**24.22 (4.82)**	**.01**	191.34 (101.14)	.84	5.06 (2.53)	.47	**.88 (.21)**	**.00**
Female	124 (79%)	**22.25 (3.63)**		195.98 (115.32)		4.73 (2.22)		**.30 (.05)**	
Ethnicity									
White	138 (87%)	**22.34 (3.51)**	**.01**	**202.20 (109.74)**	**.03**	4.93 (2.30)	.06	.39 (.79)	.27
Non-White	18 (13%)	**25.08 (6.10)**		**140.11 (119.34)**		3.83 (1.89)		.61 (.78)	
BMI									
Normal	129 (83%)	**21.32 (2.00)**	**.00**	195.32 (114.52)	.95	4.78 (2.31)	.83	.38 (.78)	.20
Overweight/ Obese	27 (17%)	**29.02 (4.83)**		193.63 (102.82)		4.89 (2.17)		.59 (.80)	

Abbreviations: BMI, body mass index; SD, standard deviation; MVPA, moderate to vigorous physical activity; FVC, fruit and vegetable consumption.
* P-value determined from ANOVA.

Table 2. Association of accessibility to resources with mean metabolic equivalents of mild, moderate, and strenuous physical activity, N=156

	BMI Adjusted R^2=.119		MVPA (MET/week) Adjusted R^2=.096		FVC (Servings/day) Adjusted R^2=.011		Fast Food Intake (Meals/week) Adjusted R^2=0.056	
	β (SEM)	***p***	**β (SEM)**	***P***	**β (SEM)**	***p***	**β (SEM)**	***p***
Recreation Facility Proximity	**-.342 (1.297)**	**.011**	.116 (6.974)	.390	-.153 (.788)	.279	-.051 (.266)	.713
Grocery Store Proximity	**.346 (2.115)**	**.011**	-.159 (11.375)	.243	.161 (1.286)	.259	.035 (.434)	.803
Gender	**-.177 (.755)**	**.023**	.023 (4.062)	.772	-.078 (.459)	.340	**-.302 (.155)**	**.000**
Age	095 (.169)	.245	.010 (.910)	.903	.142 (.103)	.101	.014 (.035)	.870
Ethnicity	.142 (.341)	.078	**-173 (1.834)**	**.035**	**-.170 (.207)**	**.048**	-.032 (.070)	.700
Perceived Health	**-.166 (.445)**	**.049**	**-.262 (2.393)**	**.002**	-.010 (.270)	.908	-.055 (.091)	.524

Abbreviations: BMI, body mass index; MVPA, moderate to vigorous physical activity; FVC, fruit and vegetable consumption; SEM, standard error of the mean; MET=metabolic equivalent; SEM=standard mean error; β=standardized coefficient; Bolded=statistically significant at p-values <0.05

NOTES