Parental Nutrition Knowledge Rather Than Nutrition Label Use Is Associated With Adiposity in Children

Lisa Kakinami, PhD^{1,2}, Stephanie Houle-Johnson, BA³, and Jennifer J. McGrath, PhD, MPH³

¹Department of Mathematics and Statistics, Concordia University, Montreal, Quebec, Canada

²PERFORM Centre, Concordia University, Montreal, Quebec, Canada

³Pediatric Public Health Psychology Laboratory, Concordia University, Montreal, Quebec, Canada

Abstract

Objective—Determine how parental nutrition label use, label literacy, and nutrition knowledge may be associated with cardiovascular health in parents and their children.

Design and Setting—Cross-sectional analyses of 2006 data from the *Healthy Heart Project* in Montreal, Canada.

Participants—Among community recruited families, parents were predominantly mothers (n = 127 [80%]; mean age, 45.0 years) and half of their children were female (44%; mean age, 12.5 years).

Main Outcome Measures—Blood pressure, lipids, and weight. Nutrition label use, label literacy, and nutrition knowledge among parents were collected using existing scales.

Analyses—Multivariable linear regression models.

Results—Among parents, nutrition label use was associated with lower total cholesterol (B[SE] = $-.53$ [.20]; $P = .009$), lower low-density lipoprotein (B[SE] = $-.57$ [.21]; $P = .007$), and lower total cholesterol/high-density lipoprotein cholesterol ratio (B[SE] = $-.82$ [.30]; $P = .008$) but was not associated with adiposity. Among children, greater parental nutrition knowledge was associated with lower body mass index percentiles (B[SE] = -3.6 [1.49]; $P = .02$), lower waist circumference (B[SE] = -1.27 [.55]; $P = .02$), and lower percent body fat (B[SE] = -1.28 [.47]; $P = .008$). Parental nutrition label use or nutrition knowledge was not associated with children's lipids.

Conclusions and Implications—Parents with greater nutrition label use had more favorable lipids, but children's lipids were unaffected. Children of parents with greater nutrition knowledge had lower adiposity. Further research on the correlates of label use and health is needed.

Address for correspondence: Lisa Kakinami, PhD, Department of Mathematics and Statistics, Concordia University, Montreal, Quebec, Canada; Phone: (514) 848-2424 Ext 3397; Fax: (514) 848-2831; lisa.kakinami@concordia.ca.

Conflict of Interest Disclosure: The authors' conflict of interest disclosures can be found online with this article on www.jneb.org.

CONFLICT OF INTEREST

The authors have not stated any conflicts of interest.

Keywords

nutrition labeling; cardiovascular biomarkers; adolescents; children; parents

INTRODUCTION

Nutrition labels are mandatory for all prepackaged foods in the US, Canada, and countries in the European Union.^{1–3} Over half of the Canadian adult population report regularly using nutrition labels,⁴ and regular label use has been associated with healthier dietary behaviors such as lower fat consumption and increased consumption of healthier alternatives to certain foods (eg, low-fat meats, skim milk).^{5–9} Such healthy dietary behaviors have a well-documented link to favorable cardiovascular risk markers, such as lower body mass index (BMI), lower blood lipids, and lower blood pressure.^{10–12} In 1 study, for example, it was found that women who adhered to choosing foods with a heart-healthy nutrition label had a decreased intake of saturated and monounsaturated fats and cholesterol, and a 24% reduction in risk of metabolic syndrome.¹²

Research suggests that the link between nutrition label use and dietary quality is attributable to nutrition knowledge, in that nutrition knowledge is higher in label users compared with non-label users.^{8,9} However, there is evidence that nutrition label use offers an additional benefit regarding dietary intake beyond the effects of nutrition knowledge. For example, Kim and colleagues¹³ found that among nutrition label users, the probability of consuming less total fat, less saturated fat, less cholesterol, and less sodium increased with immediate access to nutrition labels. Such findings emphasize the influence of nutrition label use on daily dietary intake, which has potential long-term implications for cardiovascular health.

Throughout childhood, parents have a strong influence on their children's dietary behaviors.¹⁴ Evidence suggests that these habits are often carried forward into adulthood, ultimately affecting the future health of the children.⁴ Thus, understanding how parental nutrition knowledge and habits influence children's dietary behaviors and how these influence the parents' own cardiovascular health may have a pivotal role in preventing future disease. Although nutrition label use and healthier dietary behaviors in adults are associated with favorable cardiovascular risk profiles and adiposity measures,¹² notable gaps exist in the literature. For instance, given consumers' reported difficulties in comprehending nutrition labels,^{15,16} the existing literature often fails to adjust findings adequately based on label literacy or nutrition knowledge. In addition, although children's diets are moderately correlated with their parents' diets,¹⁷ there is limited evidence regarding the association between parental label use and children's adiposity and cardiovascular health. In fact, studies examining the influence of parental label use on children's health are largely limited to experimental studies assessing the impact of restaurant menu labeling on parental purchasing decisions for their children's meals, and yielded mixed results.^{18,19} To the best of the authors' knowledge, no observational study has yet been conducted that examines the association between parental nutrition label use and children's cardiovascular health. Thus, the aim of this study was to investigate whether parental nutrition label use, nutrition label literacy, and nutrition knowledge were associated with cardiovascular biomarkers and

adiposity measures in a cross-sectional analysis of parents and their children from Montreal, Canada.

METHODS

Participants were parent–child dyads ($n = 134$) from the 2006 baseline measurement of the *Healthy Heart Project*, a cohort study examining early cardiovascular risk factors among youth, conducted at Concordia University in Montreal, Canada. Parents and youth aged 10–15 years without serious psychopathology or cardiovascular events were recruited from local schools and neighborhoods in Montreal using flyers posted in the community (eg, library) and bookmarks distributed with permission in local schools. Informed consent and assent were obtained from parents and youth, respectively. Participants were financially compensated for their time. The study was approved by the Research Ethics Unit at Concordia University (Ethics Approval No. UH2005-077). Participants with missing data for any of the nutrition label use questions ($n = 7$) were excluded from analyses.

Measures

All nutrition measures were collected by parent report, as outlined in the following sections. The parent who knew the child best completed a parent-report questionnaire, which included questions on their own use of nutrition labels, nutrition label literacy, nutrition knowledge, and attitudes regarding their dietary habits, as well as food screeners (for both themselves and their child).

Nutrition label use—Questions assessing the frequency of reading nutrition labels and use of labels for purchasing and eating choices were adapted from existing instruments.^{5,7,8} Using a 5-point Likert scale, parents indicated the extent to which they make food purchasing decisions based on the food label, make eating choices based on the food label, and read the food label. Nutrition label use reported as often or almost always for all 3 questions (purchasing, eating, and reading) was recoded into nutrition label users. Label use reported as never, almost never, or sometimes was recoded into non-label users. Internal consistency for this measure was high (Cronbach $\alpha = .90$).

Nutrition label literacy—Comprehension of nutrition labels was assessed using a nutrition label literacy questionnaire released by the US Food and Drug Administration (survey instrument available upon request to the author). Parents answered 20 questions covering 4 types of label literacy pertaining to nutrition facts labels: (1) basic nutrition label information (eg, How many calories are in a single serving?), (2) sources of calories (eg, How many calories would you get from saturated fat if you ate 1 serving of this food?), (3) ability to convert nutrition information from a single serving to multiple servings (eg, If you ate 2 portions of this food, how many grams of fiber would you consume?), and (4) comparison of 2 labels (eg, Which of these 2 products has more calcium?). Correct answers (binary coded 0/1) were summed to yield a total correct score (out of a possible 20) and are reported as percentages. This questionnaire was primarily used as a knowledge-building resource from the US Food and Drug Administration; internal consistency was high (Cronbach $\alpha = .82$) in this sample.

Nutrition knowledge—Nutrition knowledge was assessed using the validated 10-item Choosing Everyday Foods scale from the Nutrition Survey of Parmenter and Wardle.²⁰ Questions were adapted for the Canadian context and assessed parental knowledge in selecting foods to meet specific nutrition requirements. Correct answers (binary coded 0/1) were summed to yield a total correct score (out of a possible 10) and are reported as percentages. Original reliability coefficients were reportedly moderate ($r = .76$ for internal consistency; $r = .87$ for test-retest reliability).²⁰

Covariates—Self-rated perceptions of eating habits were assessed based on the theoretical Stages of Change model of Prochaska and DiClemente.²¹ Questions were adapted from the validated Readiness to Change Questionnaire in accordance with the literature.^{22,23} Parents who reported having tried to eat healthy or having had healthy eating habits for at least the past month in response to the question, What are your plans for your eating habits over the next 6 months? were labeled as having healthy diet habits for at least the last month.

Consumption of fruits and vegetables in parents and youth were assessed with food screeners, adapted from various sources on dietary intake.^{24–26} Parents and youth who consumed 100% fruit juice and/or fruit more than twice per day were coded as at least 2 fruits/d. The same method was used to obtain a value of at least 2 vegetables/d, derived from questions on daily consumption of green salad, potatoes, carrots, and other vegetables. Parents also reported the number of days their child was physically active for at least 20 minutes in the past week.

Cardiovascular Biomarkers

Trained study staff collected blood samples and anthropometric measures for both parents and children. Fasting plasma lipids (total cholesterol [TC], high-density lipoprotein cholesterol [HDL], total-cholesterol/high-density lipoprotein cholesterol ratio [TC/HDL-C], low-density lipoprotein cholesterol [LDL], and triglycerides) were analyzed with the CardioChek PA Analyzer (Polymer Technology Systems, Inc., Indianapolis, IN). Systolic and diastolic blood pressure was measured on the non-dominant with an oscillometric instrument (IBS Corporation, Model SD-700A automated sphygmomanometer, Waltham, MA). Appropriate blood pressure cuff size was based on arm circumference. After a seated resting period, 3 blood pressure measures were taken; the average of the last 2 measurements was used. Height and waist circumference were measured in duplicate using a stadiometer and standard measuring tape to the nearest 0.1 cm. Weight was measured with a calibrated spring scale to the nearest 0.1 kg. The average of the 2 measurements was used. Anthropometric measurements included BMI, waist circumference, and percent body fat measured with the Tanita Body Composition Analyzer BF-350 (Arlington Heights, IL). Due to developmental growth changes, BMI was converted to age- and sex-referenced *Z* scores and percentiles.²⁷

Data Analysis

All analyses were conducted with SAS 9.4 (SAS Institute, Cary, NC, 2014). The association between nutrition label use, adiposity measures, and cardiovascular biomarkers was assessed using multivariable linear regression after adjusting for covariates. Covariates included in

analyses were those shown to be associated with cardiovascular risk profiles or nutrition label use from the literature. Parents' covariates were specified for the parents' models; children's covariates were specified for the children's models, unless otherwise indicated. These included demographic (age, sex), education (whether 1 parent had at least a university-level education), and health characteristics (parents' dietary habits, children's physical activity, fruit and vegetable intakes in the past week). There was no evidence of multicollinearity when including nutrition label use, label literacy, and nutrition knowledge in the same model (variance inflation factor [VIF] < 1.0).²⁸ Lipid and blood pressure models also adjusted for BMI (parents) or BMI Z score (youth). A sensitivity analysis also adjusting for household income and parental physical activity levels did not affect the results; thus, these covariates were excluded from the final model.

RESULTS

Descriptive Characteristics

Almost half of the youth participants were girls (44%) and the majority of parents who knew the child best were mothers (80%) (Table 1). Youth participants ranged in age from 10 to 15 years, the majority were in middle or high school. Over half of the parents were overweight or obese, and over one third of youth were overweight or obese. One third of parents reported using nutrition labels. Accuracy on the nutrition label literacy questionnaire was approximately 69% overall in parents, but accuracy varied based on subsection. Whereas the majority of parents were able to identify basic nutrition information, accuracy was lower for comparing nutrition information between 2 labels (59%) and identifying sources of calories (28%). Parents who reported using nutrition labels had higher label literacy and nutrition knowledge than did non-label users (71% vs 67%, $P = .14$; and 64% vs 58%, $P = .07$, respectively, data not shown).

Multivariable Linear Regression: Parents

Multivariable linear regression models revealed that parent nutrition label use was significantly associated with lower TC (B[SE] = $-.53$ [.20]; $P = .009$), lower LDL (B[SE] = $-.57$ [.21]; $P = .007$), and a lower TC/HDL-C ratio (B[SE] = $-.82$ [.30]; $P = .008$) (Table 2). No such association was observed in adiposity measures (Table 3); however, nutrition knowledge was associated with higher TC (B[SE] = $.13$ [.06]; $P = .03$), a higher TC/HDL-C ratio (B[SE] = $.20$ [.10]; $P = .03$), and higher diastolic blood pressure (B[SE] = 1.2 [.6]; $P = .04$).

Multivariable Linear Regression: Youth

Among youth, parental nutrition label use was significantly associated with higher percent body fat in their children (B[SE] = 4.60 [1.7]; $P = .008$); however, no association was observed for lipids or blood pressure. Higher parental nutrition knowledge was significantly associated with children's lower BMI percentiles (B[SE] = -3.60 [1.49]; $P = .02$), a smaller waist circumference (B[SE] = -1.27 [.55]; $P = .02$), and lower percent body fat (B[SE] = -1.28 [.47]; $P = .008$).

DISCUSSION

Although previous research focused on the relationship between nutrition label use and dietary intake,^{5,7,12,29} minimal attention was directed to whether nutrition label use was associated with cardiovascular biomarkers and adiposity among parents and their children. The literature on parental use of nutrition labels and youth's cardiovascular health was unclear. Whereas some experimental studies found that parents provided with restaurant menus containing nutrition information selected lower-calorie items for their children,^{18,30} others did not.^{19,31} Few observational studies assessed the association between parents' label use on cardiovascular risk and adiposity measures in their children. To the authors' knowledge, this study was the first to directly assess the relationship between nutrition label use and cardiovascular biomarkers and adiposity among parents and their children. In this sample, approximately one third of parents reported using nutrition labels, which was inconsistent with the reported rate of use of 57% among Canadian adults.⁴ However, research has shown that nutrition label use was reportedly lower in households with children compared to adult households with no children.^{7,32,33}

In this study, parental nutrition knowledge was associated with children's lower adiposity, but limited evidence was found regarding nutrition label use with children's adiposity. Whether this reflects a more favorable dietary profile composed of foods with no nutrition food labels (such as fruits and vegetables) or an improved understanding of foods without needing to consult nutrition labels is unclear and should be investigated further. The researchers found no evidence of associations among parental nutrition label use, nutrition label literacy, or nutrition knowledge on children's lipids or blood pressure. Whether these results indicate that it is too early to detect these cardiovascular biomarker differences among youth or that no association truly exists is unclear and should be investigated further. In contrast, the literature in adults report that greater nutrition label use, nutrition label literacy, and nutrition knowledge was consistently associated with healthier diets.^{9,13} However, results varied across demographic and health characteristics.^{32,34–37} Indeed, the parental influence on children is further complicated with additional competing demands, such as the need to maintain a routine in the household while maintaining harmony.^{33,38}

In parents, nutrition label use was associated with more favorable cardiovascular biomarkers, whereas nutrition knowledge was associated with less favorable cardiovascular biomarkers. These associations were small and may be less clinically meaningful. Nevertheless, among nutrition label users, LDL was 0.57-mmol/L lower compared with non-label users, which is approximately a 20% difference in LDL, and equivalent to the average change in LDL from statin use. In contrast, nutrition knowledge was associated with a 0.13-mmol/L higher TC, which is approximately a 3% difference. These conflicting results speak to the cross-sectional nature of the analyses; the potential causal link between nutritional knowledge and cardiovascular biomarkers could not be addressed in this study.

In contrast to previous findings, parental label use was not associated with label literacy or nutrition knowledge. A potential reason for this incongruence in findings may be that great variability exists in the way nutrition label use is measured in the literature, in which binary responses, frequency of use, and Likert scales all are used to assess nutritional label use.^{8,9}

and some measures lack validation. To address such discrepancies, an effort should be made to develop reliable and valid measures of nutrition label use and literacy that can be applied consistently.

This study had limitations. The sample size was relatively small, with ages ranging from 10 to 15 years, which limited the generalizability of the findings. Although cardiovascular risk profiles were assessed using objective measurements, behavioral measures were based on self-report. Many variables were assessed on 5-point Likert rating scales, which made it difficult to quantify between-subject variation owing to differences in perceptions and interpretations. Nutrition label use questions were not specific to a time frame, and thus the researchers were unable to determine whether any detected associations were caused by recent or persistent nutrition label use behaviors. Longitudinal studies would add considerably to knowledge of associations among cardiometabolic health, nutrition knowledge, and behavior. Further study using more extensive nutrition and dietary habit measures, such as with 24-hour dietary recalls, and more developed and validated measures of nutrition label use over multiple follow-ups are needed.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Current understanding of nutrition label use, nutrition label literacy, and nutrition knowledge and how these affect parental and children's nutrition behavior in observational studies is narrow. Although experimental studies in parents and children, and observational studies in adults, indicate that nutrition label use is associated with healthier food choices^{9,13,18,30}, the measurable impact of this on health is poorly understood. Previous studies reported that nutrition label use is higher among females and those with higher education and age.^{32,34,35} However, there is considerable variation in how nutrition label use, label literacy, and nutrition knowledge is measured.^{32,35,36} Thus, to improve understanding of the relationships among nutrition label literacy and use and nutrition knowledge, considerable research and methodological work are needed into standardizing these nutrition measures.

The results from this study suggest that nutrition label use and literacy are associated with more favorable cardiovascular biomarkers among parents and with adiposity measures among their children. The relatively weak correlations in nutrition label use, label literacy, and nutrition knowledge found among the parents highlight the need for further public health education regarding how to use and comprehend nutrition labels. With the anticipated changes to nutrition labels in the US and potential changes in Canada,^{39,40} improving understanding of the relationships among nutrition label use, literacy, and nutrition knowledge with health merits further investigation.

Acknowledgments

We thank the participants and their families of the *Healthy Heart Project*, the teachers and principals of the Montreal English School Board, and the research assistants and study coordinators of the Pediatric Public Health Psychology Laboratory at Concordia University. Special thanks to Natasha Hunt, Sabrina Giovannello, and Neressa Noel for their continued dedication. This work was made possible through funding support from the Canadian Institute of Health Research (CIHR) Operating Grants (MOP89886 and OCO79897) and New Investigator Award (J.J. McGrath MSH95353). Portions of these data were presented at the 72nd annual scientific meeting of the American Psychosomatic Society, March 12–15, 2014, in San Francisco, CA.

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Table 1

Selected Descriptive Characteristics of Study Participants, Healthy Heart Project (n = 127)

Characteristic	Parents	Youth
Male, n (%) ^a	25 (20)	71 (56)
Age, y (mean [SD])	45.0 (5.7)	12.5 (1.8)
Overweight/obese, n (%)	67 (53)	44 (35)
Uses nutrition labels, n (%)	48 (38)	10 (8)
Nutrition label literacy percentage, mean (SD)		
Total accuracy	68.8 (17.0)	–
Basic comprehension	74.2 (15.3)	–
Calorie sources	28.3 (39.4)	–
Converting information to multiple servings	86.3 (25.6)	–
Label comparison	59.3 (32.8)	–
Nutrition knowledge accuracy, mean (SD)	60.0 (19.3)	–
Cardiovascular biomarkers, mean (SD)		
Total cholesterol, mmol/L ^b	4.87 (1.1)	3.80 (0.9)
High-density lipoprotein, mmol/L ^b	1.45 (0.5)	1.19 (0.4)
Low-density lipoprotein, mmol/L ^c	3.02 (0.9)	2.24 (0.8)
Triglycerides, mmol/L ^d	1.40 (0.9)	1.17 (0.9)
Ratio total cholesterol/high-density lipoprotein ^b	3.83 (1.6)	3.55 (1.2)
Systolic blood pressure, mmHg ^e	116 (17)	106 (13)
Diastolic blood pressure, mmHg ^e	74 (11)	59 (9)
Body mass index (Z score for youth)	26.0 (4.8)	0.51 (1.2)
Waist circumference, cm	85.0 (12.2)	74.8 (10.7)
Body fat (%) ^f	30.3 (7.7)	22.8 (9.8)

^a n = 121;^b n = 124 (parents) and n = 114 (youth);^c n = 80 (parents) and n = 68 (youth);^d n = 88 (parents) and n = 73 (youth);^e n = 124 (parents and youth);^f n = 125 (youth).

Unstandardized Beta Coefficients and SEs From Multivariable Linear Regression: Models Describing Association Between Parental Nutrition Measures and Cardiovascular Biomarkers in Parents and Youth

Table 2

	TC		HDL		LDL		TG		TC/HDL		SBP		DBP	
		P		P		P		P		P		P		P
Parents^{ab}														
Label use	-0.53 (0.20)	.009	0.10 (0.11)	.36	-0.57 (0.21)	.007	-0.13 (0.21)	.55	-0.82 (0.30)	.008	1.0 (3.1)	.75	0.4 (0.8)	.83
Label literacy	-0.09 (0.03)	.003	-0.01 (0.02)	.61	-0.06 (0.03)	.05	-0.06 (0.03)	.07	-0.04 (0.05)	.37	-0.3 (0.5)	.57	-0.5 (0.3)	.13
Nutrition knowledge	0.13 (0.06)	.03	-0.01 (0.03)	.86	0.09 (0.06)	.17	0.06 (0.06)	.35	0.20 (0.10)	.03	1.1 (0.2)	.21	1.2 (0.6)	.04
Youth^{cd}														
Label use	0.15 (0.14)	.31	0.12 (0.09)	.18	-0.03 (0.22)	.91	0.18 (0.21)	.39	-0.03 (0.25)	.91	0.2 (2.4)	.93	2.2 (1.8)	.21
Label literacy	-0.04 (0.02)	.11	-0.01 (0.01)	.68	-0.01 (0.04)	.78	-0.01 (0.04)	.72	-0.03 (0.04)	.44	0.4 (0.4)	.34	-0.5 (0.3)	.10
Nutrition knowledge	0.03 (0.04)	.42	-0.01 (0.02)	.82	-0.001 (0.06)	.99	-0.03 (0.06)	.67	0.04 (0.07)	.52	-0.3 (0.7)	.63	0.1 (0.5)	.83

DBP indicates diastolic blood pressure; HDL, high-density lipoprotein cholesterol; LDL, low-density lipoprotein cholesterol; SBP, systolic blood pressure; TC, total cholesterol; TC/HDL, total cholesterol/high-density lipoprotein cholesterol ratio; TG, triglycerides.

^a Adjusted for the following covariates: parent's sex, parent's age, parental education, parent's dietary plans, parent's fruit and vegetable intake in the past week, and parent's body mass index;

^b n = 112 for TC, HDL cholesterol, TC/HDL cholesterol ratio, SBP, or DBP. For LDL cholesterol, n = 74, and for TG, n = 80;

^c Adjusted for the following covariates: child's sex, child's age, parental education, child's physical activity, child's fruit and vegetable intake in the past week, and body mass index Z score;

^d n ranged from 107 to 117 for TC, HDL cholesterol, TC/HDL cholesterol ratio, SBP, or DBP. For LDL cholesterol, n = 66, and for TG, n = 70.

Unstandardized Beta Coefficients and SEs From Multivariable Linear Regression: Models Describing Association Between Parental Nutrition Measures and Adiposity in Parents and Youth

Table 3

	BMI		BMI Percentile		BMI Z Score ^c		Waist Circumference		% Body Fat	
		P		P		P		P		P
Parents^{ab}										
Label use	-1.16 (0.88)	.19	-	-	-	-	-2.04 (2.11)	.33	-1.51 (1.20)	.21
Label literacy	0.17 (0.14)	.21	-	-	-	-	0.16 (0.34)	.63	-0.06 (0.19)	.76
Nutrition knowledge	-0.22 (0.26)	.40	-	-	-	-	-0.01 (0.62)	.99	-0.18 (0.35)	.62
Youth^{cd}										
Label use	-	-	2.85 (5.39)	.60	0.15 (0.24)	.52	2.76 (1.99)	.17	4.60 (1.70)	.008
Label literacy	-	-	1.72 (0.85)	.05	0.08 (0.04)	.03	0.16 (0.32)	.61	-0.18 (0.29)	.54
Nutrition knowledge	-	-	-3.60 (1.49)	.02	-0.13 (0.07)	.05	-1.27 (0.55)	.02	-1.28 (0.47)	.008

BMI indicates body mass index.

^a Adjusted for the following covariates: parent's sex, parent's age, parental education, parent's dietary plans, and parent's fruit and vegetable intake in the past week;

^b n = 114 for BMI, waist circumference, and percent body fat;

^c Adjusted for the following covariates: child's sex, child's age, parental education, child's physical activity, and child's fruit and vegetable intake in the past week;

^d n ranged from 118 to 120 for BMI percentile, BMI Z score, waist circumference, and percent body fat.