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Psychometric properties and factor structure of the adapted Self-Regulation Questionnaire assessing autonomous and controlled motivation for healthful eating among youth with type 1 diabetes and their parents

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Abstract

Background—The purpose of this cross-sectional study was to examine the psychometric properties of two adapted SRQ measures assessing youth with type 1 diabetes motivation internalization for healthful eating and their parents motivation internalization for providing healthy meals for the family.

Methods—External validity of the adapted SRQ was evaluated with respect to healthy eating attitudes (healthful eating self-efficacy, barriers, and outcome expectations) assessed by questionnaire, diet quality (Healthy Eating Index-2005, HEI-2005; Nutrient-Rich Foods Index 9.3, NRF9.3; Whole Plant Food Density, WPFd) assessed by 3-day food records, and BMI assessed by measured height and weight in youth with type 1 diabetes (N=136, age 12.3±2.5 years) and their parents.

Results—Exploratory factor analysis with varimax rotation yielded a two-factor structure with the expected autonomous and controlled motivation factors for both youth and parents. Internal consistencies of subscales were acceptable ($\alpha=0.66-0.84$). Youth autonomous and controlled motivation were positively correlated overall ($r=0.30, p<0.001$); however, in analyses stratified by age (<13 vs. ≥13y), the correlation was not significant for youth ≥13y. Autonomous motivation

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was significantly associated ($p<0.001$) with greater self-efficacy (youth: $r=0.39$, parent: $r=0.36$), positive outcome expectations (youth: $r=0.30$, parent: $r=0.35$), and fewer barriers to healthful eating (youth: $r=-0.36$, parent: $r=-0.32$). Controlled motivation was positively correlated with negative outcome expectations for parents ($r=0.29$, $p<0.01$), and both positive ($r=0.28$, $p<0.01$) and negative ($r=0.34$, $p<0.001$) outcome expectations for youth. Autonomous motivation was positively associated ($p<0.05$) with diet quality indicators for parents (NRF9.3 $r=0.22$; WPF $r=0.24$; HEI-2005 $r=0.22$) and youth ≥ 13 y (NRF9.3 $r=0.26$), but not youth <13 y. Among parents, but not youth, BMI was associated negatively with autonomous motivation ($r=-.33$, $p<.001$) and positively with controlled motivation ($r=.27$, $p<.01$).

Conclusions—Findings provide initial support for the SRQ in this population and suggest potential developmental differences in the role of motivation on healthful eating among children, adolescents, and adults.

Keywords

motivation; self-regulation; healthful eating; youth; parents; type 1 diabetes

Introduction

Establishing healthy eating behaviors in childhood reduces the risk of numerous chronic diseases (Maynard et al., 2003; Mikkila et al., 2004). This is particularly important for youth with type 1 diabetes who are at increased risk of cardiovascular disease (American Diabetes Association, 2010). Dietary guidelines for this population are equivalent to those for the general population (American Diabetes Association, 2010; Smart et al., 2009). However, youth with type 1 diabetes fall short of meeting dietary guidelines for intake of fruits, vegetables and fiber (Mehta et al., 2014; Nansel et al., 2012). Type 1 diabetes management requires patients to maintain tight glycemic control by tailoring insulin dosing to dietary and physical activity behaviors (American Diabetes Association, 2013). Parents also play a key role in helping to support their child's diabetes management by encouraging and modeling healthful eating (American Diabetes Association, 2013). Research elucidating modifiable influences on healthy eating in this population is needed for developing effective interventions to improve diet quality and long-term health outcomes.

Self-determination theory (SDT) (Deci and Ryan, 2000) posits that successful and sustained behavior change depends on a person's willingness and motivation to undertake and maintain required behaviors. In regards to healthful eating, such change requires persistent self-regulation involving opting to eat health-promoting foods to achieve long-term health goals rather than non-health-promoting foods that may better satisfy immediate sensory desires (Pelletier et al., 2004). SDT describes three main motivation types falling along a continuum of internalization, the process by which an individual comes to personally value socially-sanctioned behaviors and practices (Deci and Ryan, 2000). Amotivation, defined as the absence of intention to act, is the least internalized motivation type characterized by lack of concern about behavioral consequences (Deci and Ryan, 1985). Further along the continuum of internalization is controlled motivation, when an individual behaves to satisfy extrinsic demands or reward contingencies, to avoid feelings of pressure and anxiety, or to enhance self-esteem (Pelletier et al., 2004). On the most internalized end of the continuum is

autonomous motivation, when a person performs a behavior to satisfy intrinsic values, inherent interest, or enjoyment (Pelletier et al., 2004). Autonomous motivation (versus controlled or amotivation) is associated with exerting greater effort towards achieving positive health outcomes (Pelletier et al., 2004).

The Self-Regulation Questionnaire (SRQ) (Deci and Ryan, 1985, 2000) was developed to assess the three motivation types delineated by SDT. Research evaluating adaptations of the SRQ pertaining to health behaviors including diet, weight loss, and type 2 diabetes management shows autonomous motivation is positively associated with adherence to medication regimens (Williams et al., 2004; Williams et al., 2009), lower body mass index (BMI) (Leong et al., 2012), weight loss (Williams et al., 1996), and increased physical activity (Verloigne et al., 2011), while greater controlled motivation and amotivation are associated with non-adherence to treatment and poorer health (Williams, 2002). However, the role of these motivation types in healthful eating among youth has yet to be explored. Although the importance of parents' influence on the home food environment is established (Rosenkranz and Dzewaltowski, 2008), previous research has not examined whether parent motivation internalization of healthy eating for their family facilitates youth's healthful eating. Thus, the purpose of this study was to evaluate the factor structure and construct validity of two adapted SRQ measures assessing youth motivation internalization for healthful eating and parent motivation internalization for providing healthy meals for the family.

Methods

Sample and Study Design

Baseline data were obtained from a clinical trial evaluating a behavioral intervention to promote whole plant food intake (i.e., fruit, vegetables, whole grains, nuts, and seeds) in families of youth with type 1 diabetes (Nansel et al., 2015). Parent-child dyads were recruited during routine clinic visits from an outpatient, free-standing, multidisciplinary tertiary diabetes center in Boston, Massachusetts. Youth eligibility criteria included age 8–16 years, type 1 diabetes diagnosis ≥ 1 year, insulin dose ≥ 0.5 units per kilogram/day, English speaking, and absence of chronic illness or medication interfering with dietary intake, diabetes management or glucose metabolism. Parents provided informed consent; youth provided assent. Of 611 eligible families approached, 139 (23%) participants from 136 families were enrolled and completed baseline assessment. In families with multiple siblings enrolled ($n=3$), data from the sibling with the longest diabetes duration were retained. Study procedures were approved by *Eunice Kennedy Shriver* National Institute of Child Health and Human Development Institutional Review Board and the Joslin Diabetes Center Committee on Human Subjects.

Data collection methods included medical record review, self-report surveys administered to youth and parents at the clinic visit, and three-day food records to assess dietary intake of youth and parents completed following the clinic visit. Children and parents were jointly given a sample diet record and provided with detailed instructions on how to measure and report food and beverage intake. Families kept records on 3 consecutive days following clinic visits. Research staff reviewed the completed records upon receipt from the family and

solicited missing information as needed. The Nutrition Data System for Research software (NDSR, Nutrition Coordinating Center, University of Minnesota, Minneapolis, MN, USA) was used to analyze the diet records.

Measures

Self-Regulation Questionnaire—The SRQ for Healthy Diet (Williams et al., 1996) was modified by study investigators for use in youth and parents of the target population (available upon request). The measures comprise three subscales: autonomous regulation (6 items), controlled regulation (6 items) and amotivation (3 items). Items on the parent SRQ were modified to relate to motivation for healthful eating for the family rather than for individual goals (e.g., “The reason I would eat a healthier diet is because I believe it is the best thing for my health” modified to “The reason I would provide healthy food for the family is because I believe it is the best thing for my family’s health”). Item wording was developed for the youth SRQ to be more accessible for a younger audience. For both parent and youth measures, response options are on a 7-point scale with higher score indicating greater autonomous motivation, controlled motivation, or amotivation.

Attitudes Toward Healthful Eating—Youth and parents completed the Healthful Eating Attitudes Scale (Nansel et al., 2013), which assesses self-efficacy, positive and negative outcome expectations, and barriers towards healthful eating (youth) or towards providing healthful foods for the family (parents). The self-efficacy subscale measures perceived confidence to engage in healthful eating behaviors (Nansel et al., 2013). The outcome expectations subscale assesses perceived positive and negative consequences of healthful eating. The barriers subscale assesses perceived environmental or skill impediments to healthful eating. Response options for all subscales are on a 5-point Likert scale ranging from “strongly disagree” to “strongly agree”.

Diet Quality

To capture a broad representation of overall dietary quality, a priori, three indices were selected: Healthy Eating Index 2005 (HEI-2005), Nutrient-Rich Foods Index (NRF9.3), and Whole Plant Food Density (WPFd). The HEI-2005 measures conformance to the 2005 U.S. Dietary Guidelines (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2005). The measure comprises 12 component scores contributing to a maximum total score of 100 (Guenther et al., 2007; Kennedy et al., 1995). Higher scores represent greater conformance to dietary guidelines. The NRF9.3, a measure of nutrient density (Fulgoni et al., 2009), was included because similar HEI scores reflect a wide range of dietary intake patterns. The NRF9.3 is a continuous measure (Fulgoni et al., 2009) calculated from the sum of the percentage daily values for nine nutrients to encourage (i.e., protein, fiber, calcium, iron, magnesium, potassium, and vitamins A, C and E) minus the sum of the percentage of maximum recommended values for three nutrients to limit (i.e., saturated fat, added sugar and sodium) with all daily values calculated per 100 kcal. Higher scores indicate greater nutrient density, reflecting better diet quality. WPFd measures the number of cup or ounce equivalents of whole plant foods (whole grains, whole fruit, vegetables, legumes, nuts and seeds) per 1000 kcal consumed (Lipsky et al., 2012).

Biomedical and demographic data

Hemoglobin A1c (HbA1c) was measured using a laboratory assay standardized to the Diabetes Control and Complications Trial (reference range, 4%-6%, [20–42 mmol/mol]). Initial A1c assays were performed with the Tosoh (Tosoh Medics, South San Francisco, CA, USA) followed by the Roche Cobas Integra (Indianapolis, IN). All values obtained with the Tosoh were standardized to the Roche assay. Biomedical data were extracted from participants' medical records including age, sex, diabetes duration, insulin regimen, and frequency of blood glucose monitoring. Measured height and weight were used to calculate youth BMI z-score and parent BMI. Self-report data was used for three parents with missing measured height and weight. Demographic characteristics were assessed by parent self-report.

Data Analyses

Cronbach's alpha examined the internal consistency of the SRQ subscales. Exploratory factor analyses with varimax rotation determined the SRQ factor structure separately for youth and parent measures. Scree plots and eigenvalues were examined to determine the number of factors. A cutoff of .30 was used as criteria for loading a factor (Knafl and Grey, 2007). Items that loaded more than one factor and/or did not align appropriately with the constructs making them uninterpretable were removed from subsequent analyses (Costello and Osborne, 2005). Parent and child SRQ subscales were compared using paired t-test or Wilcoxon signed rank test for non-normally distributed mean differences. To determine construct validity, Pearson correlations of SRQ subscales with healthful eating attitudes, diet quality indicators, and BMI were examined. Analyses were also stratified by child age group (8–12 years and 13–16 years) to explore potential developmental differences. Additionally, correlations between parent autonomous and controlled motivation with child diet quality indicators were explored. All analyses were performed on SPSS version 21.0 and significance was set *a priori* at $p < 0.05$.

Results

Youth ($n=136$) were predominantly white (90%) with an average diabetes duration of 6 years (6.0 ± 3.1), and mean HbA1c of $8.1 \pm 1.0\%$ (Table 1). Most parents were college-educated (66% with college degree or higher), with a family income of $> \$70,000/\text{year}$ (68%).

Exploratory factor analyses did not support the amotivation subscale for either youth or parent; the three items cross-loaded on other factors. Additionally, internal consistency of the amotivation subscale was poor for both youth ($\alpha=0.11$) and parent measures ($\alpha=0.16$), and was not substantially improved by the removal of any item. Therefore, the amotivation subscale items were eliminated from subsequent factor analyses. Examination of the eigenvalues and scree plots supported a two-factor solution for both youth and parent measures. The percentage of explained variance for the first and second factors were 33.5% and 18.6%, respectively, for the child measure and 33.0% and 22.0%, respectively, for the parent measure. Factor loadings of the 12 items designed to assess autonomous and controlled motivation are shown in Table 2. Four youth items and two parent items loaded

across both factors and were therefore eliminated. Additionally, one youth item designed to assess controlled motivation (“Because my parents say I should.”) loaded on the autonomous motivation factor. Because this item was inconsistent with the construct of autonomous motivation, it was also eliminated.

Internal consistency of the modified subscales was good for both youth and parent autonomous motivation (4-items, $\alpha=0.83$ and 6-items, $\alpha=0.84$, respectively), and acceptable for controlled motivation (3-items, $\alpha=0.66$ and 4-items, $\alpha=0.77$, respectively). Youth autonomous and controlled motivation were positively correlated ($r=0.30$, $p<0.001$); however, in analyses stratified by age group (i.e., 8 to 12 years ($n=70$) and 13 to 16 years ($n=66$)), the correlation was significant for the younger ($r=0.38$, $p<0.001$) but not the older age group (Table 3). Parent autonomous and controlled motivation were uncorrelated (Table 4). Youth had on average lower autonomous scores ($5.3 \pm 1.4SD$ vs. $6.0 \pm 0.9SD$; $t=4.71$, $df=133$, $p<0.001$) and higher controlled scores ($3.0 \pm 1.5SD$ vs. $2.0 \pm 1.1SD$; $Z=-5.62$, $p<0.001$) than their parents. There were no significant differences in autonomous or controlled motivation scores between younger and older youth.

Both youth and parent SRQ subscales were significantly associated with healthful eating attitudes (Tables 3 & 4). Among youth, autonomous motivation was correlated positively with self-efficacy and positive outcome expectations, and negatively with barriers ($p<0.001$), but was not associated with negative outcome expectations. Controlled motivation was positively correlated with both positive and negative outcome expectations ($p=0.001$), but was not associated with self-efficacy or barriers. Parent autonomous motivation was positively correlated with self-efficacy and positive outcome expectations, and negatively correlated with negative outcome expectations and barriers ($p<0.001$). Controlled motivation was correlated negatively with self-efficacy ($p=0.03$) and positively with negative outcome expectations ($p=0.001$), but was not associated with positive outcome expectations or barriers.

Youth diet quality indicators (NRF9.3, WPF, HEI-2005) were uncorrelated to parent or youth autonomous and controlled motivation (Tables 3 & 4). In analyses stratified by child age group, youth SRQ subscales were positively correlated with NRF9.3 and WPF only in the older age group (13–16 years). Parent autonomous motivation was positively correlated with parent diet quality indicators NRF9.3, WPF and HEI-2005 ($p<0.01$), while controlled motivation was uncorrelated with parent diet quality indicators. Among youth, neither autonomous nor controlled motivation was associated with BMI z-score; however, parent BMI was correlated negatively with autonomous motivation ($p<0.001$), and positively with controlled motivation ($p<0.01$).

Discussion

This is the first study to examine autonomous and controlled motivation for healthful eating among youth with type 1 diabetes and their parents using an adapted version of the SRQ for healthy eating. Factor analysis and internal reliability supported autonomous and controlled motivation subscales for both youth and parent measures. Autonomous motivation was related to positive healthful eating outcome expectations, greater self-efficacy, and fewer

barriers, while controlled motivation was related to negative outcome expectations. Autonomous motivation was also associated with better diet quality among parents and adolescents (age 13–16 years) but not among children (ages 8–12 years). Additionally, autonomous motivation was related to lower BMI in parents but not in youth.

Findings regarding the psychometric properties of this SRQ are generally consistent with previous research in adults. The poor internal consistency of the amotivation subscale has been demonstrated previously (Levesque et al., 2007). After eliminating these items, exploratory factor analysis indicated a two-factor structure with distinguishable autonomous and controlled motivation factors. However, several items that loaded across both factors were eliminated. Some of these cross-loaded items were intended to assess the type of motivation (“introjected” motivation), in which the behavior is partially internalized, and is performed to avoid feelings of guilt or to enhance ego (pride) (Deci and Ryan, 2000). Previous research on self-regulation of exercise behavior showed that this motivation type (classified as controlled motivation) and autonomous motivation types do not represent a distinct dichotomy, but rather represent a gradual change from internal pressures to personal convictions (Mullan et al., 1997).

As postulated, youth autonomous motivation was related to more positive attitudes towards healthful eating, while controlled motivation was related to more negative attitudes towards healthful eating. Among youth and parents, autonomous motivation was associated with greater healthful eating self-efficacy and positive healthful eating outcome expectations, and fewer healthful eating barriers. These findings are similar to previous research among adults linking autonomous motivation to positive dietary health behaviors such as eating healthier foods, as well as research linking controlled motivation to negative dietary health behaviors such greater total calories from fat (Levesque et al., 2007; Pelletier et al., 2004; Teixeira et al., 2011).

Youth SRQ subscales were not significantly correlated with youth diet quality indicators, except among the older group of youth (13–16 years). Among youth 8–12 years of age, but not among those 13–16 years, autonomous and controlled motivations were positively correlated. This is consistent with previous research indicating that younger children are less consciously aware of their motivations for healthy eating as compared to adults because their neurocognitive structures are still in development (Sturman and Moghaddam, 2011). Additionally, there is some evidence that children’s motivation for behaviors becomes more internalized over time in concert with increases in cognitive capacities and ego development (Chandler and Connell, 1987). Our findings suggest cognitive differences between younger and older youth may have relevance for assessment of motivations towards healthful eating in this population.

Among parents, all diet quality indicators were significantly associated with autonomous motivation and were not associated with controlled motivation, while BMI was negatively associated with autonomous motivation and positively associated with controlled motivation. Previous research shows similar findings among adults in associations of autonomous motivation with positive dietary health indicators and lower BMI (Leong et al., 2012; Levesque et al., 2007). However, parent autonomous motivation was uncorrelated with youth

diet quality, which may reflect the influence of other factors on youths' dietary intake, such as social and cultural norms around food, and exposure to food away from home (Taylor et al., 2005).

Several limitations should be noted. These data are observational and cross-sectional, so no determination of causality can be made, and the SRQ's test-retest reliability and sensitivity to change remains to be examined in future research. The amotivation subscale demonstrated poor internal consistency, suggesting the need for future research on measurement of this construct. Additionally, the sample was obtained from a single pediatric diabetes center with a limited number of minority and low-income families, potentially limiting the generalizability of these findings. As with all self-report measures of food intake, food records may be biased by social desirability (Thompson and Subar, 2008).

This study provides support for the importance of autonomous and controlled motivation in diet and diet-related attitudes in families of youth with type 1 diabetes. Additional research is needed to determine whether educational and behavioral interventions promoting healthful dietary changes are likely to be more effective if they enhance families' personal valuation (internal motivation) of healthful eating, rather than relying on prescriptions from healthcare providers or other external sources of motivation (Quick et al., 2015). Additionally, further research to determine whether tailoring educational and behavioral interventions according to a person's motivation internalization improves efficacy would be informative. Given the differences observed in associations of autonomous and controlled motivation with dietary intake between youth with type 1 diabetes and their parents, future research exploring potential developmental differences in the role of motivation internalization in regards to healthful eating is warranted.

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Table 1

Sample characteristics of youth with type 1 diabetes and their parents (N=136)

Characteristic	Mean $\pm$ SD or N (%)
Age (years)	12.3 $\pm$ 2.5
Youth BMI z-score	0.7 $\pm$ 0.6
Sex	
Male	66 (48.5)
Female	70 (51.5)
Race/ethnicity	
White, non-Hispanic	123 (90.4)
Hispanic	7 (5.1)
Black	5 (3.7)
Other	1 (0.7)
Highest parent education level *	
High school or equivalent	15 (11.0)
Junior college, technical or some college	32 (23.6)
College degree	44 (32.4)
Graduate education	44 (32.4)
Family income (annual \$) *	
<30,000	12 (8.8)
30,000–49,999	12 (8.8)
50,000–69,999	16 (11.8)
70,000–99,999	26 (19.1)
100,000–149,999	30 (22.1)
>150,000	38 (27.9)
Duration of diabetes (years)	6.0 $\pm$ 3.1
Regimen	
Injection	92 (67.6)
Pump	42 (30.9)
Both	2 (1.5)
Frequency of blood glucose monitoring (times/d)	5.7 $\pm$ 2.4
Hemoglobin A1c (%)	8.1 $\pm$ 1.0
Youth Diet Quality	
NRF9.3 ^a	19.6 $\pm$ 10.5
WPDF ^b	1.9 $\pm$ 1.0
HEI-2005 ^c	54.8 $\pm$ 11.8
Parent Diet Quality	
NRF9.3 ^a	25.3 $\pm$ 13.5
WPDF ^b	2.4 $\pm$ 1.2
HEI-2005 ^c	57.7 $\pm$ 12.8
Parent BMI (weight (kg)/Height (m²))	28.8 $\pm$ 7.4

Abbreviations: NRF9.3, Nutrient-Rich Foods Index 9.3; WPDF, Whole Plant Food Density; HEI, Healthy Eating Index

* Missing data for highest parent education (n=135) and family income (n=134).

^a NRF9.3: measure of overall dietary nutrient density is calculated as the sum of the percentage of daily values for 9 nutrients to encourage minus the sum of the percentage of maximum recommended values for 3 nutrients to limit, with all daily values calculated per 100 kcal. Higher scores indicate a greater nutrient rich diet.

^b WPDF: indicates number of serving of whole plant foods (whole grains, whole fruit, vegetables, legumes, nuts and seeds) per 1000 kcal consumed.

^c HEI-2005: measures conformance to the 2005 dietary guidelines; higher scores indicate greater conformance to guidelines (possible score range 0–100).

Table 2

Factor loadings from the exploratory factor analysis of SRQ concerning healthful eating for youth with type 1 diabetes and their parents

	Factors	
	Autonomous	Controlled
Youth SRQ		
Because of the good things it does for me	0.80	0.25
Because it's important to me	0.79	0.02
Because I think it's a good way to take care of myself	0.78	-0.04
Because it's a choice I really want to make for myself	0.76	0.15
Because I would feel proud of myself	0.67	0.38
Because it's what I'm supposed to do	0.55	0.19
Because I like healthy foods	0.53	-0.39
Because it helps me look or feel better	0.52	0.37
Because my parents say I should	0.42	0.37
Because I want others to be pleased with me	0.19	0.77
Because I feel pressured to eat healthy	-0.04	0.76
Because I would feel bad about myself if I did not	0.24	0.62
<i>Eigenvalue</i>	<i>4.02</i>	<i>2.24</i>
Parent SRQ		
Because it is an important choice I really want to make	0.85	-0.10
Because I have carefully thought about it and believe it is very important for many aspects of my family's life	0.77	0.01
Because it is very important for being as healthy as possible	0.77	-0.07
Because I believe it is the best thing for my family's health	0.75	-0.11
Because it is consistent with my life goals	0.73	0.01
Because I want to take responsibility for my family's health	0.66	0.02
Because I would feel proud of myself	0.54	0.37
Because I would feel bad about myself if I did not	0.47	0.42
Because I want others to approve of me	-0.03	0.82
Because I want other to see I can do it	0.07	0.80
Because I feel pressure from others to do so	-0.05	0.72
Because others would be upset with me if I did not	-0.10	0.69
<i>Eigenvalue</i>	<i>3.96</i>	<i>2.64</i>

Note: Bolded values indicate questions retained.

Table 3

Pearson correlations of youth autonomous and controlled motivation with attitudes toward healthful eating, diet quality, and body mass index

	All participants (n=136)			8 to 12 years (n=70)		13 to 16 years (n=66)	
	Autonomous	Controlled		Autonomous	Controlled	Autonomous	Controlled
Youth							
Autonomous scale	—	0.30**		—	0.38**	—	0.17
Controlled scale	0.30**	—		0.38**	—	0.17	—
Attitudes Toward Healthful Eating Measures							
Self-efficacy	0.39***	−0.01		0.47***	0.05	0.27*	−0.06
Positive Outcome Expectations	0.30***	.28**		0.29*	0.25*	0.31*	0.38***
Negative Outcome Expectations	−0.07	.34***		0.02	0.42***	−0.20	0.25*
Barriers	−.36***	0.10		−0.49***	0.04	−0.18	0.16
Diet Quality							
NRF9.3 ^a	0.16	0.10		0.09	0.01	0.26*	0.25*
WPPFD ^b	0.05	0.08		−0.07	−0.16	0.19	0.35**
HEI-2005 ^c	0.09	−0.01		0.00	−0.13	0.22	0.17
BMI z-score	0.01	0.05		0.13	0.01	0.05	0.14

Abbreviations: NRF9.3, Nutrient-Rich Foods Index 9.3; WPPFD, Whole Plant Food Density

^aNRF9.3: measure of overall dietary nutrient density calculated as the sum of the percentage of daily values for 9 nutrients to encourage minus the sum of the percentage of maximum recommended values for 3 nutrients to limit, with all daily values calculated per 100 kcal. Higher scores indicate a greater nutrient rich diet.

^bWPPFD: indicates number of serving of whole plant foods (whole grains, whole fruit, vegetables, legumes, nuts and seeds) per 1000 kcal consumed.

^cHEI-2005: measures conformance to the 2005 dietary guidelines.

* p<0.05

** p<0.01

*** p<0.001

Table 4

Pearson correlations of parent autonomous and controlled motivation with attitudes toward healthful eating, diet quality, and body mass index

Parent	Autonomous	Controlled
Autonomous scale	–	–0.04
Controlled scale	–0.04	–
Attitudes Toward Healthful Eating Measures		
Self-efficacy	0.36 ***	–0.19 *
Positive Outcome Expectations	0.35 ***	0.02
Negative Outcome Expectations	–0.30 ***	0.29 **
Barriers	–0.32 ***	0.14
Parent Diet Quality		
NRF9.3 ^a	0.22 *	0.03
WPF ^b	0.24 **	0.02
HEI-2005 ^c	0.22 **	0.03
Youth Diet Quality		
NRF9.3	0.12	–0.15
WPF ^b	0.10	–0.12
HEI-2005	0.12	–0.04
Parent Body Mass Index	–0.33 ***	0.27 **

Abbreviations: NRF9.3, Nutrient-Rich Foods Index 9.3; WPF, Whole Plant Food Density

^a NRF9.3: measure of overall dietary nutrient density calculated as the sum of the percentage of daily values for 9 nutrients to encourage minus the sum of the percentage of maximum recommended values for 3 nutrients to limit, with all daily values calculated per 100 kcal. Higher scores indicate a greater nutrient rich diet.

^b WPF: indicates number of serving of whole plant foods (whole grains, whole fruit, vegetables, legumes, nuts and seeds) per 1000 kcal consumed.

^c HEI-2005: measures conformance to the 2005 dietary guidelines.

*
p<0.05

**
p<0.01

p<0.001