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Abstract

Certain aspects of the home environment as well as individuals' knowledge of energy balance are believed to be important correlates of various dietary and physical activity behaviors, but no known studies have examined potential relationships between these correlates. This study evaluated cross-sectional associations between characteristics of the home environment and energy balance knowledge among 349 youth/parent pairs recruited from the Minneapolis-St. Paul metropolitan area from September 2006 to June 2007. Linear regression models adjusted for student grade and highest level of parental education were used to compare data from home food, physical activity, and media inventories (parent-reported) with energy balance knowledge scores from youth and parent questionnaires. Paired energy balance knowledge (average of youth and parent knowledge scores) was associated with all home food availability variables. Paired knowledge was also significantly associated with a media equipment availability and accessibility summary score ($\beta = -1.40$, $p=0.005$) as well as an activity:media ratio score ($\beta = 0.72$, $p=0.003$). Youth and/or parent knowledge alone was not significantly associated with most characteristics of the home environment, supporting the importance of developing intervention strategies that target the family as a whole.

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Keywords

home environment; energy balance knowledge; adolescents; parents

Introduction

The high prevalence of obesity is a major public health concern (1). While the causes of this nationwide epidemic are not clear, obesity is generally attributed to a variety of genetic, behavioral, social, and environmental factors leading to chronic energy imbalance. Recently, there has been interest in the home environment and how it can influence dietary, physical activity (PA), and sedentary behaviors. For example, consumption of fruits and vegetables, as well as soft drinks and less healthful snacks, by children and adolescents has been correlated with home availability of these foods (2-9). Similarly, the presence of PA equipment in the home has been associated with behavior in the form of higher levels of PA in adults (10-12) and female college students (13), though results for children have been mixed (14-19). Home media environments (e.g., number of televisions in the home) also have been positively correlated with television viewing among children (20,21).

Despite these associations, it remains unclear which psychological, personal, social, and demographic factors have the greatest impact on the home environment. Individuals' energy balance (EB) knowledge, is one such factor with potential to influence the nature of the home environment, though little research has explored this issue. Significant positive associations have been found between greater nutrition knowledge and healthier eating and/or food purchasing behaviors among adolescents (22), college students (23), and adults (24-28), but the evidence is not consistent across all studies (3,27,29). PA knowledge has not been consistently linked to favorable PA behaviors (30,31). This lack of consistency may be explained by the notion that knowledge is just one of many elements that influence behavior. For example, behavioral skills, role models, reinforcements, and incentives are also believed to have an impact on children's behaviors (32).

According to the conceptual model (based on a social ecological framework) from the Transdisciplinary Research in Energetics and Cancer (TREC): The Identifying Determinants of Eating and Activity (IDEA) study, knowledge and various other factors are believed to influence the home environment (33). All of these variables then are believed to influence behavior. Although increased EB knowledge alone may not result in behavior change, it may be an important aspect of the behavior change process. Nelson et al. (34) noted that relatively low EB knowledge scores among parents and youth were not significant predictors of weight-related outcomes. However, the authors suggested educational strategies may be effective when combined with other strategies targeting familial, social, and environmental factors.

To date, no known studies have examined possible relationships between EB knowledge and the home food, PA, and media environments. Therefore, the purpose of this study was to evaluate the associations between EB knowledge and the home environment among youth, parents, and overall family units (including both youth and parents). It was hypothesized that greater EB knowledge would be positively associated with the availability and/or accessibility of healthful food and PA equipment in the home and negatively associated with the availability and/or accessibility of less healthful food and media equipment when controlling for education level.

Methods

This study was a cross-sectional analysis of baseline data collected for the TREC IDEA study, a three-year longitudinal etiologic study of the social and environmental influences on unhealthy weight gain in adolescence. From September 2006 to June 2007, 349 youth (ages 10-16 years) were recruited from within a seven-county metropolitan area of the Minneapolis/St. Paul region of Minnesota and were required to participate with one adult (parent/guardian or other significant caregiver). Recruitment occurred through a preexisting cohort (35), a permit application listing from the Minnesota Department of Motor Vehicles, and a local convenience sample. At baseline, both the youth and the parents completed similar self-report questionnaires evaluating various EB behaviors and attitudes as well as their EB knowledge. Parents provided written consent, and youth provided written assent prior to completing questionnaires. Additional details regarding subject recruitment and data collection methods for the TREC IDEA study have been described elsewhere (33). Study procedures were approved by the University of Minnesota Institutional Review Board.

EB knowledge

A 15-item scale was included in the youth and parent questionnaires to assess EB knowledge. Example questions included the following: “If someone sits all day, they do not need to eat any calories” (true or false); “How many calories does the average teenage boy need to consume every day?” (multiple choice). The questions were pretested among youth similar in age to the study sample and from the same geographic area. The EB knowledge scale was tested for internal consistency (Cronbach α was .56 among youth and .67 among parents), and has been described in detail elsewhere (34). To represent overall household knowledge, youth/parent scores were averaged to create a paired knowledge score.

Home Food Inventory (HFI)

The Home Food Inventory (HFI) was validated for face, criterion, and construct validity and is described in detail elsewhere (36). The final HFI instrument included 208 food items in 13 major categories. Six variables assessed whether or not the item(s) were present anywhere in the home and included fruit, vegetables (not including French fries or tater tots), healthful snacks (whole grain crackers, graham crackers, pretzels, and reduced-fat versions of the following: crackers, potato/tortilla/bagel chips, cheese curls/puffs, granola/sports bars), less healthful snacks (corn chips, popcorn, peanuts, cashews, other nuts, and regular (not reduced-fat) versions of the following: crackers, potato/tortilla/bagel chips, cheese curls/puffs, granola/sports bars), healthful beverages (skim/1%/2% milk, 100% fruit juice, water, soy/rice milk), and less healthful beverages (regular soda, prepared iced teas or lemonade, fruit drinks, sports drinks). Higher scores represent greater availability. Of note, each item was assessed by its typical fat and sugar content (which are expected to directly impact the calorie content of the product) when determining its category as “healthful” or “less healthful.” Given the focus on energy balance and obesity in this work, it is important to recognize that the designations of “healthful” and “less healthful” within the HFI generally reflect this expected calorie content of the foods included, and do not necessarily reflect other dimensions of nutritional content (e.g., micronutrient composition, extent of food processing, etc.). Parents received the HFI and were instructed to complete it at home and return by mail.

PA and Media Inventory (PAMI)

The self-report PA and Media Inventory (PAMI) was designed to comprehensively reflect the home availability and accessibility of PA and screen media equipment. The PAMI was validated by Sirard et al. (37), and included 50 PA equipment items and five media

equipment items (television, VCR/DVD, digital video recorder, video game system, and computer). Parents were instructed to look for items in all areas of their home, including storage areas, yards, and garages.

PAMI household density scores were calculated separately for PA and media equipment by dividing the total number of items by the total number of rooms/locations in the home. Higher density scores indicate greater availability of equipment. Accessibility was determined by multiplying each item by an accessibility code, with 1= “put away and difficult to get to” and 4= “in plain view and easy to get to”. Two summary scores were created to account for availability and accessibility of the PA equipment (PA Availability and Accessibility Summary Score (PAASS)) and media equipment (Media Availability and Accessibility Summary Score (MAASS)). Higher summary scores reflect a greater overall presence in the home (both availability and accessibility). A third summary score, referred to as the Activity:Media Ratio Score was calculated as the ratio of the PAASS to the MAASS. A higher ratio indicated a home was more conducive for being physically active and less sedentary.

Statistical Methods

Analyses were performed using the Statistical Analysis Software (version 9.1.3, 2006, SAS Institute Inc, Cary, NC). Differences between youth and parent EB knowledge scores were identified using a paired t-test. Spearman correlation coefficients were calculated to examine bivariate associations between youth and parent knowledge scores and between the knowledge scores and the HFI and PAMI variables.

Variables yielding statistically significant bivariate associations with paired knowledge were entered into unadjusted and adjusted linear regression models. Potential confounders were selected *a priori* and included student grade, parent education level (i.e., highest adult education in the home), youth gender, and parent gender. Confounders were retained in adjusted models if they changed the regression coefficient by ≥10%. According to these criteria, student grade and parent education level were included in all adjusted models.

Results and Discussion

Table 1 displays demographic characteristics of the youth and parent samples. The study population was almost exclusively White and well-educated.

Descriptive statistics for youth and parent EB knowledge scores have been presented elsewhere (34). Means of the youth and parent scales were 7.5 (range, 1-14) and 10.7 (range, 3-15), respectively. Overall, parents scored significantly ($p<0.0001$) higher than youth, and knowledge scale scores were weakly correlated between youth and parents ($r=0.17$, $p=0.001$). The mean of the paired knowledge scores was 9.1 (range, 3-14).

Table 2 presents results from eight separate linear regression models. Only paired knowledge was modeled after initial analyses revealed this score was generally more strongly correlated with the HFI and PAMI variables than either the youth or parent knowledge scores alone. After adjusting for education level, paired EB knowledge was negatively associated with the MAASS ($p=0.005$), while knowledge was positively associated with fruit ($p=0.0004$), vegetable ($p=0.032$), healthful snack ($p=0.005$), and healthful beverage availability ($p=0.003$), and the Activity:Media Ratio Score ($p=0.003$). Knowledge was not associated with media density ($p=0.122$) and the PAASS ($p=0.114$) in the adjusted models.

In support of the original hypothesis, paired EB knowledge was significantly associated with six of eight home environment variables. Specifically, greater EB knowledge was associated with greater availability of fruit, vegetables, healthful snacks, and healthful beverages. These correlations between EB knowledge and healthy home environments are supported by prior associations between nutrition knowledge and healthy food purchasing behaviors among adults (24) and are consistent with relationships proposed by the TREC IDEA conceptual model (33). Also according to this model, higher consumption of fruit, vegetables, healthful snacks and beverages, and reduced consumption of less healthful foods would be expected in more healthful home environments. Previous research among youth indicates that associations between home availability and consumption are particularly apparent for fruits and vegetables (2-4). Calcium intake has also been linked to milk availability among adolescents (38). However, no known studies have observed associations between availability of healthful foods and consumption of other categories of healthful or less healthful foods.

This study failed to find a statistically significant association between EB knowledge and availability or accessibility of PA equipment in the home. Investigating other potential correlates of home PA equipment may be worthwhile, since some previous studies have linked home PA equipment availability to benefits in the form of higher levels of PA (15,16), lower levels of sedentary behavior (15), and lower body mass index (girls only) (14) among youth. Studies of accessibility are currently lacking.

Media accessibility (MAASS) appeared to have a stronger association with EB knowledge than did media density. This finding reinforces the need for further investigation into equipment accessibility in the home, particularly in examining the extent to which these factors influence behavior. Assessing whether televisions and other media equipment are located in bedrooms may be one of the best surrogates of accessibility currently available. There is evidence that the presence of media equipment in bedrooms of youth is associated with more sedentary behavior (15), less PA (39,40), poor eating habits (39), and a higher body mass index (15,40-42).

In general, youth or parent knowledge alone had weaker associations with the home environment than paired knowledge. This may be a consequence of the stronger buying power and overall synergistic effect of the family as a whole on the home environment. In light of these results, future behavioral intervention programs may wish to target the entire family rather than only one family member.

This study had a number of strengths. For example, the instruments used were previously pilot-tested and shown to be reliable and valid, and high response rates translated into a low amount of missing data. Most importantly, few studies have investigated home environmental factors related to nutrition and PA. This unique analysis can help us understand how EB knowledge and aspects of the home environment may impact each other before ultimately influencing behavior.

Despite these strengths, the ability to infer causality is limited due to the cross-sectional nature of the data. It is hypothesized that knowledge influences specific behaviors that influence home environments, and changes in knowledge may lead to changes in home environments. While these concepts are fairly intuitive, these conclusions cannot be made without longitudinal data. Because of the racially and socioeconomically homogeneous nature of the study population, it is difficult to generalize the findings of this study. However, if small differences in knowledge were associated with various outcomes in this group of families, one would expect that larger disparities in knowledge among more heterogeneous populations would generally lead to stronger associations.

Conclusions

The results of this study suggest EB knowledge, especially among households as a whole, may influence the home food and media environments, and to a lesser extent, the home PA environment. These findings support the importance of developing interventions that target family units, rather than only one member of the family. Further research is needed to examine these and other factors that promote healthy home environments, particularly using longitudinal data from diverse populations.

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Table 1

Demographic characteristics of the Identifying Determinants of Eating and Activity (IDEA) Study sample*

Variable	Youth n=349**	Parents n=349**
Females, n (%)	178 (51.0)	264 (75.6)
Race/ethnicity, n (%)		
White	326 (93.4)	345 (98.8)
Other	23 (6.6)	4 (1.2)
Age, mean (standard deviation)	15.4 (1.87)	46.7 (5.60)
BMI (kg/m^2), mean (standard deviation)	21.9 (3.74)[1]	26.6 (5.60)
Overweight or Obese, n (%)	69 (19.8)[2]	189 (54.2)[3]
Education, n (%)†		
Less than a college degree		123 (35.2)
College degree or greater		220 (63.0)
Grade level, n (%)††		
6th-8th grade	105 (30.1)	
9th-11th grade	242 (69.3)	

*349 youth/parent pairs recruited in 2006-2007 from Minneapolis/St. Paul, Minnesota

**Includes the 8 individuals with missing education/grade level data

†6 parents had missing data; n=343

††2 youth had missing data; n=347

[1]Youth's BMI-for-age weight status categories based on the 2000 Centers for Disease Control BMI-for-age growth charts

[2]≥ 85th percentile

[3]BMI ≥ 25.0

Table 2

Results from linear regression models of associations between paired energy balance (EB) knowledge scores and selected Home Food Inventory (HFI) and Physical Activity and Media Inventory (PAMI) variables from the Identifying Determinants of Eating and Activity (IDEA) Study sample*

			Paired EB Knowledge			
			Unadjusted		Adjusted***	
Model #	**Dependent Variable**	**n**	**β****	**p**	**β****	**p**
1	Fruit	340	0.44	<0.0001	0.41	0.0004
2	Vegetables	341	0.20	0.018	0.21	0.032
3	Healthful snacks	333	0.12	0.005	0.14	0.005
4	Healthful beverage	332	0.06	0.003	0.07	0.003
5	Media density[1]	340	-0.01	0.047	-0.01	0.122
6	PAASS	339	9.37	0.024	7.14	0.114
7	MAASS	339	-1.30	0.005	-1.40	0.005
8	AMRS	339	0.76	0.0005	0.72	0.003

*349 youth/parent pairs recruited in 2006-2007 from Minneapolis/St. Paul, Minnesota

**β = Non-standardized regression coefficient

***All models controlled for student grade and parent education level

[1]Log-transformed to preserve normality

PAASS: Physical activity Availability and Accessibility Summary Score

MAASS: Media Availability and Accessibility Summary Score

AMRS: Physical activity and Media Ratio Score