Associations Among Measures of Energy Balance Related Behaviors And Psychosocial Determinants in Urban Upper Elementary School Children

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INTRODUCTION

Childhood obesity is a pressing issue in the United States, where one third of children are overweight or obese (Ogden, Carroll, Kit, & Flegal, 2014). Consequences highly associated with obesity range from high blood pressure, Type 2 diabetes, and depression experienced in childhood, to chronic diseases such as stroke and various cancers experienced when children become adults (Daniels, Jacobson, McCrindle, Eckel, & Sanner, 2009; Ogden, Carroll, Curtin, Lamb, & Flegal, 2010; Ogden et al., 2014). Black and Hispanic individuals and those of lower socioeconomic status in the U.S. are disproportionately affected by obesity at all ages (Wang & Beydoun, 2007), and youths who reside in economically distressed urban neighborhoods have higher rates of obesity than those who do not live in these conditions (Ogden et al., 2010; Ogden et al., 2014; Singh, Kogan, & van Dyck, 2010; Story et al., 1999; Thorpe et al., 2004).

Interventions to address these health issues generally aim to improve individual behaviors and the collective environment, as the rapid population level increase in obesity and chronic disease risk suggests these as causal agents instead of a genetic shift. The research literature and recommendations by government and expert committees for encouraging energy balance have identified several behaviors as particularly important to address for childhood obesity prevention and health promotion: intakes of fruits and vegetables, sweetened beverages, processed, packaged snacks, and fast food, and physical activity and sedentary behavior (Barlow & Expert committee, 2007; Springer, Hoelscher, Castrucci, Perez, & Kelder, 2009; U.S. Department of Agriculture and U.S. Department of Health and Human Services, 2015). These are often referred to as energy balance related behaviors (EBRBs).

Interventions are more likely to be effective at changing behaviors when they target specific behaviors and the appropriate motivators and facilitators of behavior change,

collectively referred to here as determinants of behavior change from valid social psychological and ecological theories (Contento, Balch, Bronner, Lytle, Maloney, Olson, & Sharaga Swadener, 1995; Baranowski, Lin, Wetter, Resnicow, & Hearn, 1997; Baranowski, Cullen, Nicklas, Thompson, Baranowski; 2003, Rothman, 2004). This study in a large sample of low income, urban, upper elementary school children in the U.S has two aims 1) to provide an understanding of the relationships of individual EBRBS to each other and 2) describe relationships between EBRBs and determinants of change. This age range was chosen because children at this age are beginning to make food choices on their own and understanding their behaviors and associated determinants will be helpful for designing interventions.

In terms of the first aim, while there is increasing evidence that physical activity and sedentary behavior are two different sets of behaviors (Taveras, Field, Berkey, Rifas-Shiman, Frazier, Colditz, & Gillman, 2007), studies have not examined the relationships among dietary energy-balance related behaviors to identify which, if any, are highly related and how these related groups or sets of dietary EBRBs are related to the physical activity and sedentary behaviors. Studies tend to focus on individual dietary behaviors. For example, one study found physical activity to be correlated with fruit and vegetable intake in adolescents (Fernandes, Christofaro, Casonatto, Kawaguti, Ronque, . . . Oliveira, 2011). One study examined the relationship between screen time and the Healthy Eating Index score found it to be negatively associated with lower quality diet in children and adults (Sisson, Shay, Broyles, & Leyva, 2012). This score is based on the total diet. If there are relationships among dietary behaviors as well, it may be more effective to develop interventions directed at several behaviors that are highly correlated rather than at one behavior at a time.

In terms of the second aim, theory provides a framework by which to examine the relationships among psychosocial determinants (theory variables) and to assess the impact of the various determinants on behavior change (Baranowski, Cullen, Baranowski, 1999, Baranowski, Anderson, & Carmack, 1998, Contento, 2008, Baranowski, Cerin, & Baranowski, 2009).

The theories most often used in the dietary and physical activity areas are variations of the theory of planned behavior (TPB) (Ajzen 1991) / reasoned action approach (Fishbein and Ajzen, 2010) and social cognitive theory (SCT) (Bandura 1986, 2004). The theory of planned behavior/ reasoned action approach proposes that the most immediate determinant of behavior change is behavioral intention. Behavioral intention is in turn influenced by attitudes towards the behavior, which are largely determined by beliefs about the expected outcomes of the behavior (outcome expectations) and social norms. Perceived control over the behavior or self-efficacy influences both intention and the behavior itself. The *extended* theory proposes that behavioral intentions are translated into behaviors through the development of implementation plans similar to goal setting in social cognitive theory (Gollwitzer, 1999). Some models include habit strength as well (Brug, de Vet, de Nooijer, Verplanken, 2006).

SCT proposes, in brief, that personal, behavioral, and environmental factors work in a dynamic and reciprocal fashion to influence behavior. The sense of ability to exert personal influence over one's environment as well as over one's own behaviors is described as personal agency (Bandura 2001). Behavior change is enhanced by: beliefs that the outcome of taking action will be beneficial (outcome expectations); proactive commitment to take action (goal intention); self-efficacy (individuals' confidence in their ability to organize and execute particular behaviors); and self-regulation of behavior through self-assessment and goal-setting processes.

More recently, the usefulness of self-determination theory (SDT) (Deci & Ryan, 2008) has also been investigated for health behavior change (Ryan, Patrick, Deci, & Williams, 2008). In its simplest terms, self-determination theory proposes that individuals have innate psychological needs for autonomy, competence, and relatedness, which, when satisfied, enhance their autonomous motivation and well-being. There are some overlapping determinants among these theories, such as outcome expectations, self-efficacy, and behavioral or goal intentions. In addition, TPB has now added implementation intentions as a determinant which is similar to goal-setting in SCT. Thus, there has been increasing call for interventions to integrate variables from various theories based on evidence of their predictive value for behavior change (Institute of Medicine 2002, Baranowski et al., 1998; Baranowski et al., 2009).

To develop effective childhood obesity prevention interventions it is crucial, of course, to identify and understand the specific psychosocial determinants that are correlated with individual or groups of EBRBs in order to effectively address determinants of behavior change interventions to increase likelihood of changing behavior.

Many studies have been conducted to date to examine such correlates of eating behaviors in children and adolescents but they usually each addressed one behavior (e.g. fruits and vegetables) or a limited set of behaviors, and a limited set of psychosocial determinants. One review identified 77 studies conducted in many countries which examined the following dietary behaviors in separate studies: fruit, juice and vegetable intake, fat in the diet, total energy intake, sweetened beverages, sugary snacks, total fiber, other more healthy and less healthy intake (McClain, Chappuis, Nguyen-Rodriguez, Yaroch, & Spruijt-Metz, 2009). A variety of psychosocial variables from many theories were used in these studies. Across all the dietary behaviors, the most consistently supported correlates were: perceived modeling (SCT), dietary

intentions (TPB), social norms (TPB), liking and preferences (outcome expectations from both SCT and TPB). A review of 98 studies promoting fruit and vegetable consumption (some overlapping those above) found that age, gender, socio-economic position, preferences, parental intake, and home availability/accessibility were most consistently associated with intake (Rasmussen . Krolner, Klepp, Lytle, Brug, Bere, & Fue, 2006).

In terms of physical activity behaviors, a focus group study found that enjoyment, prevention of boredom, mental health benefits, and freedom from parental control were related to active play (Brockman, Jago & Fox, 2011). A systematic review of SDT and physical activity found that autonomous forms of motivation had moderate, positive associations with physical activity while controlled forms of motivation had only weak associations (Owen, Smith, Lubans, Ng, & Lonsdale, 2014). Again, the studies examined only a limited number of determinants in relation to physical activity.

This study adds to the literature by examining the associations among EBRBs and between potential psychosocial determinants and these behaviors. SCT, SDT and select variables of TPB have been used together in previous work (Contento, Koch, Lee, & Calabrese-Barton, 2010) and provided a useful model for examining these associations in this study. Understanding these associations will help researchers and practitioners choose the appropriate behaviors and determinants of these behaviors that have the greatest chance of reducing childhood obesity risk. Further, studying low-income minority students in an urban setting will provide information applicable to populations at highest risk.

METHODS

Study Design

This study is a cross-sectional analysis of the EBRBs and psychosocial determinants baseline survey data collected from fifth grade school children in public elementary schools participating in *Food, Health & Choices* (FHC), a childhood obesity prevention program.

Sample

The schools participating in the FHC program were chosen from districts within New York City with the highest health risks. All 117 schools in the selected districts were invited to participate via one mailed recruitment brochure, one phone call, and two emails to the principal or assistant principal within two weeks of the mailing. Forty schools responded to the invitation within the designated one-month period after the mailing. These schools were prompted to schedule a meeting with one of the principal investigators. The first 20 schools to agree to the *Food, Health & Choices* study terms were included in the final group of schools. All students who were becoming fifth grades in the 2012-2013 school year at the schools were invited to participate in the study (n=1387). Informed consent forms were distributed to parents of the students and assent forms were completed by the students. Twenty-two students were excluded because their parents did not consent to participation. The survey required two sessions to complete, and 124 students missed one or both survey sessions due to absenteeism or removal from class for other activities. Of the enrolled students, 1241 (89.5%) completed the survey. Age and gender data were collected when students participated in weight, height, and body fat measurement (Gray, Contento, Koch, & Di Noia 2016). Of all participants who completed the survey, 289 missed the anthropometric measurement due to absenteeism or removal from class for other activities, and therefore the final sample for this study was 952 students who had all data required, including age, gender and both sets of survey data. There were no significant behavioral score differences between the final sample of 952 students and 289 students who

missed the anthropometric measurement. Detailed baseline demographic characteristics of the *Food, Health & Choices* have been reported elsewhere (Gray, Contento, Koch, & Di Noia 2016). The final sample for this study was 952 students. Mean age was 10 years and 49.3% of the sample was male. The majority of students were eligible for free or reduced-priced lunch (86.3%), indicating low socioeconomic status, and were Hispanic (57.5%) or African American (29.6%).

Institutional review board approval for the *Food, Health & Choices* study was obtained from the research university and the city's Department of Education.

Measurements and Instruments

The Food, Health & Choices questionnaire (FHC-Q) was developed specifically for the *Food, Health & Choices* study.

EBRBs were classified into two categories: “Do more” behaviors were eating more fruits and vegetables and engaging in more physical activity; “Do less” behaviors were drinking fewer sweetened beverages, eating fewer processed packaged snacks and fast food, and engaging in less recreational screen time (**Table 1**). Questions focused on both frequency as well as typical portion size (food) or duration (physical and sedentary activities) in the past week. Questions had four to six options, which were always listed from smallest to greatest. Color photographs of the foods and activities accompanied the questions.

Psychosocial determinants measured in the FHC-Q included determinants from SCT: outcome expectations, goal intention, habit, and self-efficacy, and from SDT: goal-setting skills, competence and autonomous motivation. The SDT variables of goal setting, competence, and autonomous motivation were assessed with general questions involving only one scale each for all behaviors, whereas the other determinants had specific questions for each of the six behaviors

(**Table 2**). Thus, there were a total of 27 determinant scales. Questionnaire items and scales were based on our previous work (Contento et al., 2010).

The final FHC-Q had 116 questions, and validity and reliability for FHC-Q are described elsewhere (Gray et al., 2016). In brief, the relative validity for scales are: physical activity 0.52 ($p<0.001$); recreational screen time 0.60 ($p<0.001$); fruits and vegetables 0.38 ($p<0.01$); sweetened beverages 0.55 ($p<0.001$); processed packaged snacks: 0.61 ($p<0.001$). Test-retest assessment of reliability of the instrument found intraclass correlations of $r=0.59$ – 0.81 for behaviors and $r=0.51$ – 0.68 for the determinants scales. Finally, internal consistency reliability assessments of the instrument found that Cronbach's alpha ranged from 0.77–0.92 for behaviors, and 0.60–0.83 for the psychosocial determinants scales except for physical activity self-efficacy, which was 0.44.

Data Collection

Trained research staff administered the FHC-Q using the Audience Response System (ARS) in two class periods. The questions, along with colored photos, are placed on slides, and displayed on a screen through a LED projector, one question at a time. Students use a hand-held device to respond to the questions. The responses are automatically captured by Meridia® ARS software. Detailed survey administration procedure and validation of using the ARS technique is reported elsewhere (Gray, Koch, Contento, Bendelli, Ang, & Di Noia., 2016).

Data Analysis

Pearson correlations were used to evaluate the relationships among EBRBs. Hierarchical linear modeling (HLM) was employed in the data analysis because participant data in this study were nested, i.e. students were nested in schools, which can overestimate variable effects, and also some variables were only available at either at the school or individual level (Warne,

McKyer, Condie, Diep & Murano, 2012). HLM was used to examine the relationships between EBRBs and psychosocial determinants, controlling for individual children's ages and gender, as well as the school-level covariates of percent of students receiving free and reduced lunch, percent of students of black race, percent of students of Hispanic ethnicity, and percent of students who are English Language Learners. EBRBs were dependent variables and psychosocial determinants were included as independent variables in the HLM models. For all analyses of psychosocial determinants, items were coded so higher scores indicated selection of the more desirable, healthier, options (higher score=healthier). Items for the behavior specific determinants were: outcome expectations, self-efficacy, habit, and goal intentions, and the general determinants for the behaviors taken as a whole were: goal setting, competence, and autonomous motivation.

Models were constructed for each EBRB frequency and duration scale, explained by all psychosocial determinants. All statistical tests were two-sided at the 0.05 significance level. Data analyses for correlations were run using SPSS Version 20, and regression analyses were run using HLM Version 7 to take into account multi-level modeling with individual and school-level data. Missing cases were deleted listwise for each analysis.

RESULTS

Results for aim 1, the correlations examining relationships between EBRBs, are presented in **Table 3**. Correlations between the “do more” fruit and vegetables and physical activity behaviors, while low ($r=0.173-0.316$) were positive and highly significant ($p<0.01$). Although the frequency of each behavior was not highly correlated with the size/duration of that behavior ($r=0.111-0.494$), these associations were highly significant ($p<0.01$).

Correlations among the “do less” behaviors were also all positive and highly significant ($p < 0.01$) and ranged from low to moderate (0.109-0.718). Specifically, recreational screen time was correlated with consumption of sweetened beverages ($r = 0.109$ -0.432), processed packaged snacks ($r = 0.214$ -0.443), and fast food ($r = 0.224$ -0.360). Sugar sweetened beverage consumption was further correlated with consumption of processed packaged snacks ($r = 0.224$ -0.694) and fast food ($r = 0.243$ -0.622). Finally, processed packaged snack consumption was highly correlated with fast food consumption ($r = 0.535$ -0.718). The correlations between frequency and size/duration of each behavior were also highly significant ($p < 0.01$) and showed low to moderate associations: recreational screen time ($r = 0.284$ -0.598), sugar sweetened beverages ($r = 0.193$ -0.526), processed packaged snacks ($r = 0.614$), and fast food ($r = 0.356$).

Fruit and vegetable intake was significantly ($p \leq 0.05$ - ≤ 0.01) negatively correlated with the “do less” behaviors of recreational screen time engagement ($r = -0.178$ to -0.126), and consumption of fruit drinks, sweetened iced teas, and sodas ($r = -0.159$ to -0.125), processed packaged snacks ($r = -0.129$ to -0.125), and fast food ($r = -0.143$ to -0.113). However, fruit and vegetable intake was significantly ($p < 0.05$ or < 0.01) positively correlated with sports drinks and flavored water consumption ($r = 0.095$ -0.215).

Significant correlations ($p < 0.05$ or < 0.01) between physical activity and the “do less” behaviors (recreational screen time and consumption of sweetened beverages, processed packaged snacks, and fast food) were all positive ($r = 0.083$ -0.263).

Overall, the results for aim 2 found correlations between specific determinants and behaviors were low to moderate, with many significant for both frequency and size/duration. The results of the hierarchical linear models examining how much psychosocial determinants explained each EBRB frequency are displayed in **Table 4**, which also accounted for each child’s

gender and age, as well as school-level covariates. The determinants questions asked about doing healthy behaviors, that is doing more of the “do more” behaviors and doing less of the “do less” behaviors. Therefore, for “do more” behaviors, the desired result is a positive coefficient and for the “do less” behaviors the desired result is a negative coefficient. Doing *more* of the “do more” behaviors was significantly explained by self-efficacy (most $p < 0.001$) and habit (most $p < 0.001$). Doing *less* of the specific “do less” behaviors of processed packaged snacks, fruit drinks, sweetened iced tea, and soda consumption was significantly explained by outcome expectations, habit, and goal intention ($p < 0.05$ to $p < 0.001$). Drinking *less* sports drinks and flavored water, however, was significantly explained by outcome expectations only. Eating *less* fast food, including both unhealthy and healthy options, was significantly explained by self-efficacy, habit, and goal intention ($p < 0.05$ to $p < 0.001$). *Less* recreational screen time engagement was explained by all behavior specific determinants (outcome expectations for less screen time engagement, self-efficacy, habit, and goal intention) ($p < 0.05$ to $p < 0.001$).

Similar patterns were found in relationships between EBRB size/duration and psychosocial determinants (**Table 5**). Doing *more* of the “do more” behaviors was generally explained by self-efficacy and/or habit ($p < 0.05$ to $p < 0.001$). Specifically, while vegetable size was explained by self-efficacy ($p < 0.001$) and habit ($p = 0.047$), fruit size was explained only by self-efficacy ($p < 0.001$), and physical activity was explained only by habit ($p = 0.017$). Doing *less* of the “do less” behaviors was generally explained by outcome expectations, self-efficacy, habit, and goal intention ($p < 0.05$ to $p < 0.001$). Specifically, consuming *less* of processed packaged snacks, and soda, fruit drinks, and iced tea were all strongly explained by outcome expectations, self-efficacy, and habit ($p < 0.001$), while consuming *less* fast food was explained by self-efficacy, habit, and goal intention ($p < 0.05$ to $p < 0.001$). Drinking *less* sports drinks and flavored water was

explained only by outcome expectations ($p < 0.001$). Participating in *less* recreational screen time was strongly explained by outcome expectations, self-efficacy, and habit ($p < 0.001$).

The relationships between general determinants from SDT and behaviors were less clear, with only a few significant relationships for goal setting and competence, mainly for the do less behaviors.

DISCUSSION

The present study provided a comprehensive examination of the patterns of relationships among a wide variety of EBRBs and between potential psychosocial determinants and these EBRBs in a large sample of urban low income school children. While previous studies have examined the association of psychosocial determinants with behaviors (McClain et al., 2009) they have not looked at correlations within categories of food intake and at the same time examined associations of psychosocial determinants with behavior with these categories.

In this study, correlation analyses showed that “do more” and “do less” behaviors were significantly related with each other within their categories, suggesting that children who consume more and larger portions of fruits and vegetables may exercise more often and for longer periods of time, and children who consume unhealthy foods (e.g. processed packaged snacks) are likely to consume other types of unhealthy foods (e.g. sweetened beverages) as well as participate in more sedentary behaviors (e.g. recreational screen time). Studies have not examined the relationships among dietary behaviors looking for similarity, instead examining only the relationship of dietary variables to physical activity or sedentary behavior.

The “do more” behaviors were generally inversely correlated, when significant, with most “do less” behaviors in this study, indicating that upper elementary school children indicating that healthy behaviors (more “do more” and less “do less”) appear to be generally all

correlated with each other. This is consistent with previous studies that found higher fruit and vegetable intake among adolescents to be associated with physical activity (Fernandes et al., 2011) and a higher overall HEI diet score among children and adults inversely correlated with screen time (Sisson, et al., 2012). Our study found that more specifically, though, the patterns are more nuanced: For fruit and vegetable intakes, the pattern of inverse relationships was particularly clear for vegetable size eaten and also fruit and vegetable intake was positively correlated with sports drinks and flavored /“mineral” waters, which may indicate that students perceive these beverages as more healthful than the actually are.

Physical activity was not significantly related to television screen time as found in other studies (Taveras et al., 2007), suggesting that these behaviors are independent and not two ends of a continuum. The current study also examined video game usage separately from other screen time and found this relationship to be positive. However, the correlations are very small ($r=.09$ to $.1$) and may not be meaningful. In addition, this study provides a more detailed look: although physical activity was positively correlated with fruit and vegetable intake as in some other studies (Fernandes et al., 2011), in this study it was also correlated with the “do less” dietary behaviors of sweet drinks, processed packaged snacks and fast food, possibly suggesting that participating in physical activity is not necessarily related to eating fewer less healthy foods. One explanation of this finding may be that food companies’ marketing efforts influence subsequent undesired social consumption norms. For instance, sports drinks are often provided, emphasized, and purchased in recreational settings such as sports clubs frequented by children (Kelly Baur, Bauman, King, Chapman, & Smith, 2010; Kelly, Chapman, King, Hardy, & Farrell, 2008).

In this study, leisure screen-time was clearly inversely related to fruit and vegetable intake and positively related to sweetened beverages, packaged snacks and fast food. These

results are similar to those found for similar behaviors in a national US sample (Lipsky & Iannotti, 2012), and in a systematic review (Pearson & Biddle, 2011). Another study found screen time to be related to lower diet quality (Sisson et al., 2012). Taken together, these results suggest that it is important to also address screen time in nutrition education interventions.

In general, regression analyses indicated that the behavior-specific determinants of outcome expectations, self-efficacy, habit, and goal intention, were predictive of many of the behaviors, in terms of their frequencies and/or sizes/duration, a finding in line with several reviews (Cerin, et al., 2009; McClain et al., 2009; Sleddens, Kroeze Kohl, Bolten, Velema, . . . Kremers., 2015). For example, one review found that while it was difficult to generalize because of the variability in age groups and research designs, self-efficacy and outcome expectations were the mechanisms most consistently associated with dietary behavior change (Cutler, Flood, Hannan, & Neumark-Sztainer, 2011). The umbrella review of Sleddens et al. (2015) found that while intention predicted most behaviors, most other psychosocial determinants did not predict fruit and vegetable intake or breakfast; attitude /outcome expectations, self-efficacy, and habit predicted sugar-sweetened beverages; and attitude /outcome expectations predicted snack and fast food consumption (Sleddens et al., 2015). The review of McClain et al. (2009) also found that across numerous dietary behaviors, intentions predominated, but liking or preferences was also important for fruit and vegetable intakes and perceived modeling for sweetened beverages, determinants not examined in this study. One study found that adolescents who reported greater self-efficacy chose to stay in the cafeteria instead of going off campus for fast food (Beaulieu & Godin, 2012).

Interestingly, in the current study, the psychosocial variables from SDT, in particular autonomous motivation, did not significantly explain most behaviors. It could be argued that this

was a result of the fact that the questions were more general in nature and not specific to each of the behaviors. However, this is different from a study with middle school students, which found that autonomous motivation was a significant mediator of behavior change for similar behaviors (Gray, Contento, Koch, & Di Noia, 2016). Perhaps autonomous motivation is more relevant for older children than for these elementary school children.

The results of this study suggest that framing and examining determinants in relation to patterns of “do more” and “do less” behaviors, and not just individual behaviors, may be useful for interventions so that the determinants for several behaviors can be addressed at the same time and lead to higher likelihood of changing more behaviors.

This study found that different theory-based determinants are important for “do more” behaviors and “do less” behaviors. For fruit and vegetable intake and physical activity, (“do more”) self-efficacy and habit generally explained these behaviors, indicating that higher confidence and perception of routine were associated with these beneficial behaviors and can be encouraged in interventions. Children may already know that these behaviors are good for them so strategies can focus on “how-to” do the behaviors by emphasizing skills to enhance self-efficacy and habit maintenance.

For “do less” behaviors, outcome expectations and goal intention generally explained these behaviors with self-efficacy and habit important as well. Goal intention was more relevant for frequency of these behaviors. Thus, these children engage in the “do less” behaviors when they consider them to be beneficial to their overall health and personal wellbeing (outcome expectations), are confident they can do less of the behaviors (self-efficacy), intend to do less of them (goal intention) and consider them to part of their daily routine (habit). This suggests that children need convincing that reducing these behaviors are really beneficial for them by using

strategies to increase motivation and enhance intention formation. That is, children need strategies for these behaviors that emphasize “why-to” take action, as well as those related to “how-to” take action.

The finding that the psychosocial determinants associated with in this study are similar to those in other demographic populations studied suggests that, given the ubiquitous nature of similar food products and universal marketing environment for children, these determinants may be useful to target in interventions with children more generally.

Limitations

The study has some limitations. The correlations among behaviors, though highly significant, are small, so the results need to be interpreted with caution. In addition, the dietary intake data were self-reported. However, the dietary intake instrument had been validated and self-report is common practice in assessing the dietary intakes of large samples. The cross-sectional design of the study does not allow us to make inferences regarding the causal relationships between the psychosocial determinants and the behaviors of interest. A low internal consistency (Cronbach’s alpha of 0.44) for the physical activity self-efficacy scale means the results from this scale may be somewhat unreliable. The large number of participants with missing age and gender data is also a limitation. However, the behavioral scores of those with missing data did not differ from those with complete data, suggesting that the resulting data were not biased. The participants in the study were 9-11 years old and thus the results may not generalize to younger or older children. The study also has some strengths: the large sample size, the use of a valid and reliable instrument to collect the data, and the use of ARS technology to increase student interest in completing the survey instrument and reduce data entry errors.

Implications for Practice

Research shows there is some stability in consumption patterns. In a Norwegian study by Lien and colleagues (Lien, Lytle, & Klepp, 2001), the proportion of teenagers that remained in the same tracking categories through age 21 for fruit, vegetables, high sugar foods, and sweetened beverages was 50-70%. Similar results were found for a US sample (Craigie, Lake, Kelly, Adamson, & Mathers, 2011). Fast food consumption has also been shown to track (Larson et al., 2008). Understanding the relationships among behaviors and between psychosocial determinants and behaviors can help in the design of interventions with this young age group that may help mitigate obesity and related diseases later in life.

The finding that healthy behaviors and less healthy behaviors were significantly related within their categories means that interventions may be designed to address each of these categories together. An exception is that for children who are physically active, a focus on reducing the “do less” behaviors of sweetened drinks, packaged snacks and fast foods is still necessary. The determinants of behavior also tended to be generally similar within the categories. Thus, interventions designed to foster *healthy* eating behaviors and physical activity in upper elementary school aged children can usefully focus on behavior change strategies that enhance their self-efficacy and help them develop the habit of eating healthy food and participating in physical activity. In order to facilitate decreasing *unhealthy* behaviors, however, interventions need to focus on strategies to address relevant positive outcome expectations or perceived benefits from reducing these less healthy behaviors so as to motivate them to want to make an intention or actively choose to do so. These can be accompanied by strategies to enhance their self-efficacy and intention and to develop habits to decrease these less healthy behaviors.

Future Directions for Research

The results of this study indicate that increasing healthier behaviors is generally associated with self-efficacy and habit, and decreasing less healthy behaviors is associated with outcome expectations, self-efficacy, habit, and goal intention in a sample of upper elementary school children. Future research should examine these relationships in other samples. Future research should also examine these relationships in both younger and older children. For younger children, the role of parents warrants further study as parents still play an important role for children of this age. For older children, the role of autonomy should be examined as autonomy may prove to have a larger role than in these upper elementary school children. Future research should build upon these results to examine the impact of intervention based on addressing these clusters of “do more” and “do less” behaviors and their associated psychosocial variables together to determine whether such an approach would be more effective than addressing the behaviors and determinants separately. Such studies could also examine cost-effectiveness issues for such an approach.

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Table 1. Examples of Questions for Energy Balance Related Behavior Size/Duration Individual Items and Accompanying Descriptive Statistics

Behavior	# of Questions	Range of responses	Examples of Questions	N	Mean	SD
“DO MORE” BEHAVIORS						
Fruits and Vegetables						
Frequency						
Individual fruits and vegetables	8	1-5*	In the past week, I ate apples...	850	2.15	0.80
Fruit at breakfast	1	1-5*	In the past week, I ate fruits at breakfast...	788	2.08	1.17
Fruit at lunch	1	1-5*	In the past week, I ate fruits at lunch...	796	2.65	1.16
Vegetables at lunch	1	1-5*	In the past week, I ate vegetables at lunch (DO NOT count fried potatoes or French fries)...	786	1.97	1.09
Vegetables at dinner	1	1-5*	In the past week, I ate vegetables at dinner (DO NOT count fried potatoes or French fries)...	810	2.32	1.17
Size						
Fruits	1	1-6**	In the past week, how much did you usually eat at one time? Fruits (such apples, grapes, oranges, or bananas)	808	4.53	1.43
Vegetables	1	1-6**	In the past week, how much did you usually eat at one time? Vegetables (such as green salad, broccoli, carrots, corn, or tomatoes. DO NOT count fried potatoes or French fries)	762	3.31	1.75
Physical Activity						
Frequency	3	1-5*	In the past week I did things that got my heart beating really fast...	845	3.55	1.06
Duration	3	1-5***	In the past week, how long each time did I do things that got my heart beating really fast?	818	3.19	1.25
“DO LESS” BEHAVIORS						
Sweetened Beverages: <i>Drink with added sugar such as soda, sweetened iced teas and sweetened, flavored drinks</i>						
Frequency						
Fruit drinks, sweetened iced teas & sodas	2	1-5*	In the past week I drank fruit drinks and sweetened iced teas...	864	3.18	1.28
Sport drinks	1	1-5*	In the past week I drank sports drinks...	843	2.62	1.63
Flavored water	1	1-5*	In the past week I drank flavored water...	839	2.17	1.52
Size						
Sodas, fruit drinks or iced teas	1	1-6**	In the past week, how much did you usually drink at one time? Sodas, fruit drinks or iced-teas	760	3.93	1.44
Sports drinks or flavored waters	1	1-6**	I In the past week, how much did you usually drink at one time? Sports drinks and flavored waters	797	3.36	1.78
Processed Packaged Snacks: <i>Food items packaged in individual serving containers and made up of several ingredients typically including added fats and sugars; examples are chips and candy</i>						
Frequency	6	1-5*	In the past week I ate candy...	892	2.97	1.20
Size	4	1-6**	In the past week, how much did you usually eat at one time? Chips and other salty snacks (such as Ruffles, Cheese Nips, Chex Mix, or pretzels)	881	3.95	1.37
Fast Food: <i>Foods from quick service, counter style restaurants such as burgers, fries, fried chicken, pizza, tacos, burritos, and take-out Chinese food</i>						
Frequency						
Fast food, general	1	1-5*	In the past week I ate fast food...	852	3.10	1.50
Combo meals	1	1-4****	In the past week, at fast food restaurants, I had combo meals (such	804	2.68	1.08

			as a burger with fries and a drink)...			
Healthy (baked or grilled) options	1	1-4****	In the past week, at fast food restaurants, I had baked or grilled options (such as baked potatoes or grilled chicken sandwiches)...	807	2.54	1.15
Salad, apples, or a fruit cup	1	1-4****	In the past week, at fast food restaurants, I had salad, apples, or a fruit cup...	814	2.48	1.14
Size	3	1-6**	In the past week, what size did you usually have? Fast food burgers or sandwiches	878	3.84	1.40

Recreational Screen Time

Time spent in sedentary game play or computer use for non-educational purposes

Frequency						
TV	1	1-5*	In the past week I sat and watched TV...	807	3.86	1.29
Video games	1	1-5*	In the past week I sat and played video or computer games (DO NOT count Wii Fit or other fitness games)...	811	3.37	1.54
Duration						
TV	1	1-5***	In the past week, how long each time did I sit and watch TV?	774	3.43	1.58
Video games	1	1-5***	In the past week, how long each time did I sit and played video or computer games (DO NOT count Wii Fit or other fitness games)?	774	3.16	1.65

*Response options: 1=0 times/week, 2=about 1-2 times/week, 3=about 3-4 times/week, 4=almost every day, 5=2 or more times every day

**Response options: 1=I didn't eat/drink this, 2=less than small, 3=small, 4=medium, 5=large, 6=more than large

***Response options: 1=Less than half an hour, 2=half an hour to 1 hour, 3=2 hours, 4=3 hours, 5=more than 3 hours

****Response options: 1=Never, 2=rarely, 3=sometimes, 4=always

Table 2. Examples of Questions for Psychosocial Determinants and Accompanying Descriptive Statistics

General Determinants	# of Questions	Range of responses	Examples of Questions	N	Mean	SD
Goal setting skills: <i>Part of the concept of self-regulation; identification of incremental and long-term changes that can be achieved</i>	4	1-5*	I believe that I can set a goal for healthy eating.	843	4.14	0.91
Autonomous motivation: <i>ability to reflect on and engage in behaviors while having a full sense of choice</i>	3	1-5**	The reason I would eat healthy foods is because it fits in with what I want to do with my life	881	4.08	1.10
Competence: <i>Belief about the ability to perform a task</i>	3	1-5**	When I think about myself and my daily routine I am capable of eating healthy regularly.	883	3.86	1.13
Behavior-Specific Determinants	# of Questions	Range of responses	Examples of Questions	N	Mean	SD
Outcome expectations: <i>Beliefs about the likelihood and value of consequences that result from behavior</i>						
Fruits and Vegetables	3	1-5**	Eating fruits and vegetables makes me feel good about myself.	849	3.81	1.12
Physical Activity	3	1-5**	Being physically active helps me do better in school.	847	4.14	1.00
Sweetened Beverages	3	1-5**	Drinking lots of sweetened beverages helps me stay in energy balance.	882	3.12	1.30
Processed Packaged Snacks	3	1-5**	Eating lots of packaged snacks makes me feel good about myself.	880	3.44	1.29
Recreational Screen Time	3	1-5**	Sitting and watching TV or playing video games helps me stay in energy balance.	848	3.19	1.44
Self-efficacy: <i>Beliefs about personal ability to perform behaviors that lead to desired outcomes</i>						
Fruits and Vegetables	5	1-5*	I am sure I can eat fruits at school lunch.	826	3.49	1.02
Physical Activity	3	1-5*	I am sure I can walk or bike to school instead of taking a car, bus, or subway	846	4.35	0.85
Sweetened Beverages	3	1-5*	I am sure I can drink fewer sweetened beverages after school.	868	3.25	1.28
Processed Packaged Snacks	3	1-5*	I am sure I can bring fewer packaged snacks to school.	864	3.30	1.34
Fast Food	3	1-5*	At fast food restaurants, I am sure I can eat only a small size of hamburger or French fries.	837	3.20	1.35
Recreational Screen Time	3	1-5*	I am sure I can watch TV no more than 1 hour per day	840	3.13	1.35
Goal intention: <i>Degree to which a person has consciously planned to perform a specific behavior</i>						
Fruits and Vegetables	1	1-5**	I would like to eat more fruits and vegetables.	736	3.77	1.40
Physical Activity	1	1-5**	I would like to do more physical activity.	760	4.33	1.14
Sweetened Beverages	1	1-5**	I would like to drink fewer sweetened beverages.	790	2.93	1.54
Processed Packaged Snacks	1	1-5**	I would like to eat fewer processed packaged snacks.	792	2.93	1.56
Fast Food	1	1-5**	I would like to eat fewer fast foods.	818	2.80	1.59

Recreational Screen Time	1	1-5**	I would like to spend less time on computer games or watching TV.	758	2.64	1.63
Habit strength: <i>Degree to which a person currently performs a specific behavior</i>						
Fruits and Vegetables	1	1-5**	Eating fruits and vegetables is part of my daily routine.	816	3.39	1.50
Physical Activity	1	1-5**	When I think about myself exercise is part of my daily routine.	819	3.88	1.40
Sweetened Beverages	1	1-5**	When I think about myself, drinking sweetened beverages is part of my daily routine.	820	2.99	1.60
Processed Packaged Snacks	1	1-5**	When I think about myself, eating packaged snacks is part of my daily routine.	836	3.08	1.59
Fast Food	1	1-5**	When I think about myself, eating fast food is part of my daily routine.	811	3.26	1.57
Recreational Screen Time	1	1-5**	When I think about myself, watching TV or playing video games is part of my daily routine.	810	2.47	1.58

*Response options: 1=Not at all sure, 2=a little sure, 3=neutral, 4=sure, 5=very sure

**Response options: 1=Not at all true for me, 2=not true for me, 3=neutral, 4=somewhat true for me, 5=very true for me

Table 3. Correlations Among Energy Balance Related Behaviors

		Fruit and Vegetables			Physical Activity			Sweetened Beverages				Processed Packaged Snacks		Fast Food		Recreational Screen Time			
		FVF	FS	VS	F	D	SF	SDF	FWF	SS	SFS	F	S	F	S	TVF	VGf	TVD	VGD
Fruit and Vegetables (FV)	FV Frequency (FVF)	1																	
	Fruit Size (FS)	0.345**	1																
	Vegetable Size (VS)	0.350**	0.159**	1															
Physical Activity	Frequency (F)	0.316**	0.215**	0.113**	1														
	Duration (D)	0.295**	0.173**	0.111**	0.494**	1													
Sweetened Beverages	Sweetened drinks & sodas Frequency (SF)	-0.042	0.004	-0.159**	0.070	0.086*	1												
	Sport drinks Frequency (SDF)	0.170**	0.161**	-0.020	0.204**	0.263**	0.325**	1											
	Flavored Water Frequency (FWF)	0.215**	0.095*	0.007	0.171**	0.171**	0.293**	0.417**	1										
	Sodas, fruit drinks or iced teas Size (SS)	0.005	0.032	-0.125*	0.000	0.020	0.504**	0.242**	0.193**	1									
	Sports drinks or flavored waters Size (SFS)	0.173**	0.150**	-0.026	0.195**	0.194**	0.291**	0.526**	0.388**	0.417**	1								
Processed Packaged Snacks	Frequency (F)	0.053	0.054	-0.125**	0.152**	0.135**	0.694**	0.411**	0.394**	0.475**	0.350**	1							
	Size (S)	0.003	0.033	-0.129**	0.083*	0.051	0.466**	0.243**	0.224**	0.622**	0.407**	0.614**	1						
Fast Food	Frequency (F)	0.046	0.065	-0.113**	0.134**	0.102**	0.540**	0.249**	0.243**	0.520**	0.312**	0.613**	0.535**	1					
	Size (S)	0.043	0.061	-0.143**	0.101**	0.102**	0.471**	0.310**	0.256**	0.622**	0.442**	0.555**	0.718**	0.356**	1				
Recreational Screen Time	TV Frequency (TVF)	-0.126**	0.079*	-0.165**	0.060	-0.022	0.362**	0.147**	0.109**	0.201**	0.109**	0.344**	0.214**	0.326**	0.224**	1			
	Video Games Frequency (VGf)	-0.042	0.010	-0.128**	0.111**	0.087*	0.432**	0.208**	0.221**	0.281**	0.188**	0.443**	0.346**	0.347**	0.345**	0.405**	1		
	TV Duration (TVD)	-0.127**	-0.043	-0.172**	-0.025	0.036	0.337**	0.108**	0.146**	0.252**	0.124**	0.343**	0.240**	0.278**	0.266**	0.489**	0.399**	1	
	Video Games Duration (VGD)	-0.049	0.038	-0.178**	0.051	0.107**	0.369**	0.225**	0.194**	0.284**	0.213**	0.406**	0.338**	0.324**	0.360**	0.284**	0.598**	0.458**	1

* Correlation significant at the 0.05 level
**Correlation significant at the 0.01 level
Items are scored so that the healthy direction is positive

Table 4. Hierarchical linear models explaining energy balance related behavior frequency by psychosocial determinants ^a

Behavior Frequencies		Behavior Specific Determinants								General Determinants					
		Outcome Expectations		Self-Efficacy		Habit		Goal Intention		Goal Setting		Competence		Autonomous Motivation	
		β	P	β	P	β	P	β	P	β	P	β	P	β	P
Fruits and Vegetables	Frequency	-0.002	0.958	0.190	<0.001	0.096	<0.001	0.007	0.779	0.053	0.179	0.038	0.254	0.026	0.454
	Fruit at breakfast	-0.021	0.705	0.297	<0.001	0.075	0.045	0.059	0.143	0.021	0.741	0.032	0.539	0.044	0.422
	Fruit at lunch	0.657	0.222	0.214	<0.001	0.038	0.346	-0.020	0.609	0.092	0.150	-0.082	0.123	0.076	0.174
	Vegetables at lunch	0.017	0.721	0.266	<0.001	0.128	<0.001	0.012	0.739	-0.009	0.878	0.009	0.852	0.030	0.543
	Vegetables at dinner	-0.004	0.939	0.362	<0.001	0.137	<0.001	0.037	0.324	0.002	0.970	0.043	0.376	0.009	0.868
Physical Activity		0.040	0.379	0.281	<0.001	0.084	0.006	0.049	0.170	-0.006	0.904	0.036	0.403	0.073	0.097
Sweetened Beverages	Fruit drinks, sweetened iced teas & sodas	-0.215	<0.001	-0.021	0.597	-0.141	<0.001	-0.068	0.039	-0.179	0.001	-0.024	0.644	0.018	0.733
	Sport drinks	-0.222	<0.001	0.076	0.173	-0.038	0.422	-0.013	0.777	0.118	0.124	0.064	0.372	-0.047	0.524
	Flavored water	-0.237	<0.001	0.024	0.656	-0.016	0.725	0.030	0.480	-0.054	0.463	0.211	0.002	0.008	0.913
Processed Packaged Snacks		-0.270	<0.001	-0.041	0.254	-0.146	<0.001	-0.068	0.020	-0.086	0.074	0.056	0.199	-0.034	0.468
Fast Food	Frequency	-	-	-0.116	0.017	-0.348	<0.001	-0.102	0.007	0.092	0.155	-0.160	0.007	0.051	0.399
	Combo meals	-	-	-0.175	<0.001	-0.120	<0.001	-0.068	0.019	0.037	0.448	-0.031	0.486	0.015	0.745
	Healthy options: salad, apples, or a fruit cup	-	-	0.153	<0.001	-0.083	0.010	0.085	0.011	0.106	0.059	0.024	0.638	0.057	0.282
	Healthy options: baked or grilled options	-	-	-0.102	0.012	-0.209	<0.001	-0.002	0.962	0.125	0.021	0.051	0.306	-0.049	0.325
Recreational screen time	TV	-0.125	0.004	-0.091	0.029	-0.215	<0.001	-0.030	0.378	-0.084	0.168	-0.024	0.652	0.055	0.322
	Video games	-0.314	<0.001	-0.155	<0.001	-0.188	<0.001	-0.074	0.042	0.089	0.175	-0.035	0.527	0.031	0.599

Variables in bold are significant predictors

Items are scored so that the healthy direction is positive

^a Hierarchical linear modeling: covariates at individual level: gender, age. School level covariates: % free & reduced lunch, % African-American, % Hispanic, % English Language Learners

Table 5. Hierarchical linear models explaining EBRB size/duration by psychosocial determinants^a

Behavior Size/Duration		Behavior-Specific Determinants								General Determinants					
		Outcome Expectations		Self-Efficacy		Habit		Goal Intention		Goal Setting		Competence		Autonomous Motivation	
		β	P	β	P	β	P	β	P	β	P	β	P	β	P
Fruits and Vegetables, size	Fruit	0.039	0.539	0.312	<0.001	0.083	0.063	0.016	0.743	0.084	0.264	-0.078	0.213	0.046	0.482
	Vegetable	0.019	0.806	0.716	<0.001	0.105	0.047	0.045	0.421	-0.057	0.523	-0.056	0.458	0.001	0.998
Physical Activity, duration		0.083	0.117	0.330	0.117	0.086	0.017	-0.044	0.279	0.024	0.691	0.189	<0.001	-0.078	0.127
Sweetened Beverages, size	Sodas, fruit drinks or iced teas	-0.266	<0.001	-0.078	<0.001	-0.241	<0.001	-0.064	0.090	0.008	0.898	-0.079	0.189	-0.110	0.077
	Sports drinks or flavored waters	-0.245	<0.001	0.058	0.358	-0.101	0.062	-0.020	0.686	0.136	0.113	0.030	0.717	-0.069	0.409
Processed Packaged Snacks, size	PPS	-0.302	<0.001	-0.125	<0.001	-0.246	<0.001	-0.039	0.221	0.106	0.040	-0.095	0.044	-0.015	0.760
Fast Food, size	Size			-0.229	<0.001	-0.303	<0.001	-0.068	0.040	0.077	0.171	-0.015	0.772	-0.074	0.772
Recreational screen time, duration	TV	-0.257	<0.001	-0.168	<0.001	-0.229	<0.001	-0.075	0.054	-0.047	0.495	0.017	0.774	-0.011	0.866
	Video games	-0.388	<0.001	-0.218	<0.001	-0.158	<0.001	-0.064	0.103	0.134	0.056	-0.134	0.028	0.048	0.455

Variables in bold are significant predictors

Items are scored so that the healthy direction is positive

^aHierarchical linear modeling: covariates at individual level: gender, age. School level covariates: % free & reduced lunch, % African-American, % Hispanic, % English Language Learners