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The association between worksite physical environment and employee nutrition, and physical activity behavior and weight status

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Abstract

Objective—Explore the relationship between worksite physical environment and employee dietary intake, physical activity behavior, and weight status.

Methods—Two trained research assistants completed audits (Checklist of Health Promotion Environments at Worksites) at each worksite (n = 28). Employees (n = 6,261) completed a brief health survey prior to participation in a weight loss program.

Results—Employees' access to outdoor areas was directly associated with lower BMI, while access to workout facilities within a worksite was associated with higher BMI. The presence of a cafeteria and fewer vending machines were directly associated with better eating habits. Better eating habits and meeting physical activity recommendations were both related to lower BMI.

Conclusions—Selected environmental factors in worksites were significantly associated with employee behaviors and weight status; providing additional intervention targets to change the worksite environment and promote employee weight loss.

The obesity epidemic has become a major public health concern around the world.[1] In the United States (U.S.), this growing epidemic is costing employers billions of dollars every year.[2] Additionally, U.S. employers must also address obesity-related health issues such as employee absenteeism, loss of productivity and overall quality of life.[3,4] As a result, over the past 30 years, numerous worksite health promotion strategies to address employee weight status have been investigated.[5]

In fact, the literature on worksite health promotion strategies to address employee overweight and obesity is extensive,[6,7] but less is known about the influence of the physical characteristics of the worksite on employee behaviors related to dietary intake, physical

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activity, and weight status. A recent review conducted by the Task Force on Community Preventive[8] Services found that only four out of the forty-seven studies included in its review had looked at policy and environmental changes in the worksite.[6]. These studies, in general, attempted to make healthy choices easier for the entire workforce by improving access to healthy foods (i.e. changing cafeteria and vending machine options) and providing more opportunities to be physically active (i.e. providing on-site facilities for exercise). Nonetheless, questions remained regarding the effect of environmental and policy strategies on employee weight status, and more research is needed to investigate potential associations.[6]

As a response to this growing need, the National Heart, Lung, and Blood Institute (NHLBI) funded seven studies to investigate the effectiveness of environmental and policy approaches to lead to weight control and obesity prevention in worksites.[9] More recently, a number of studies[10–13] have reported on the results of environmental interventions to weight control and obesity prevention. To date the results have been equivocal showing few, and inconsistent, relationships between environmental changes and employee weight status.[10–13] It may be that the specific environmental strategies used are not effective in changing employee dietary and physical activity behavior and thus, weight status remains constant (at best).[11] There continues to be a need for further research to better understand the potential associations between environmental factors and employee dietary and physical activity behavior to identify potential environmental intervention targets that may lead to more effective programs.[6]

Therefore, the purpose of this study was to investigate the association between the worksite physical environment, and employee dietary intake, physical activity, and weight status among a group of 28 worksites participating in the Tailored Worksite Weight Control Programs (Worksite [14]) study. We hypothesized that selected environmental factors (i.e. cafeteria, number of vending machines, presence of workout room) would have a direct relationship with dietary and physical activity behavior, which in turn would be associated with weight status among employees.

METHODS

Study Design

The Worksite study is a two-group, cluster randomized control trial (RCT) conducted over a period of 4 years to investigate the reach and effectiveness of individually targeted, computer mediated worksite weight loss programs. *Randomization took place after an initial brief health survey and was stratified based on worksite size (100–300 and 301–600 employees).* The Worksite study has been introduced and described in more detail elsewhere. [14] The current study uses cross-sectional employee survey data and baseline worksite audits using the Checklist of Health Promotion Environments at Worksites (CHEW) to investigate the association between physical environmental factors and employee dietary and physical activity behavior and weight status. This study and protocol were approved by the Virginia Tech Institutional Review Board (protocol #07-296) and is registered at clinicaltrials.gov (NCT01880060).

Recruitment

Recruitment of worksites began in August 2007 and continued through May 2010. Worksites were identified through a variety of strategies, including 1) contacting local Chambers of Commerce and business associations; 2) advertising in local newspapers; 3) television news coverage of the project; 4) contacting insurance carriers; 5) internet searches focusing on websites devoted to economic development in the targeted area; and 6) phonebook searches in targeted cities and towns.

To be eligible to participate in the study, worksites had to meet five criteria: 1) have a total workforce between 100 and 600 employees; 2) all employees needed to have access and permission to access the internet at work; 3) all employees had to be located in the same physical environment (no branch offices or off-site locations); 4) agree to conduct a brief health survey of the entire employee population; and 5) management support for employee participation in kickoff and follow-up activities during the typical work day.

Twenty-eight small and medium-sized worksites were recruited to participate in Virginia (27) and Colorado (1) with a total employee population of 8,680. Worksites included 7 governmental agencies represented by city municipal services, social services, public works, state and regional housing, and water authorities (n=1,840), 6 manufacturing and distribution centers (n=1,690), 5 professional groups in law, advertising, engineering, sales, and information technology support (n=1,820), 4 medical facilities (n=1,626), 4 small colleges (n= 1,377), and 2 call centers (n=330). The employee population was predominately female (64%) and Caucasian (79%) with an average age of 45.03 (SD 12.11) and an average BMI of 28.84 (SD 6.80). Additional employee demographic data is provided in Table 1.

Measures

Brief Health Survey—A brief health survey (BHS) was developed based on recommendations by Glasgow and colleagues[15] and completed using the passive acceptance method developed by Linnan and colleagues.[16] Modifications included the use of short validated measures to assess primary health behaviors (physical activity, eating behaviors). Questions related to risky alcohol and substance consumption were omitted (due to potential adverse effects on participation). The BHS also gathered information on self-reported assessments of height (“About how tall are you without shoes?”) and weight (“About how much do you weigh without shoes?”), which were used to calculate BMI and weight status (i.e. normal weight, overweight, obese, severely obese, morbidly obese). Socio-demographic variables included age, sex, race/ethnicity, and education.

Eating behaviors, such as consumption of sugary beverages, fried foods, fruits, vegetables and deserts were assessed using the previously validated Starting the Conversion (STC) assessment tool.[17, 18] The responses to this 7-item scale are assigned scores of 2, 1 or 0, and then summed together. The higher the score, the unhealthier the diet is considered to be. This scale has been used in a variety of primary care settings[19] and found to provide consistent estimates of unhealthy eating patterns and be sensitive to change for assessing healthy eating behaviors.[18]

Physical activity behaviors were assessed using The Center for Disease Control and Prevention Behavioral Risk Factor Surveillance Survey questions.[20] One modified question was used to assess moderate activity: (a) “Moderate activities make your heart beat faster than normal. During these activities you can talk but you can’t sing, and you are breathing harder than normal. Examples include brisk walking, bicycling, vacuuming, gardening, or anything else that causes an increase in breathing or heart rate. Do you do 30 minutes or more per day of moderate physical activities 5 or more days per week?” and a second question was added: (b) “Do you do activities to increase muscle strength, such as lifting weights or calisthenics, twice a week or more?” This second question was added in order to capture the American College of Sports Medicine’s recommendations of engaging in both cardio and strength-training activities.[21] To determine physical activity status, those who responded yes to both questions were classified as “meeting recommendations”. Those who responded no to one or both questions were classified as not meeting recommendations. Similar measurement tools have shown validity and reliability in determining if respondents are meeting recommendations or not.[20,22]

The BHS was introduced to employees as part of research efforts to gather information for the development of future worksite health promotion programs. The BHS was available for completion at each worksite for two weeks prior to the announcement about the upcoming weight loss program. No employees, with the exception of key decision-makers (CEO’s and Human Resource Directors), were aware of the future weight loss programs being offered. Employees had the option to complete the BHS electronically or on paper. All employees who completed the BHS, regardless of weight status, were eligible for a lottery of $250 in cash prizes. A total of 6,261 employees (>72% participation rate) completed the BHS (see Table 1 for participation rates across worksite types).

Checklist of Health Promotion Environments at Worksites—During the recruitment period for the weight loss programs, trained research assistants completed worksite audits using a modified version of the Checklist of Health Promotion Environments at Worksites (CHEW[23]). The CHEW protocol, scoring, validity and reliability documentation can be found at: http://www.drjamessallis.sdsu.edu/measures.html. The CHEW is a 112-item checklist, which allows for an objective assessment of the workplace environment for elements that could influence health behaviors related to nutrition, physical activity, smoking and alcohol.

The CHEW focuses on three distinct domains. The first domain assesses the physical characteristics of the workplace such as: the presence of staircases and elevators, the number and contents of vending machines, food options in cafeterias and lunchrooms, the presence of bike racks and storage areas, and access to fitness facilities, changing rooms and showers. The second domain surveys the informational environment, which included taking inventory of bulletin boards and messaging systems, the number of posters, signs, or flyers with health-related messages or opportunities and the number and placement of no-smoking signs. The third domain captures characteristics of the neighborhood surrounding the workplace for access to restaurants or food outlets, gyms or recreation facilities, and establishments to purchase cigarettes and alcohol. To increase inter-rater reliability, two

trained members of the research team conducted worksite audits. All discrepancies between raters were resolved by returning to the worksite within a few days.

For the purposes of the current study the following scales were calculated from the informational environment: physical activity signs (total number of signs encouraging physical activity within the worksite), nutrition signs (total number of signs encouraging physical activity within the worksite), and weight loss signs (total number of signs encouraging weight loss within the worksite). For the physical activity environment the following scales were calculated: number of stairs, presence of outdoor space for physical activity (outdoor space + walking paths around worksite), and presence of workout facilities. For the food environment the following scales were calculated: presence of a cafeteria, number of vending machines (total number of soda machines + total number of snack machines + total number of coffee/hot tea machines), and number of snack machines.

Data Analysis

Individual participant data from the BHS and the CHEW were coded and entered into SPSS (SPSS 20.0)[24] by trained research assistants. Descriptive statistics (Mean, SD) for individual participant health behaviors were calculated. Furthermore, Chi-square tests or Analysis of Variance tests with post-hoc tests were conducted to assess the differences in employee characteristics across different worksite types and are presented in Table 1.

The relationship between the worksite physical environment and individual participant health behaviors (STC, physical activity level, BMI) were examined using hierarchical linear modeling (HLM) with a 2-level regression model.[25] Organizational environmental characteristics (i.e. food environment, physical activity environment) were entered as level-2 predictors of individual characteristics (BMI, STC, and physical activity behavior), with level-1 being the individual level predictors of age, sex, education level (1=college, 0= less), and race (1=black, 0=other). Separate models were created and tested for each primary outcome of interest using log equations to examine the relationship between the physical activity environment and meeting physical activity recommendations. During the model building process we first created an intercept only model, followed by fitting individual-level (level 1) predictor variables, and finalizing with the addition of worksite-level (level 2) environmental predictors. All multi-level models were evaluated at 95% significance level ($p < 0.05$).

RESULTS

Individual Level

Survey participants were on average 45.03 (SD=12.11) years old with the majority being Caucasian (79%), women (64%), having completed at least some college (80%), and employed full-time (93%). When assessing participant characteristics by worksite type it was found that participants from governmental agencies and small colleges tended to be older, while those from call centers were younger. Additionally, medical facilities and call centers had more female and black participants. Finally, employees from manufacturing/ distributing worksites, medical facilities and call centers were more likely to participate in

the BHS, while employees from professional agencies were less likely to take part. Furthermore, BHS data also revealed that 68.9% of participants (n= 4,313) were not meeting ACSM guidelines of 150 minutes of moderate physical activity per week or ACSM guidelines for strength training. Weight status data indicated about 33% of participants (n=1,883) were overweight (BMI> 25) and 36% (n=2,026) were obese (BMI >30) with an average BMI of 28.85 (SD=6.83). *Finally, participants from professional agencies and small colleges reported overall healthier eating behaviors.* Full results can be seen on Table 1.

Multi-Level Modeling

BMI—We found that being older (β=0.05, p<0.001), being black (β=3.77, p<0.001), not meeting physical activity recommendations (β=−2.00, p<0.001), having a higher (unhealthier diet) starting the conversation score (β=0.34, p<0.001), and not having attended college (β=−0.40, p<0.01) were related to higher BMI. When including the environmental predictors, not having access to outdoor space (β=−0.87, p<0.05), and having exercise rooms available at the worksite (β=0.72, p<0.05) were related to higher BMI. The informational environment variables were not included in the model as they were not present in the worksites included in this study. Full results can be seen in Table 2.

Eating Behaviors—When investigating STC as an outcome of interest, the STC model did have an improvement with the addition of environmental factors over the individual factor model (χ^2 =19.47, df=4, p<0.01). Namely the presence of a cafeteria improved eating habits (β=−0.51, p<.001) while the presence of more vending machines made them worse (β =0.04, p<0.05). Additionally, women (β=−0.35, p<.01), younger people (β=−0.02, p<0.001), non-black people (β=1.19, p<.001), and people having attended at least some college (β=−0.51, p<0.001) were more likely to report healthier eating. Finally, the informational environment variables were not included in the model. Full results can be seen in Table 2.

Meeting Physical Activity recommendations—The probability of physical activity recommendations being met were significantly related to individual level predictors, while environmental predictors did not seem to influence individual physical activity. Results indicate that males (β=−0.1, p<.001) and younger employees (β=−0.002, p<.001) were more likely to be physically active. Additionally, the informational environment variables were not included in the model. Full results can be seen in Table 2.

DISCUSSION

The purpose of our study was to investigate the relationship between worksite physical environmental factors and employee dietary intake, physical activity, and weight status. Our results indicate that selected physical activity environmental factors may be directly associated with employee BMI. In fact, the association between the presence of outdoor opportunities such as walking trails and open space and lower employee BMI might be one of the first findings of its kind. Of particular interest is that outdoor opportunities were not directly associated with physical activity *(PA)* levels indicating a potential distinct

association with BMI without improving physical activity levels. *This lack of direct association between outdoor opportunities and PA could be due to the physical activity measures used in the study. The measures used did not account for overall activity, but just leisure time activity with occupational activity not included. This fact could partially account for the results of PA environmental factors being associated with BMI, but not directly with PA levels. Nevertheless,* to our knowledge, most studies[10–13,26] so far have not been able to find direct links between physical activity environmental factors and employee BMI.

However, counter to our hypothesis the presence of workout facilities at worksites were associated with a higher employee BMI. While this is another new finding in terms of the association between physical activity environmental factors and employee weight status, it goes against the generally accepted idea that workout facilities at workplaces have a positive impact on employee physical activity and BMI. In fact, our results showed no association between workout facilities and employee physical activity levels. It could be that worksites with a higher proportion of overweight and obese employees were more likely to build these facilities to address this growing problem. Additionally, it could be that employees with a higher BMI feel less comfortable using workout facilities at their workplace. *Moreover, it could be that the physical activity measures used did not fully capture overall physical activity levels or the fact that self-reported BMI could have influenced these associations.* Unfortunately, due to the cross-sectional nature of the study, we are not able to investigate these causal relationships, and thus determine whether the facilities came before or after *employees' weight status*. Additional studies investigating the potential mechanisms explaining this finding are needed.

Furthermore, our overall hypothesis that food environmental factors would be directly associated with healthier eating behaviors, and thus indirectly associated with employee BMI was supported. Our findings indicate that the presence of a cafeteria and lower numbers of vending machines have a direct association with healthier eating behaviors. While these environmental factors had no direct association with BMI, healthier eating behaviors were highly associated with lower employee BMI. Conversely, recent studies[10,11] have shown that environmental strategies to increase the availability of healthier food choices in worksite cafeterias and vending machines may not be the best approach to reduce employee BMI. Combined with our results these findings suggest that just providing employees with information and access to healthier food options may not be enough, *and additional strategies to reduce unhealthy food choices may also be needed*. While adding a cafeteria to a worksite may provide new options for healthier foods, once the cafeteria is built additional strategies may be needed to increase its utilization. *Furthermore, just the addition of a cafeteria may not lead to healthier food options. Worksite-based interventions may be needed to ensure the availability of healthier food options and eliminate unhealthier choices. Finally,* alternative strategies such as the elimination of some vending machines *and its unhealthy options* from the worksite may provide better results. These strategies need to be further tested in longitudinal studies.

A major limitation of the present study is the cross-sectional nature, which does not allow for causal conclusions. An association between the physical environment and employee

BMI was found, however we are not able to determine the directionality of this relationship. Another limitation was the use of self-report measures of all individual level variables. Self-report measures often overestimate desired behaviors (i.e. physical activity and healthy eating) and underestimate less desirable ones (i.e. weight). *Additionally, the self-report measures used in this study may not fully capture overall physical activity and eating behavior, as such all results must be considered within the limitations of the measures used. Furthermore, while we observed the availability of cafeterias we did not evaluate the quality of the food being offered; thus we are not able to determine whether the food options were related to employee BMI or not. Nevertheless, our results seem to suggest that the presence of a cafeteria may be positively associated with eating behaviors independently of its food offerings.* Some of the strengths of the study include, but are not limited to: a) the use of an objective measure for environmental factors; b) the use of multi-level modeling techniques, which allowed the full use of individual level data without aggregating employee data at the worksite level as previous studies[10,26] have done; and c) a high employee response rate (72% overall).

CONCLUSION

Our findings provide preliminary evidence that selected *worksite* environmental factors may be directly and indirectly associated with employee BMI. Access to outdoor spaces and walking trails may have a protective influence on employee weight status, while worksite workout facilities were found to have a negative association. Additionally, the presence of a cafeteria and lower amounts of vending machines were associated with healthier eating habits, which in turn were associated with lower employee BMI. These findings stress the potential that *worksite* environmental factors may have in influencing employee dietary behavior and weight status. Nevertheless, further research with longitudinal *and intervention* designs *are* needed to investigate these causal pathways and provide additional justification for making such changes in worksite settings.

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Table 1

Employee characteristics by worksite type.

Worksite Type (N=28)	Governmental agencies (7)	Manufacturing/Distribution (6)	Professional (5)	Medical facilities (4)	Small colleges (4)	Call centers (2)	Overall
Age, Mean (SD)	46.85*** (10.73)	44.13 (12.93)	43.68 (11.55)	43.65 (12.33)	48.41*** (11.86)	40.10*** (11.66)	45.03 (12.11)
BMI, Mean (SD)	29.57 (6.61)	28.66 (6.91)	27.75*** (6.29)	29.53 (7.06)	27.53*** (5.76)	32.61*** (8.98)	28.84 (6.80)
Female, %	55.7	57.3	55.2	86.9***	59.8	84.4***	64.0
Race, %							
White	69.8***	85.2	91.0	64.6***	94.8	38.9***	78.6
Black	28.0***	9.6	5.1	32.9***	3.3	59.0***	18.2
Other	2.2	5.2	3.9	2.5	1.9	2.1	3.2
Weight Status, %							
Normal (18.5–24.9)	24.2***	31.5	36.8	30.0	38.2	17.8***	31.1
Overweight (25–29.9)	34.3	33.9	35.5	28.3***	35.0	29.7***	33.2
Obese (≥ 30)	41.5***	34.6***	27.7	41.7***	26.8	52.5***	35.7
Education Level, %							
High School or less	20.9	40.0***	8.0***	14.7	13.0	18.9	20.4
Some College	32.9***	33.3***	21.7	19.5	16.1	60.5***	26.8
College or higher	46.2	26.7	70.3***	65.8***	70.9***	20.6	52.8
Not Meeting PA Guideline, %	*71.3****	*68.1*	*71.7****	*67.6*	*65.0****	*68.9*	*68.9*
Starting the Conversation, Mean (SD)	*5.82 (2.47)*	*6.20 (2.70)*	*5.11 (2.33)****	*5.56 (2.61)*	*5.08 (2.38)****	*6.29 (2.75)*	*5.62 (2.56)*
Presence of Outdoor Space, %	*47.0****	*62.5*	*18.5****	*66.0*	*81.0****	*0****	*52.4*
Presence of Exercise Room, %	*32.0*	*32.0*	*0****	*30.0*	*69.0****	*100****	*34.0*
Presence of Cafeteria, %	*15.0*	*0****	*14.0*	*48.0****	*81.0****	*0****	*27.8*
Number of Snack Machines, Mean (SD)	*2.95 (3.37)*	*3.20 (1.97)*	*1.73 (1.00)****	*5.71 (3.78)****	*2.50 (0.50)*	*2.32 (0.94)*	*3.23 (2.84)*
Number of Vending Machines, Mean (SD)	*5.11 (3.07)****	*7.15 (2.18)*	*4.48 (1.97)****	*12.90 (8.72)****	*7.87 (1.57)*	*3.98 (5.33)*	*7.37 (1.42)****

Worksite Type (N=28)	Governmental agencies (7)	Manufacturing/Distribution (6)	Professional (5)	Medical facilities (4)	Small colleges (4)	Call centers (2)	Overall
Employee Participation Rate, %	70.0	79.60***	62.80***	76.69***	71.45	77.57***	72.13

* p<.05,

** p<.01,

*** P<.001

Table 2

Multilevel modeling results for individual and environmental characteristics as predictors of BMI, Starting the Conversation and PA recommendations.

Variable	BMI		Starting the Conversation		Meeting PA Recommendation	
	β	S.E.	*β*	S.E.	*β*	S.E.
Individual Factors						
Age	0.05***	0.01	−0.02***	0.00	−0.002***	0.001
Female	−0.25	0.20	−0.35**	0.10	−0.1***	0.01
Black	3.77***	0.45	1.19***	0.23	−0.02	0.04
Education	−0.40**	0.12	−0.51***	0.04	0.004	0.006
Meeting PA Recommendations	−2.00***	0.16				
Starting the Conversation	0.34***	0.04				
PA Environmental Factors						
Outdoor Space	−0.87*	0.40			0.02	0.02
Exercise Room	0.72*	0.36			−0.008	0.02
Food Environmental Factors						
Cafeteria	−058	0.36	−0.51***	0.11		
Snack Machine	0.12	0.11	−0.03	0.03		
Vending Machine	−0.01	0.06	0.04*	0.02		

* p<.05,

** p<.01,

*** P<.001