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Estimating The Usual Intake From Fruits And Vegetables Consumed By Children At Baseline In Tx Sprouts

Taryn Alkis
UTHealth School of Public Health

ESTIMATING THE USUAL INTAKE FROM FRUITS AND VEGETABLES

CONSUMED BY CHILDREN AT BASELINE IN TX SPROUTS

by

TARYN ALKIS, BS

APPROVED:

ADRIANA PÉREZ, MS, PHD
ACADEMIC ADVISOR AND THESIS CHAIR

SHREELA SHARMA, PHD, RD, LD

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by

TARYN ALKIS
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ESTIMATING THE USUAL INTAKE FROM FRUITS AND VEGETABLES CONSUMED BY CHILDREN AT BASELINE IN TX SPROUTS

Taryn Alkis, BS, MS
The University of Texas
School of Public Health, 2019

Thesis Chair: Adriana Pérez, MS, PHD

Background: Past studies developed two- and three-part models to estimate the usual intake of episodically consumed foods in adults but not in children. The goal of this study is to evaluate if the three-part method is successful, by incorporating the dietary screener and two 24-hour recalls, in estimating the usual intake of fruits and vegetables consumed by boys and girls at baseline in TX Sprouts.

Methods: Secondary data analysis of two 24-hour recalls and a dietary screener from TX Sprouts. Two approaches were used. First, the three-part model estimated the distribution of the usual intake of fruits and vegetables in children using the program Intake_epis_food() in Rstudio. The three parts to the model included: if a fruit or vegetable was consumed, the number of servings consumed given consumption of a fruit or vegetable, and energy intake as reported by the 24-hour recalls. Five models were estimated for usual intake in boys and girls separately: (i) fruits only, (ii) vegetables including white potatoes and starchy vegetables, (iii) vegetables excluding white potatoes and starchy vegetables, (iv) fruits and vegetables including white potatoes and starchy vegetables, and (v) fruits and vegetables excluding white potatoes and starchy vegetables. Second, the average of two 24-

hour recalls was estimated for each participant and a multiple linear regression was used for the usual intake of the average fruits and vegetables, in boys and girls separately. The models controlled for the average energy from two 24-hour recalls, age, and the number of servings of fruits and vegetables as reported in the dietary screener.

Results: There was a total of 737 children (335 boys, 402 girls) from TX Sprouts with complete dietary recall and screener data at baseline. The three-part models reported point estimates for each parameter in the model, samples from posterior distributions as well as from the distribution of usual intake and usual energy intake, and summary statistics of usual intake, usual energy intake, and the energy adjusted usual intake.

Discussion: This investigation found that the usual intake of fruits and vegetables can be successfully estimated in children using the three-part method with a dietary screener. Additionally, we found that fruits and vegetables are not consumed episodically in children of TX Sprouts. Past studies have also found frequent intake of fruits and vegetables among children; however, the number of servings per day consumed do not meet dietary recommendations.

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BACKGROUND

Literature Review

Screener and 24-Hour Recall Data

Dietary screeners are used to assess an individual's food intake and help to describe the eating patterns of a study population. Screeners are used in dietary intake studies to obtain information about the foods and beverages consumed by individuals over a given time period (National Cancer Institute, n.d.-b). These screeners can be self-administered or interviewer-administered, and they are typically in the form of a questionnaire with yes or no answers. The data obtained from the screener can be used to provide information about the consumption of certain foods and beverages as well as to analyze the different food groups in an individual's diet (National Cancer Institute, n.d.-b). Dietary screeners are useful to determine if a specific food or beverage has been consumed or not; however, the screener will not provide information on how many times the food was consumed. A food frequency questionnaire, on the other hand, will provide information on the usual frequency of consumption for the specified food or beverage item over a period of time (National Cancer Institute, n.d.-a). Screeners can therefore be used to purely understand the types of foods that are being consumed in a population. Each screener is tailored so that only certain foods are listed to be asked if consumed by individuals in a population. Screeners can be used to investigate an association between certain food groups of an individual's diet and certain diseases (National Cancer Institute, n.d.-b). While screeners can provide a good insight into the types of foods that people are consuming, the details of the food like: the preparation, brands, or the time of day that the particular food item is consumed, is missing. Using data obtained from screeners can provide detailed information about the foods that are being consumed by individuals in a population.

Data obtained through 24-hour recalls can help to explain the dietary habits of an individual in a population. To determine what types of foods people consume in one day, 24-hour recalls are performed in the form of a structured interview. The structured interview for a 24-hour recall is administered by a trained interviewer, and it is used to capture all information about the foods and beverages consumed by an individual over the past 24 hours (National Cancer Institute, n.d.-c). The interviews are set up so that the individual will provide a detailed response of what food or drink they consumed as well as how much was consumed (National Cancer Institute, n.d.-c). This data can be used to analyze the dietary intake of particular food groups or beverages, to describe a given population's dietary intake, and to investigate a relationship between an individual's diet and his or her health status (National Cancer Institute, n.d.-c). Data from 24-hour recalls alone are not a good measure to describe an individual's routine diet since there is variation in the foods and beverages consumed each day. Therefore, 24-hour recalls are a useful tool when investigating the usual dietary intake consumed by participants of a study population.

In the Family Life, Activity, Sun, Health, and Eating Study performed by The National Cancer Institute, data that was obtained through a 27-item dietary screener and a two day 24-hour dietary recall was used to estimate the daily dietary intake of food groups (Smith, 2017). The study aimed to estimate the intake of fruits and vegetables, dairy, added sugars, and whole grains in adolescents aged twelve to seventeen, as well as parents and individuals older than eighteen. The screener was tailored to eating patterns of adolescents to assess the frequency of intake of the specified foods groups (Smith, 2017). Analysis was performed by first converting responses from the screener into a daily intake and denoting the intake as the dependent variable when estimated using regression coefficients. The independent variable was the portion size of the foods and beverages consumed by the parents and adolescents. The mean and standard deviations of the specified food groups from the two-day 24-hour recall data set were used in order to examine the daily dietary factor intake among the parents and adolescents (Smith, 2017). After exploring the association of the portion size for the foods in the yes- or no- consumption analysis, the study was able to report the estimated daily intake of each specified food group among male and female parents and adolescents. By utilizing data from the screener and a 24-hour recall, this study was able to estimate the dietary intake of the different specified food groups (Smith, 2017).

In the Family Life, Activity, Sun, Health, and Eating Study performed by the National Cancer Institute, data from a dietary screener and one 24-hour recall was used to obtain information about the study participant's daily intake of fruits and vegetables, dairy, added sugars, and whole grains (Smith, 2017). In our study, we used a dietary screener and two 24-hour recalls to estimate the usual intake of fruits and vegetables in children around Central Texas.

The R Function: Intake_Epis_Food()

Modeling food intake from a 24-hour recall has many challenges due to the recall bias and reports of episodically consumed foods. On one day people could report fish as a food consumed, but on a different day the intake for fish could be reported as zero (no fish consumed). Historically, a two-part model was used to estimate the distribution of the usual intake of a dietary component in adults for episodically consumed foods using a food frequency questionnaire and two 24-hour recalls (Tooze, 2006). This two-part model is known as the National Cancer Institute Method, which incorporates the probability of a food being consumed and the amount of the specified food consumed. The outcome of this two-part model is to estimate the usual food intake in individuals. A three-part measurement error model with zero inflated data was later proposed to estimate the usual and energy intake of episodically consumed foods in adults (Pérez, 2012). The first part of this model is whether or not the food was consumed by an individual as reported by their two 24-hour recalls. The second part of the model is the amount of the food that was consumed by an individual as reported at each 24-hour recall. If the food was reported as not consumed, then the amount of consumption will be equal to zero. Lastly, the third part of the model is the amount of energy intake by the individual as reported at each 24-hour recall (Pérez, 2012). However, in episodically consumed foods there are excess amounts of zeros found in 24-hour recall data obtained from adults. Therefore, Box-Cox transformations were required in order to satisfy normality assumptions. The data was also standardized to have a mean equal to zero and a variance equal to one, which allowed rapid convergence of posterior samples. The model allowed for convergence of covariates such as age, ethnic status, and results of reported intakes from food frequency questionnaires to improve estimates. Covariates were also transformed using Box-Cox transformations, centered, and scaled to improve the linearity and homoscedasticity in the model as well as to help minimize the amount of error in the model (Pérez, 2012).

This three-part model was incorporated into an R function, Intake_epis_food(). The function returned a Markov Chain Monte Carlo computation, which produced estimates known to be asymptotically equivalent to maximum likelihood estimators (Pérez, 2012). The output of the function included estimates for each level of food consumption and energy intake, variance-covariance matrices, a density plot of the posterior sample of usual intake, and the energy adjusted usual intake. This was then used to estimate the distribution of usual intake from the episodically consumed foods in adults (Pérez, 2012).

While this function utilizes data obtained by a food frequency questionnaire and two 24-hour recalls in adults, our study used data obtained through a dietary screener and two 24-hour recalls in children. Modifications were made to the function in R to account for these discrepancies and will inform us if the dietary screener helps to estimate usual intake in combination with two 24-hour recalls.

Measuring Dietary Intake in Children

There are many challenges and limitations that exist when obtaining dietary intake measurements in children (Magarey, 2011). Some of these challenges include that children's brains are still growing and developing. Therefore, they are unable to remember with high accuracy and precision all that they consumed the day before as time measures are still being developed (Livingstone, 2007). Once children have developed their cognitive abilities and are old enough to be able to self-report their food intakes, then issues of motivation and body image become limitations in dietary intake studies in children (Livingstone, 2007). Tools have been developed to obtain information on food patterns or intakes of certain foods and beverages in children (Food and Nutrition Board, 2012). Studies to measure children's dietary intake have been performed in schools through reporting the meals offered by the school or observing the children's eating habits.

Since young children spend most of their day in a child care setting it is a good place to start to gather data on their dietary intake. Plate waste, direct observation, self-report, child care menus, and food purchase receipts are methods used in child care settings (Food and Nutrition Board, 2012). Plate waste involves weighing portions that are distributed at a meal or snack, and then weighing what is left after the food is consumed. This method provides information on the food that is being consumed and the amount of food that is being consumed by the children. Direct observation is the visual estimation of the foods and beverages being consumed, as well as the amount. This direct observation method began with a simple survey for study participants to record what they had served at lunch and breakfast to children at school (Food and Nutrition Board, 2012). Now, this simple survey is pre-coded with foods and beverages commonly offered in school meals and asks more detailed questions such as what is the fat content of the milk that the child is drinking (Food and Nutrition Board, 2012). Self-report is a method of asking teachers, food staff, parents, or whoever is providing the children with food at school, about what foods are served and the amount of the foods being served. However, the self-report method does not account for the food that is not being provided by the adult but is still being consumed by the children (Food and Nutrition Board, 2012). Food purchase receipts are an additional way to gather information on the foods that a child is ordering for lunch at school or buying at the grocery store. The food purchase receipts can be provided by a child in school after ordering their food or by a child's parents who buys the food at a supermarket. These receipts are used to evaluate an association between the food cost and the quality since the foods that cost more are generally found to be associated with a higher nutritional quality. However, food purchase receipts provide limited data on the amount of the food consumed (Food and Nutrition Board, 2012).

TX Sprouts Study

The TX Sprouts study is a group randomized trial evaluating a nine month in-school gardening, nutrition, and cooking program conducted in sixteen elementary schools around Austin, Texas from 2015 to 2019. The inclusion criteria for the project was for schools at elementary level to be within sixty miles of The University of Texas at Austin. Additionally, for students enrolled in third to fifth grade, more than fifty percent of the students were Hispanic per grade and more than fifty percent of school children were on a free or reduced lunch program. The exclusion criteria of schools were if the school had an existing active garden or gardening program, school district refused participation, and lack of school or community support. Children excluded from the intervention were those taking medications, diagnosed with a disease that could influence their dietary intake, having parents diagnosed with a major illness since their birth, and those with any physical, cognitive, or psychological disability. Informed consent was obtained from parents and assent was obtained from all participating children. There were 3,137 children that participated in baseline clinical data collection. For each child included in the study, a dietary screener was collected in person from the children and two 24-hour dietary recalls were obtained by telephone. This study used measurements from the dietary screener to determine the fruit and vegetable consumption as servings per day, and measurements from the 24-hour recalls to determine the intake of fruits and vegetables (serving counts per day) as well as the energy intake (kilocalories per day). Energy intake was converted to calories for use in the three-part model.

Public Health Significance

Previous studies have been developed and performed to analyze episodically consumed foods in order to estimate the usual intake in adults (Tooze, 2006; Pérez, 2012). However, while multiple studies analyzing the foods consumed by adults have been published, there are no prior studies performed with a population of children. Therefore, there is also no information found for estimating children's usual intake from the foods they consume. Analyzing the dietary intake of children at an early stage can help link food groups to certain diseases and can help prevent obesity and other chronic diseases. Estimating the usual intake from episodically consumed foods in children can lead to future studies investigating associations with health outcomes, which can aim to reduce chronic diseases in adulthood if prevented during childhood. This information would be relevant to estimating the usual intake in children from foods, such as fruits and vegetables, to understand a child's dietary intake given that the current recommendation in 2019 for a healthy living individual is one and a half to two cups of fruits daily, and two to three cups of vegetables daily (Lee-Kwan, 2018).

Research Question

The main purpose of this study is to evaluate if the three-part method is successful, by incorporating the dietary screener and two 24-hour recalls, in estimating the usual intake for fruits and vegetables consumed by boys and girls separately at baseline in TX Sprouts, for years 2014 to 2018. There were four aims in this study. The first aim was to use the measurements obtained from the dietary screener and two 24-hour recalls to estimate the usual intake from fruits alone consumed by boys and girls separately in TX Sprouts. The second aim was to use the measurements obtained from the dietary screener and two 24-hour recalls to estimate the usual intake from vegetables alone consumed by boys and girls separately in TX Sprouts. The third aim was to use the measurements obtained from the dietary screener and two 24-hour recalls to estimate the usual intake from both fruits and vegetables together consumed by boys and girls separately in TX Sprouts. The fourth aim was to use the measurements obtained from the dietary screener and the average of two 24-hour recalls to estimate the usual intake from the average of both fruits and vegetables together consumed by boys and girls separately in TX Sprouts.

METHODS

Study Design

This is a secondary data analysis of measurements of the project entitled "A School-based Gardening Obesity Intervention for Low-income Minority Children TX Sprouts," also known as TX Sprouts. This study utilized baseline measurements from the two 24-hour recalls and the dietary screener.

Study Subjects

In order to estimate the usual intake of fruits and vegetables two 24-hour recalls were required of each child to account for the day-to-day variation of their diets. There were 737 children (23.5% of the TX Sprouts population that participated in baseline data collection), 335 boys and 402 girls, included for investigation into the aims of this study. Only those who consented to participate and had complete data for two 24-hour recalls from TX Sprouts were included for analysis.

Outcomes

There were five food constraints considered in boys and girls separately: (i) fruit only, (ii) vegetables including white potatoes and starchy vegetables, (iii) vegetables excluding white potatoes and starchy vegetables, (iv) fruits and vegetables including white potatoes and starchy vegetables, and (v) fruits and vegetables excluding white potatoes and starchy vegetables.

Measurements

Since the parental income was not available in January 2019 we could not estimate the socioeconomic status of the children. The variables for fruits and vegetables were separated into multiple subcategories by the data owners of TX Sprouts according to the Nutrition Data System for Research (Regents of The University of Minnesota, 2016). For this secondary analysis, we were only interested in whole fruits and vegetables not fried or juiced.

Fruit

- Citrus Fruit – Fresh, cooked and canned citrus fruits (e.g., oranges, grapefruit, tangerines, lemons), citrus fruit in recipes (e.g., salads, Jell-O)
- Other Fruit Excluding Citrus Fruits – Fresh, frozen, cooked, canned, and dried, in recipes (e.g., salads, Jell-O, caramel apples), fruit relish, or salsa, fruit in cereal if actual fruit pieces (e.g., raisins)
- Avocado and similar – Includes avocado in guacamole.

Vegetables

- Dark Green Vegetables – Raw, cooked, and canned, vegetables (e.g., broccoli, spinach, romaine, collards), vegetable in recipes (e.g., stew, soup)
- Deep Yellow Vegetables – Raw, cooked, and canned, deep-yellow vegetables (e.g., carrots, pumpkin, sweet potatoes, winter squash), vegetable in recipes (e.g., stew, soup).
- Tomato - Raw, cooked and canned tomato, salsa, tomato sauce, spaghetti sauce, tomato-based sauce, tomato puree, tomato paste, tomato in recipes (e.g., stew, soup)

- White Potatoes - Baked, boiled, canned white potatoes, in recipes (e.g., stew).
- Other Starchy Vegetables – Raw, cooked, and canned, starchy vegetables (e.g., cassava, corn, green peas, jicama), vegetable in recipes (e.g., stew, soup), vegetables with more starch than peas.
- Other Vegetables – Raw, cooked, canned, vegetable in recipes (e.g., stew), vegetable relishes, mixed from other categories (e.g., peas and carrots; corn, peas, lima beans).
- Legumes – Dried beans, mature lima beans, refried beans, beans in sauce (e.g., pork and beans), beans in recipes (e.g., stew, soup).

Three-Part Model for Estimating Usual Intake

The mathematical model using the dietary screener and two 24-hour recalls is shown below (Pérez, 2012). Transformations to the data were necessary to reach normality and standardization since the data was skewed. For person i =1, …, 335 in boys, and i=1, …, 402 in girls, and for k = 1, 2 repeats of the 24-hour recall, and the data are $Y_{ik} = (Y_{i1k}, Y_{i2k}, Y_{i3k})^T$, where

- Y_{i1k} = Indicator of whether fruits and vegetables were consumed.
- Y_{i2k} = Number of servings of fruits and vegetables consumed as reported by the 24-hour recalls, which equals zero if fruits and vegetables were not consumed.
- Y_{i3k} = Amount of energy consumed as reported by the 24-hour recalls.

Box-Cox transformations were used to account for the skewness of the data. The Box-Cox transformation with the transformation parameter λ, is $h(y, \lambda) = (y^{\lambda}-1)/\lambda$ if $\lambda \neq 0$, and h(y, λ)

= log(y) if $\lambda = 0$. After the Box-Cox transformation, we further standardized and centered the transformed variables to have a mean of zero and variance of one. We let $\mu_{\lambda F}$ and $\sigma_{\lambda F}$ be the mean and standard deviation of the transformed nonzero food data $h(Y_{i2k}, \lambda_F)$, and let $\mu_{\lambda E}$ and $\sigma_{\lambda E}$ be the mean and standard deviation of the transformed energy data $h(Y_{i3k}, \lambda_E)$. Analysis was then be performed using:

$$Q_{i1k} = Y_{i1k}; \quad (1)$$

$$Q_{i2k} = \sqrt{2}\, Y_{i1k} \{h(Y_{i2k}, \lambda_F) - \mu_{\lambda F}\} / \sigma_{\lambda F}; \quad (2)$$

$$Q_{i3k} = \sqrt{2}\, \{h(Y_{i3k}, \lambda_E) - \mu_{\lambda E}\} / \sigma_{\lambda E} = htr(Y_{i3k}, \lambda_E, \mu_{\lambda E}, \sigma_{\lambda E}); \quad (3)$$

Covariates used in the model include age, body mass index (BMI), and the number of servings as reported in the dietary screener. Covariates can differ based on three types of data, so we denoted them as V_{i1}, V_{i2}, V_{i3}, which are vector-values. The normality of covariates was investigated using Shapiro-Wilk's test of normality. To improve linearity and homoscedasticity of the model, recommendations were followed (i) Box-Cox transformations were implemented on the covariates that were not normally distributed, (ii) centered, and (iii) scaled. We let λ_c represent a vector containing the Box-Cox transformation parameters used for the three covariates age, BMI, and number of servings as reported in the dietary screener. We let $\mu_{\lambda c}$ and $\sigma_{\lambda c}$ be the vector means and standard deviations of the transformed covariates respectively. The transformed, center, and scaled covariates were then denoted by:

$$X_{i1} = \{h(V_{i1}, \lambda_c) - \mu_{\lambda c}\} / \sigma_{\lambda c} \quad (4)$$

$$X_{i2} = \{h(V_{i2}, \lambda_c) - \mu_{\lambda c}\} / \sigma_{\lambda c} \quad (5)$$

$$X_{i3} = \{h(V_{i3}, \lambda_c) - \mu_{\lambda c}\} / \sigma_{\lambda c} \quad (6)$$

We let (U_i, U_{i2}, U_{i3}) = Normal$(0, \Sigma_u)$ be the random effects associated with consumption, number of servings (if the food is consumed), and energy. Similarly, for k = 1, 2, $(\epsilon_{i1k}, \epsilon_{i2k}, \epsilon_{i3k})$ = Normal$(0, \Sigma_\epsilon)$ accounts for the day-to-day variation. The model for whether there is consumption was stated as:

$$P(Q_{i1k} = 1|X_{i1}, U_{i1}, U_{i2}, U_{i3}) = \Phi(\alpha_1 + X_{i1}^T \beta_1 + U_{i1}), \tag{7}$$

Where $\Phi(.)$ is the standard normal distribution function and $(W_{i1k}, W_{i2k}, W_{i3k})$ represent their corresponding latent variables as follows. A food being consumed at visit k is equivalent to

$$Q_{i1k} = 1 \Longleftrightarrow W_{i1k} = \alpha_1 + X_{i1}^T \beta_1 + U_{i1} + \epsilon_{i1k} > 0. \tag{8}$$

The food when consumed and energy intake were modeled as

$$[Q_{i2k}|Q_{i1k} > 0] = W_{i2k} = \alpha_2 + X_{i2}^T \beta_2 + U_{i2} + \epsilon_{i2k} \tag{9}$$

$$[Q_{i3k}] = W_{i3k} = \alpha_3 + X_{i3}^T \beta 3 + U_{i3} + \epsilon_{i3k} \tag{10}$$

The prior distribution of parameters β_1, β_2, β_3 were assumed to be multivariate Normal with vector mean 0 and variance covariance Σ_u. An inverse Wishart denoted as IW(Ω_u, m_u) prior was specified for Σ_u. We set Ω_u to have an exchangeable correlation structure with starting values with diagonal entries all equal to 1 and correlations 0.5. We had two necessary restrictions on Σ_ϵ: (i) ϵ_{i1k} and ϵ_{i2k} are independent; and (ii) var$(\epsilon_{i1k}) = 1$, so that β_1 was identifiable, along with the distribution of U_{i1}. Furthermore, the model constrained the covariance matrix using a polar coordinate representation with $\gamma \in (-1, 1)$ and $\theta \in (-\pi, \pi)$. With these considerations Σ_ϵ was written as:

$$\Sigma_\epsilon = \begin{bmatrix} 1 & 0 & p_1 {s_{33}}^{1/2} \\ 0 & s_{22} & p_2 (s_{22} s_{33})^{1/2} \\ p_1 {s_{33}}^{1/2} & p_2 (s_{22} s_{33})^{1/2} & s_{33} \end{bmatrix}, \tag{11}$$

where $p_1 = \gamma\cos(\theta)$ and $p_2 = \gamma\sin(\theta)$. The recommended prior distributions for s_{22} and s_{33} were Uniform(0, 3), for γ was Uniform(−1, 1), and for θ was Uniform($-\pi$, π) (Zhang et al. 2011). The corresponding inverse of Σ_u was a Wishart distribution denoted as $\Sigma_u^{-1} = W(\Omega_u^{-1}, m_u)$, and the inverse of Σ_ϵ was written as:

$$\Sigma_\epsilon^{-1} = \begin{bmatrix} 1 + wp_1{}^2 s_{33} & wp_1 p_2 s_{33} s_{22}{}^{-1/2} & -wp_1 s_{33}{}^{1/2} \\ wp_1 p_2 s_{33} s_{22}{}^{-1/2} & s_{22}{}^{-1} + wp_2{}^2 s_{33} s_{22}{}^{-1} & -wp_2 s_{33}{}^{1/2} s_{22}{}^{-1/2} \\ -wp_1 s_{33}{}^{1/2} & -wp_2 s_{33}{}^{1/2} s_{22}{}^{-1/2} & w \end{bmatrix}, \qquad (12)$$

where $w = \{s_{33}(1 - p_1{}^2 - p_2{}^2)\}^{-1}$.

The posterior samples of usual intake T_{Fi}, usual energy intake T_{Ei}, and the energy adjusted usual intake $1000T_{Fi}/T_{Ei}$, all on the original scale. Using the best-power method (Dodd et al. 2006) for estimating both usual energy intake and usual intake for person i, in boys and girls separately. We first considered energy:

$$T_{Ei} = E\{h_{tr}{}^{-1}(\alpha_3 + X_{i3}{}^T \beta_3 + U_{i3} + \epsilon_{i3}, \lambda_E, \mu_{\lambda E}, \sigma_{\lambda E})|X_{i3}, U_{i3}\} \qquad (13)$$

$$\approx h^*_{tr}\{\alpha_3 + X_{i3}{}^T \beta_3 + U_{i3}, \lambda_E, \mu_{\lambda E}, \sigma_{\lambda E}, \Sigma_\epsilon(3, 3)\ . \qquad (14)$$

where

$$h^*_{tr}\{v, \lambda, \mu, \sigma, \Sigma\} = h_{tr}{}^{-1}(v, \lambda, \mu, \sigma) + \frac{\Sigma}{2}\left(\frac{\partial^2 h_{tr}{}^{-1}(v,\lambda,\mu,\sigma)}{\partial_v{}^2}\right)$$

Similarly, a child's usual intake of the dietary component on the original scale was defined as

$$T_{Fi} = \Phi(\alpha_1 + X_{i1}{}^T \beta_1 + U_{i1})\, h^*_{tr}\{\alpha_2 + X_{i2}{}^T \beta_2 + U_{i2}, \lambda_F, \mu_{\lambda F}, \sigma_{\lambda F}, \Sigma_\epsilon(2, 2). \qquad (15)$$

When $\lambda = 0$, the back-transformations and second derivatives were:

$h_{tr}{}^{-1}(v, 0, \mu, \sigma) = \exp(\mu + \sigma v/\sqrt{2})$;

$\partial^2 h_{tr}^{-1}(v, 0, \mu, \sigma)/\partial v^2 = \sigma^2 h_{tr}^{-1}(v, 0, \mu, \sigma)/2.$

Similarly, when $\lambda \neq 0$, the back-transformations and second derivatives were:

$H_{tr}^{-1}(v, \lambda, \mu, \sigma) = (1 + \lambda\mu + \lambda\sigma v/\sqrt{2})^{1/\lambda};$

$\partial^2 h_{tr}^{-1}(v, \lambda, \mu, \sigma)/\partial v^2 = \frac{\sigma^2}{2}(1 - \lambda)(1 + \lambda\mu + \lambda\sigma v/\sqrt{2})^{-2+1/\lambda}.$

Statistical Analysis

Summary statistics included the percent of boys and girls that reported consumption of a fruit or vegetable in the dietary screener as well as the percentage that reported consumption of fruits or vegetables at each 24-hour recall, the average consumption of fruits or vegetables was reported in serving counts at each 24-hour recall, and the average energy intake is reported in kilocalories at each 24-hour recall. The average consumption of each food constraint at the first and second 24-hour recall was estimated for boys and girls separately. Participants with missing age and race were included for analysis. All participants with reports from both 24-hour recalls, regardless of whether or not there was intake, were included in analyses. For each participant, the program took into account four different possibilities to model: (i) intake at the first 24-hour recall and intake at the second 24-hour recall, (ii) intake at the first 24-hour recall and no intake at the second 24-hour recall, (iii) no intake at the first 24-hour recall and intake at the second 24-hour recall, (iv) no intake at the first 24-hour recall and no intake at the second 24-hour recall. All Box-Cox Transformations were obtained using STATA 15 (StataCorp, 2017). Data analysis was performed in Rstudio version 1.1453 with modifications to the program Intake_epis_food()

(Pérez, 2012). Modifications were made to the program to account for the use of a dietary screener as opposed to a food frequency questionnaire (Zhang, 2011; Pérez, 2012). The package R2WinBUGS and WinBUGS was installed prior to running the program in order to generate and run the script of the three-part model and obtain output simulations in R. Estimates reported from the five three-part models in boys and girls separately list the means and standard deviations as well at the 5^{th}, 10^{th}, 25^{th}, 50^{th}, 75^{th}, 90^{th}, and 95^{th} percentiles for the usual intake, usual intake per 1000 calories, and the energy usual intake. Estimates of the posterior density are of the average over 10,000 MCMC and list posterior mean, posterior standard deviation, 2.5^{th}, 25^{th}, 50^{th}, 75^{th}, and 97.5^{th} percentiles for the intercepts and coefficients from equations modeling whether there was consumption, the number of servings consumed given consumption, and energy intake as well as the matrices Σ_u, Σ_ϵ, Σ_u^{-1}, and Σ_ϵ^{-1}. Trace plots were generated from 1000 MCMC and used to assess convergence. Density plots were also generated for each food by sex to display the distributions of the posterior density estimate of the mean for usual intake from 1000 MCMC, and the posterior density estimate of the mean for usual intake per 1000 calories.

Multiple Linear Regression for Estimating Usual Intake

For the fourth hypothesis, there were two linear regression models used to estimate the usual intake of the average of both fruits and vegetables together in boys and girls separately. One for analysis of the average consumption of both fruit and vegetables together including white potatoes and starchy vegetables, and another for analysis of average consumption of both fruit and vegetables together excluding white potatoes and starchy vegetables. Model selection was performed for each model to determine the best set of covariates to explain the usual intake. We found that BMI was not significant and so would not be included as a covariate in any of the models. For the model in boys, covariates included the energy from the average of the two 24-hour recalls recorded in calories, age, and the number of servings of fruits and vegetables consumed as reported in the dietary screener. In the models for girls, covariates included the energy from the average of the two 24-hour recalls recorded in calories and the number of servings of fruits and vegetables consumed as reported in the dietary screener.

The multiple linear regression models were estimated in SAS version 9.4 (SAS Institute Inc., Cary, N.C.). Diagnostics were checked in each model for the normality of residuals using Shapiro-Wilk test of normality. Constant variance of the residuals was estimated using the Breusch-Pagan test and scatterplots of semi-studentized residuals to check the linearity and independence of residuals. Sensitivity analyses was performed in each model by identifying and removing outliers to fit a second regression model. Outliers in the usual intake and covariates were identified as values larger than threshold values. For boys, the threshold values were intakes greater than 3.76, and covariate values greater than 0.024. Threshold values in girls were intakes greater than 3.75, and covariate values were greater than 0.015. The preliminary models containing outliers were then compared to the second models with outliers removed. The two models were compared by looking at the diagnostics, coefficients, and the coefficient of determination (R^2).

IRB Approval

I was added to the IRB for the project entitled "A School-based Gardening Obesity Intervention for Low-income Minority Children TX Sprouts" for the purpose of this project at The University of Texas at Austin. The data used in this study was previously collected through TX Sprouts, I did not come in contact with any of the individuals included in this study or with any animals. The data was analyzed only in a secure UT Austin or UTHealth network in order to ensure the safety of the individuals. Data was de-identified before I began this secondary data analysis. The protocol was approved by University of Texas Health Science Center at Houston IRB (HSC-SPH-18-0794).

RESULTS

There were initially 3,137 children included in the TX Sprouts baseline demographic data collection. Of those included for baseline demographic data collection, 761 children participated in at least one of the two 24-hour recalls at baseline, and only 737 children participated in two 24-hour recalls. There were 335 boys and 402 girls, with complete data for two 24-hour recalls and sex. The socio-demographic characteristics of the total 737 children who participated in both the first and second 24-hour recalls are shown in Table 1. Among boys the average age was 9.3 years old. For boys, 53.7% were Hispanic with an average height of 140.4 centimeters, average BMI was 20.13 kg/m^2, and average weight of 41.76 kg. For girls the average age was 9.2 years old. Additionally, 52.2% of the girls were Hispanic with an average height of 140.7 centimeters, average BMI of 20.32 kg/m^2, and average weight of 42.91 kg.

Table 1. Socio-Demographics of TX Sprouts Baseline

	Children who Participated in Two 24-Hour Recalls	
Variable	**Boys (n=335) n (%)**	**Girls (n=402) n (%)**
Age		
7 years	3 (0.90)	0 (0.00)
8 years	81 (24.18)	84 (20.90)
9 years	103 (30.75)	158 (39.30)
10 years	108 (32.24)	132 (32.84)
11+ years	35 (10.45)	23 (5.72)
Missing	5 (1.49)	5 (1.24)
Grade		
Third	91 (27.16)	101 (25.12)
Fourth	113 (33.73)	160 (39.80)
Fifth	120 (35.82)	132 (32.84)
Missing	11 (3.28)	9 (2.24)
Race		
Non-Hispanic	118 (35.22)	149 (37.06)
Hispanic	180 (53.73)	210 (52.24)
Missing	37 (11.04)	43 (10.70)
Height (cm) Mean (s.d.)	140.44 (48.09)	140.72 (44.50)
BMI (kg/m^2) Mean (s.d.)	20.13 (4.55)	20.32 (4.39)
Weight (kg) Mean (s.d.)	41.76 (54.08)	42.91 (49.91)

Usual Fruit Intake Among Boys

Summary statistics of the dietary intake used for analysis of fruits alone consumed by boys and girls at baseline in TX Sprouts, as well as results from the three-part model, are presented in Table 2. The table shows the percentage of boys and girls who reported they had consumed any fruit by the dietary screener, as well as the percentage of children who reported consumption at each 24-hour recall. In addition, the table also shows the average number of serving counts per day of fruits consumed and the average amount of energy consumed reported in kilocalories at each 24-hour recall. The reported three-part model estimates are after being controlled for age, BMI, and the number of servings of fruit reported in the dietary screener. The full summary statistics for the analysis of fruits alone from the three-part model using a Bayesian approach with reports of posterior density estimates for the usual intake, the usual intake per 1000 calories, and the usual energy intake can be found in Table 10 of Appendix A.

Table 2. Fruit Intake from Children in TX Sprouts

	Boys (n=335)			**Girls (n=402)**		
	Reported Consumed (%)	**Number of Servings per Day** Mean(s.d.)	**Energy Consumed in kcal** Mean(s.d.)	**Reported Consumed** (%)	**Number of Servings per Day** Mean(s.d.)	**Energy Consumed in kcal** Mean(s.d.)
Dietary Screener	68.66	--	--	72.39	--	--
First 24-Hour Recall	54.93	1.06 (2.51)	1,490.68 (690.23)	59.95	0.99 (1.32)	1,439.56 (838.13)
Second 24-Hour Recall	51.64	0.85 (1.49)	1,500.40 (610.60)	53.98	0.79 (1.33)	1,465.63 (607.07)
Three-Part Model Estimates	--	0.74 (0.56)	1,477.05 (273.18)	--	0.68 (0.30)	1,432.97 (184.31)

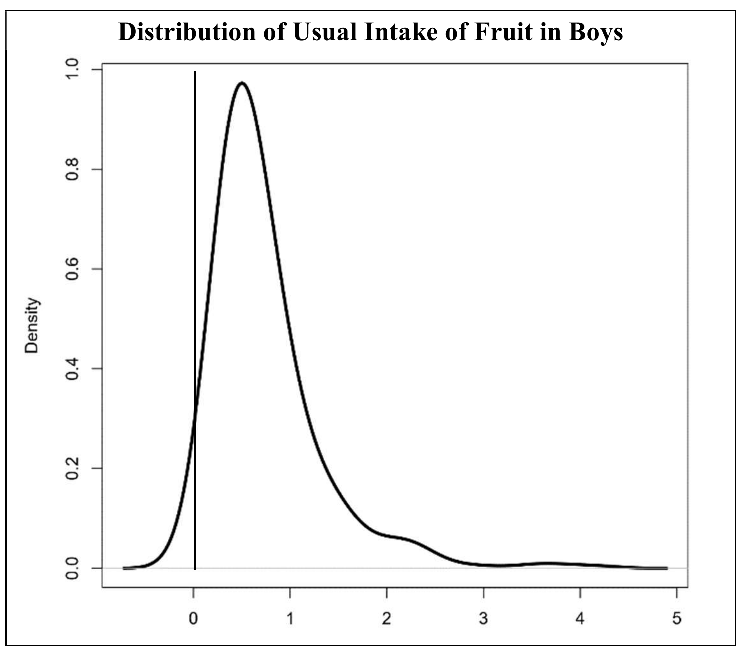
Table 3 shows for fruits alone in boys the transformed and standardized estimates of the posterior density from the three equations being modeled by the three-part method (i) whether consumption occurred, (ii) the number of servings consumed given consumption, and (iii) the energy intake. The mean and standard deviation of the intercepts and covariates are reported as after controlling for age, BMI, and the number of servings as reported in the dietary screener. Full output of posterior means for the analysis of fruits alone in boys from the thee-part model can be found in Table 15 of Appendix B.

Table 3. Posterior Means of Usual Intake of Fruits and Vegetables Alone in Boys (n=335)

Standardized and Transformed Variables	**Fruits Alone**		**Vegetables Including White Potatoes and Starchy Vegetables**		**Vegetables Excluding White Potatoes and Starchy Vegetables**	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Intercept at Consumption	0.10	0.06	1.27	0.10	1.17	0.09
Intercept at Consumption Level Given Consumption	-0.10	0.10	-0.01	0.06	-0.02	0.06
Intercept at Energy Intake Level	0	0.06	0	0.07	0	0.06
Age at Consumption	0.08	0.06	0.02	0.08	0.04	0.07
BMI at Consumption	-0.08	0.07	-0.02	0.07	-0.06	0.07
Number of Servings Reported in Dietary Screener at Consumption	0.10	0.07	0.11	0.07	0.14	0.07
Age at Consumption Level Given Consumption	0.01	0.08	0.12	0.06	0.1	0.06
BMI at Consumption Level Given Consumption	-0.06	0.08	-0.07	0.06	-0.02	0.06
Number of Servings Reported in Dietary Screener at Consumption Level Given Consumption	0.19	0.08	0.14	0.06	0.16	0.06
Age at Energy Intake Level	0.12	0.06	0.13	0.07	0.12	0.06
BMI at Energy Intake Level	-0.10	0.07	-0.07	0.06	-0.07	0.06
Number of Servings Reported in Dietary Screener at Energy Intake Level	-0.11	0.06	-0.12	0.06	-0.06	0.06

The Box-Cox transformation parameters found were the log of the number of servings of fruit consumed reported from the 24-hour recalls, 0.1 for energy intake reported from the 24-hour recalls, -0.15 for boy's age, -0.8 for BMI, and no transformation was needed for the number of servings of fruit consumed reported in the dietary screener. The following density plots in Figure 1 shows the density of usual fruit intake in boys as skewed. The dietary screener showed that a larger percentage of boys reported consumption of a fruit than the percentage at both 24-hour recalls. The number of servings of fruit consumed by boys was 1.06 servings at the first 24-hour recall, 0.85 servings at the second 24-hour recall, and 0.74 servings per day was estimated as the usual intake by the three-part model after controlling for age, BMI, and the number of servings of fruit reported in the dietary screener.

Figure 1. Posterior Density Distribution for Boys Usual Intake of Fruits Alone (n=335)



Usual Fruit Intake Among Girls

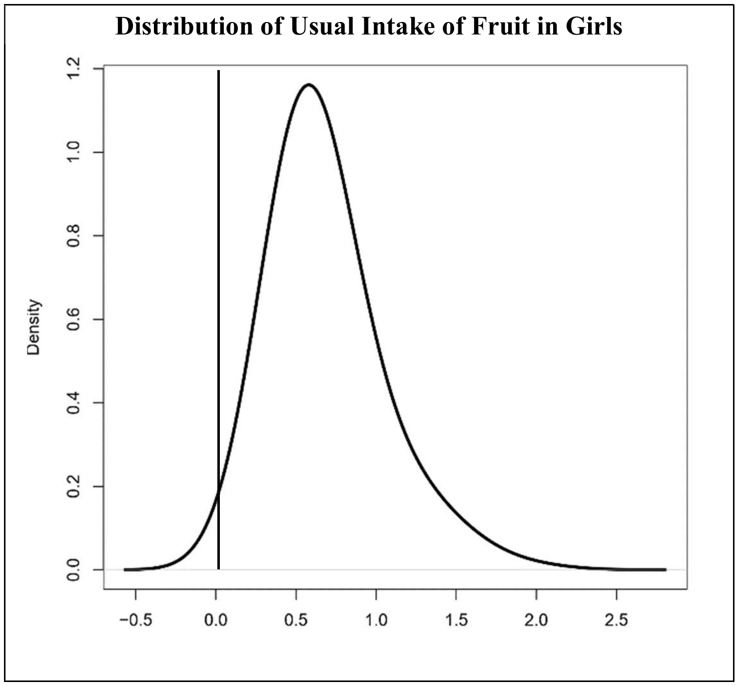
Summary statistics of the dietary intake of fruits alone for girls at baseline in TX Sprouts and results from the three-part model are presented in Table 2. Full summary statistics for the analysis of fruits alone in girls from the three-part model can be found in Table 10 of Appendix A. Transformed and standardized estimates of the posterior density from the three equations being modeled by the three-part method for fruits alone in girls is shown in Table 4. The mean and standard deviation of the intercepts and covariates are reported as after controlling for age, BMI, and the number of servings as reported in the dietary screener. Full output of posterior means for the analysis of fruits alone in girls from the thee-part model can be found in Table 16 of Appendix B.

The Box-Cox transformation parameters found were 0.05 for the number of servings of fruit consumed reported from the 24-hour recalls, 0.1 for the energy intake reported from the 24-hour recalls, no transformation was needed for girl's age, -0.6 for BMI, and no transformation was needed for the number of servings of fruits consumed reported in the dietary screener. The density plot shown in Figure 2 for the distribution of usual fruit intake in girls appears to be skewed. The dietary screener showed that a larger percentage of girls reported consumption of a fruit than the percentage at both 24-hour recalls. The number of servings of fruit consumed by girls was 0.99 servings at the first 24-hour recall, 0.79 servings at the second 24-hour recall, and 0.68 servings per day was estimated as the usual intake by the three-part model after controlling for age, BMI, and the number of servings of fruit reported in the dietary screener.

Table 4. Posterior Means of Usual Intake of Fruits and Vegetables Alone in Girls (n=402)

Standardized and Transformed Variables	**Fruits Alone**		**Vegetables Including White Potatoes and Starchy Vegetables**		**Vegetables Excluding White Potatoes and Starchy Vegetables**	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Intercept at Consumption	0.21	0.06	1.37	0.09	1.22	0.08
Intercept at Consumption Level Given Consumption	-0.06	0.08	0.01	0.05	0.01	0.06
Intercept at Energy Intake Level	0	0.05	0	0.06	0	0.06
Age at Consumption	-0.06	0.06	-0.03	0.07	-0.07	0.06
BMI at Consumption	-0.05	0.06	-0.13	0.07	-0.13	0.07
Number of Servings Reported in Dietary Screener at Consumption	0.14	0.06	0.16	0.06	0.18	0.07
Age at Consumption Level Given Consumption	-0.04	0.06	0.06	0.05	0.08	0.05
BMI at Consumption Level Given Consumption	-0.06	0.06	0	0.05	-0.02	0.05
Number of Servings Reported in Dietary Screener at Consumption Level Given Consumption	0.04	0.06	0.16	0.05	0.17	0.05
Age at Energy Intake Level	0.07	0.06	0.07	0.06	0.07	0.06
BMI at Energy Intake Level	-0.15	0.05	-0.16	0.06	-0.15	0.06
Number of Servings Reported in Dietary Screener at Energy Intake Level	0.03	0.06	-0.03	0.06	-0.04	0.05

Figure 2. Posterior Density Distribution for Girls Usual Intake of Fruits Alone (n=402)



Usual Vegetable Intake Among Boys

Table 5 presents the summary statistics of the dietary intake used for the analysis of vegetables alone consumed by boys and girls at baseline in TX Sprouts, as well as results from the three-part model. Summary statistics for the consumption of vegetables including white potatoes and starchy vegetables and vegetables excluding white potatoes and starchy vegetables are reported separately. The table shows the percentage of children who reported that they had consumed any vegetable by the dietary screener, as well as the percentage of children who reported consumption at each 24-hour recall. In addition, the table also shows the average number of serving counts per day of vegetables consumed as well as the average amount of energy consumed as reported in kilocalories at each 24-hour recall. The reported three-part model estimates are after being controlled for age, BMI, and the number of servings of vegetables reported in the dietary screener. The full summary statistics for the analysis of vegetables alone from the three-part model using a Bayesian approach with reports of posterior density estimates for the usual intake, the usual intake per 1000 calories, and usual energy intake for boys can be found in Table 11 of Appendix A. Additionally, Table 3 reports for vegetables alone, including and excluding white potatoes and starchy vegetables, the transformed and standardized estimates of the posterior density from the three equations being modeled by the three-part method in boys. Full output of posterior means for the analysis of vegetables alone in boys from the thee-part model can be found in Tables 18 and 19 of Appendix B.

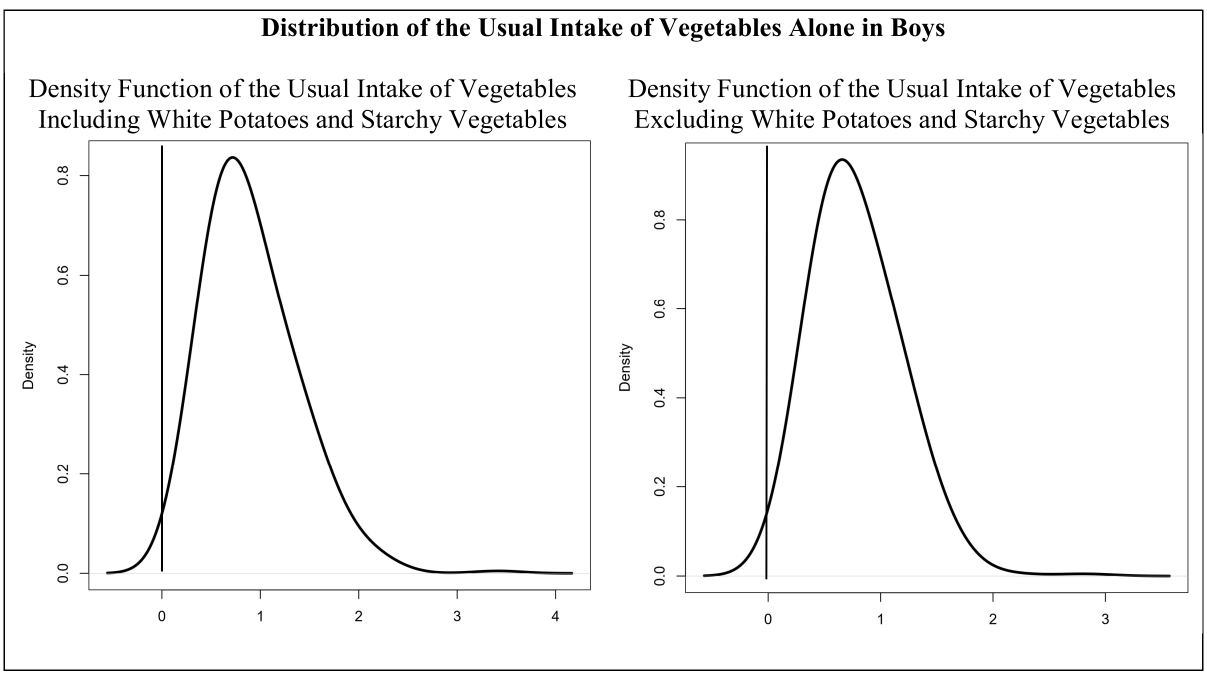
For the analysis of vegetable consumption including white potatoes and starchy vegetables, the Box-Cox transformation parameters were found to be 0.2 for the number of servings of vegetables consumed including white potatoes and starchy vegetables reported from the 24-hour recalls, 0.1 for energy intake reported from the 24-hour recalls, -0.15 for boy's age, -0.8 for BMI, and 0.3 for the number of servings of vegetables consumed reported in the dietary screener. The density plot shown in Figure 3 for the usual intake of vegetables including white potatoes and starchy boys appears skewed. The dietary screener showed that a smaller percentage of boys reported consumption of a vegetable than the percentage at both 24-hour recalls. The number of servings of vegetables consumed including white potatoes and starchy vegetables by boys was 1.61 servings at the first 24-hour recall, 1.58 servings at the second 24-hour recall, and 0.91 servings per day was estimated as the usual intake by the three-part model after controlling for age, BMI, and the number of servings of vegetables reported in the dietary screener.

Table 5. Vegetable Intake from Children in TX Sprouts

	Boys (n=335)			**Girls (n=402)**		
	Reported Consumed (%)	**Number of Servings per Day** Mean(s.d.)	**Energy Consumed in kcal** Mean(s.d.)	**Reported Consumed** (%)	**Number of Servings per Day** Mean(s.d.)	**Energy Consumed in kcal** Mean(s.d.)
Vegetable Intake Including White Potatoes and Starchy Vegetables						
Dietary Screener	79.40	--	--	83.33	--	--
First 24-Hour Recall	87.46	1.61 (1.68)	1,490.68 (690.23)	88.81	1.72 (1.77)	1,439.56 (838.13)
Second 24-Hour Recall	85.67	1.58 (1.77)	1,500.40 (610.60)	89.30	1.61 (1.51)	1,465.63 (607.07)
Three-Part Model Estimates	--	0.91 (0.45)	1,477.68 (270.84)	--	0.94 (0.26)	1,431.64 (188.78)
Vegetable Intake Excluding White Potatoes and Starchy Vegetables						
Dietary Screener	77.01	--	--	79.10	--	--
First 24-Hour Recall	85.97	1.37 (1.55)	1,490.68 (690.23)	85.07	1.46 (1.66)	1,439.56 (838.13)
Second 24-Hour Recall	83.28	1.39 (1.67)	1,500.40 (610.60)	87.06	1.36 (1.40)	1,465.63 (607.07)
Three-Part Model Estimates	--	0.79 (0.36)	1,478.52 (269.10)	--	0.82 (0.27)	1,433.16 (188.08)

For the analysis of vegetable consumption excluding white potatoes and starchy vegetables, the Box-Cox transformation parameters were found to be 0.2 for the number of servings of vegetables consumed excluding white potatoes and starchy vegetables reported from the 24-hour recalls, 0.1 for energy intake reported from the 24-hour recalls, -0.15 for boy's age, -0.8 for BMI, and 0.05 for the number of servings of vegetables consumed as reported in the dietary screener. Density plot for the usual intake of vegetables excluding white potatoes and starchy vegetables in boys is shown in Figure 3 and appears to be skewed. The dietary screener showed that a smaller percentage of boys reported consumption of a vegetable than the percentage at both 24-hour recalls. The number of servings of vegetables consumed excluding white potatoes and starchy vegetables by boys was 1.37 servings at the first 24-hour recall, 1.39 servings at the second 24-hour recall, and 0.79 servings per day was estimated as the usual intake by the three-part model after controlling for age, BMI, and the number of servings of vegetables as reported in the dietary screener.

Figure 3. Posterior Density Distribution for Boys Usual Intake of Vegetables Alone (n=335)

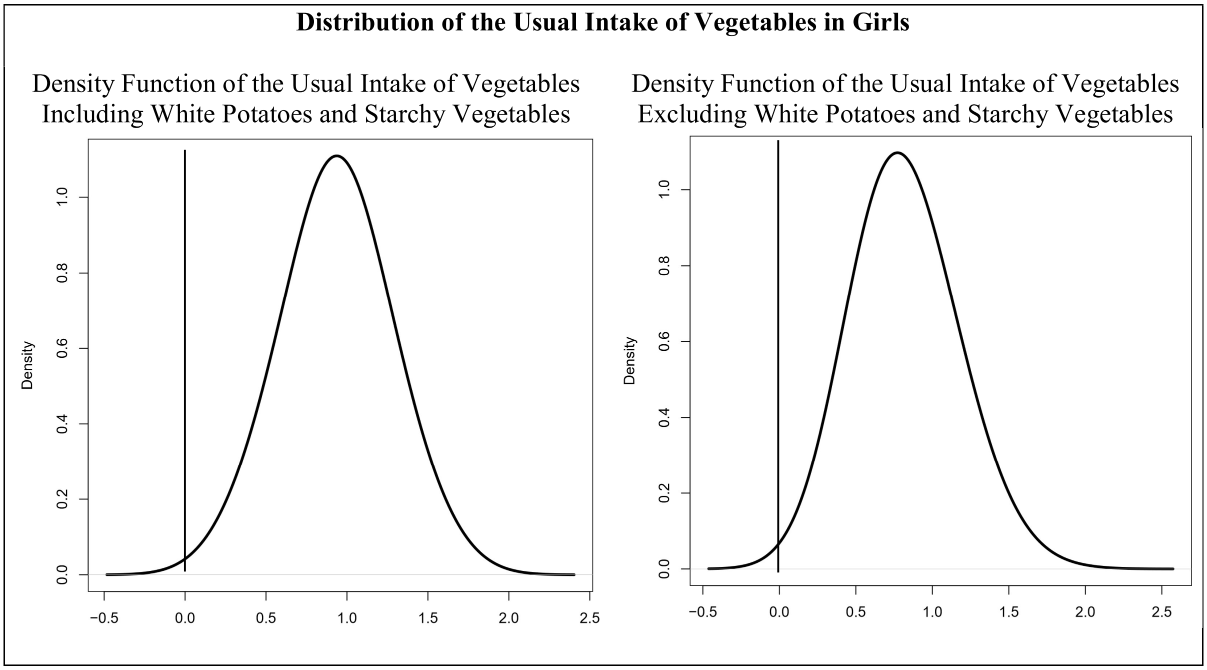


Usual Vegetable Intake Among Girls

Summary statistics of the dietary intake of vegetables alone for girls at baseline in TX Sprouts and results from the three-part model are presented in Table 5. Full summary statistics for the analysis of vegetables alone from the three-part model using a Bayesian approach with reports of posterior density estimates can be found in Table 12 of Appendix A. Table 4 presents the transformed and standardized estimates of the posterior density from the three equations being modeled by the three-part method in girls for analysis of vegetables alone, including and excluding white potatoes and starchy vegetables. Full output of posterior means for the analysis of vegetables alone in girls from the thee-part model can be found in Tables 19 and 20 of Appendix B.

For the analysis of vegetable consumption including white potatoes and starchy vegetables, the Box-Cox transformation parameters found were 0.25 for the number of servings of vegetables consumed including white potatoes and starchy vegetables reported from the 24-hour recalls, 0.1 for the energy intake reported from the 24-hour recalls, no transformation was needed for girl's age, -0.6 for BMI, and 0.1 for the number of servings of vegetables consumed reported in the dietary screener. The density plot in Figure 4 for the distribution of the usual intake of vegetables including white potatoes and starchy vegetables in girls to appears skewed. The dietary screener showed that a smaller percentage of girls reported consumption of a vegetable than the percentage at both 24-hour recalls. The number of servings of vegetables consumed including white potatoes and starchy vegetables by girls was 1.72 servings at the first 24-hour recall, 1.61 servings at the second 24-hour recall, and 0.94 servings per day was estimated as the usual intake by the three-part model after controlling for age, BMI, and the number of servings of vegetables as reported in the dietary screener.

Figure 4. Posterior Density Distribution for Girls Usual Intake of Vegetables Alone (n=402)



For the analysis of vegetable consumption, excluding white potatoes and starchy vegetables, the Box-Cox transformation parameters were 0.2 for the number of servings of vegetables consumed excluding white potatoes and starchy vegetables as reported from the 24-hour recalls, 0.1 for the energy intake reported from the 24-hour recalls, no transformation parameter was needed for girl's age, -0.6 for BMI, and the log of the number of servings of vegetables consumed reported in the dietary screener. The following density plots in Figure 4 for the usual intake of vegetables excluding white potatoes and starchy vegetables in girls is skewed. The dietary screener showed a smaller percentage of girls reported consumption of a vegetable than the percentage at both 24-hour recalls. The number of servings of vegetables consumed excluding white potatoes and starchy vegetables by girls was 1.46 servings at the first 24-hour recall, 1.36 servings at the second 24-hour recall, and 0.82 servings per day was estimated as the usual intake by the three-part model after controlling for age, BMI, and the number of servings of vegetables as reported in the dietary screener.

Usual Fruit and Vegetable Intake Among Boys

For analysis of both fruit and vegetables together in boys, the summary statistics of the dietary intake and results from the three-part model are presented in Table 6. The summary statistics are reported separately for the consumption of fruits and vegetables including white potatoes and starchy vegetables, and vegetables excluding white potatoes and starchy vegetables. The table shows the percentage of children who reported they had consumed any fruits or vegetables by the dietary screener, as well as the percentage of children who reported consumption of a fruit or vegetable at each 24-hour recall. In addition, the table also shows the average number of servings counts per day of both fruits and vegetables consumed and the average amount of energy consumed as reported in kilocalories at each 24-hour recall. Reported three-part model estimates are after controlling for age, BMI, and the number of servings of fruits and vegetables reported in the dietary screener. The full summary statistics for the analysis of both fruits and vegetables together in boys from the three-part model using a Bayesian approach with reports of posterior density estimates for the usual intake, the usual intake per 1000 calories, and the usual energy intake for boys can be found in Table 13 of Appendix A. The transformed and standardized estimates of the posterior density from the three equations being modeled by the three-part method for analysis of fruits and vegetables together in boys is presented in Table 7. The reported mean and standard deviation of the intercepts and covariates are after controlling for age, BMI, and the number of servings of both fruits and vegetables reported in the dietary screener. Full output of posterior means for the analysis of both fruits and vegetables together in boys from the thee-part model can be found in Tables 21 and 22 of Appendix B.

For the analysis of both fruit and vegetable consumption together including white potatoes and starchy vegetables, the Box-Cox transformation parameters were found as 0.2 for the number of servings of both fruits and vegetables consumed including white potatoes and starchy vegetables as reported from the 24-hour recalls, 0.1 for energy intake reported from the 24-hour recalls, -0.15 for the boy's age, -0.8 for BMI, and 0.3 for the number of servings of fruits and vegetables consumed as reported in the dietary screener. The density plot appears skewed for the usual intake of both fruits and vegetables together including white potatoes and starchy vegetables in boys as shown in Figure 5. The dietary screener showed a smaller percentage of boys reported consumption of both fruits and vegetables when compared to the percentage at each 24-hour recall. The number of servings of both fruits and vegetables consumed including white potatoes and starchy vegetables by boys was 2.67 servings at the first 24-hour recall, 2.43 servings at the second 24-hour recall, and 1.41 servings per day was estimated as the usual intake by the three-part model after controlling for age, BMI, and the number of servings of both fruits and vegetables as reported in the dietary screener.

Table 6. Fruit and Vegetable Intake from Children in TX Sprouts

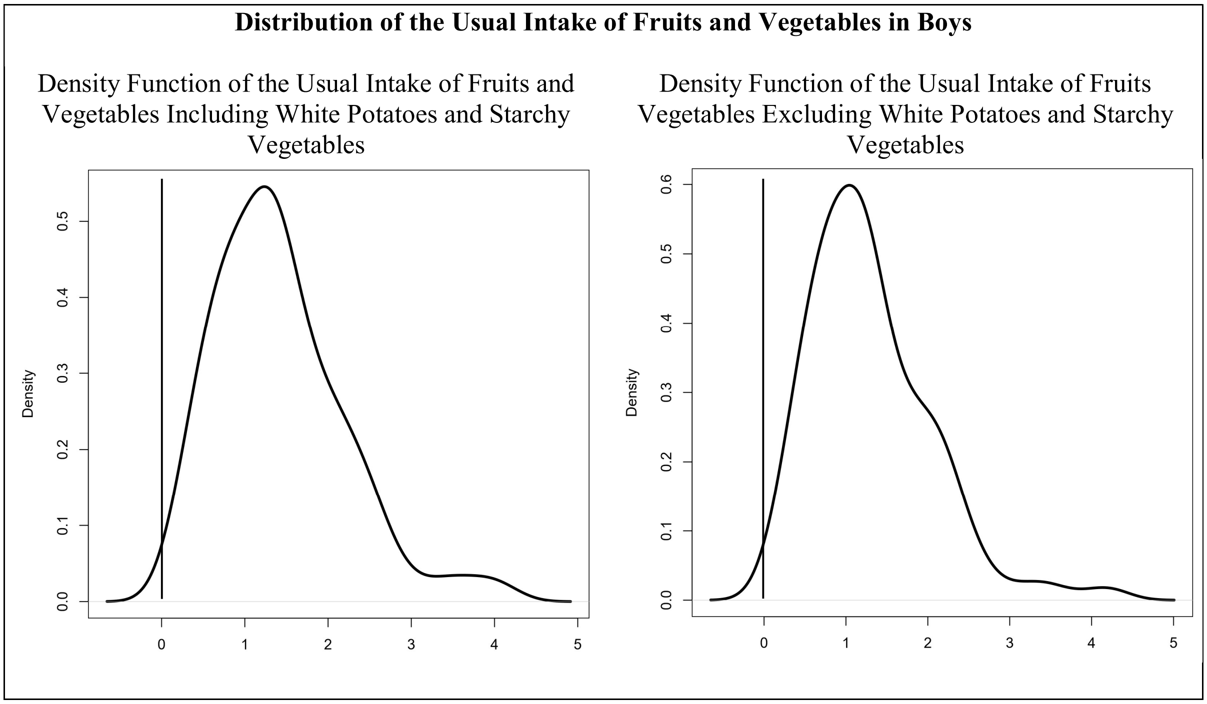
	Boys (n=335)			Girls (n=402)		
	Reported Consumed (%)	**Number of Servings per Day** Mean(s.d.)	**Energy Consumed in kcal** Mean(s.d.)	**Reported Consumed** (%)	**Number of Servings per Day** Mean(s.d.)	**Energy Consumed in kcal** Mean(s.d.)
Fruit and Vegetable Intake Including White Potatoes and Starchy Vegetables						
Dietary Screener	86.87	--	--	91.29	--	--
First 24-Hour Recall	93.73	2.67 (3.03)	1,490.68 (690.23)	95.27	2.71 (2.22)	1,439.56 (838.13)
Second 24-Hour Recall	91.04	2.43 (2.44)	1,500.40 (610.60)	94.78	2.40 (2.04)	1,465.63 (607.07)
Three-Part Model Estimates	--	1.41 (0.78)	1,477.81 (275.09)	--	1.36 (0.52)	1,432.92 (180.07)
Average of 24-Hour Recall	98.81	2.57 (2.12)	1,499.97 (534.52)	99.50	2.54 (1.62)	1,446.01 (549.60)
Fruit and Vegetable Intake Excluding White Potatoes and Starchy Vegetables						
Dietary Screener	86.57	--	--	90.30	--	--
First 24-Hour Recall	93.13	2.43 (2.97)	1,490.68 (690.23)	93.53	2.45 (2.17)	1,439.56 (838.13)
Second 24-Hour Recall	89.55	2.24 (2.36)	1,500.40 (610.60)	94.03	2.15 (1.96)	1,465.63 (607.07)
Three-Part Model Estimates	--	1.30 (0.74)	1,477.26 (272.58)	--	1.24 (0.48)	1,432.81 (180.68)
Average of 24-Hour Recalls	98.81	2.35 (2.07)	1,499.97 (534.52)	99.50	2.29 (1.57)	1,446.01 (549.60)

Table 7. Posterior Means of Usual Intake of Fruits and Vegetables Together in Boys (n=335)

Standardized and Transformed Variables	**Fruits and Vegetables Including White Potatoes and Starchy Vegetables**		**Fruits and Vegetables Excluding White Potatoes and Starchy Vegetables**	
	Mean	Standard Deviation	Mean	Standard Deviation
Intercept at Consumption	1.59	0.10	1.53	0.10
Intercept at Consumption Level Given Consumption	-0.01	0.06	-0.01	0.06
Intercept at Energy Intake Level	0	0.06	0	0.06
Age at Consumption	0	0.08	0.02	0.08
BMI at Consumption	-0.03	0.08	-0.07	0.08
Number of Servings Reported in Dietary Screener at Consumption	0.06	0.08	0.08	0.08
Age at Consumption Level Given Consumption	0.16	0.06	0.13	0.06
BMI at Consumption Level Given Consumption	-0.15	0.06	-0.12	0.06
Number of Servings Reported in Dietary Screener at Consumption Level Given Consumption	0.15	0.06	0.18	0.06
Age at Energy Intake Level	0.12	0.07	0.13	0.06
BMI at Energy Intake Level	-0.06	0.06	-0.06	0.06
Number of Servings Reported in Dietary Screener at Energy Intake Level	-0.11	0.06	-0.08	0.07

For the analysis of both fruit and vegetable consumption together excluding white potatoes and starchy vegetables, the Box-Cox transformation parameters were found to be 0.25 for the number of servings of both fruits and vegetables consumed excluding white potatoes and starchy vegetables as reported from the 24-hour recalls, 0.1 for energy intake reported from the 24-hour recalls, -0.15 for boy's age, -0.8 for BMI, and 0.2 for the number of servings of fruits and vegetables consumed as reported in the dietary screener. Figure 5 shows the density plots for the usual intake of both fruits and vegetables excluding white potatoes and starchy vegetables as skewed. The dietary screener showed that a smaller percentage of boys reported consumption of both fruits and vegetables than the percentage at each 24-hour recall. The number of servings of both fruits and vegetables consumed excluding white potatoes and starchy vegetables by boys was 2.43 servings at the first 24-hour recall, 2.24 servings at the second 24-hour recall, and 1.30 servings per day was estimated as the usual intake by the three-part model after controlling for age, BMI, and the number of servings of both fruits and vegetables as reported in the dietary screener.

Figure 5. Posterior Density Distribution for Boys Usual Intake of Both Fruits and Vegetables (n=335)



Usual Fruit and Vegetable Intake Among Girls

The summary statistics of the dietary intake of both fruits and vegetables together for girls at baseline in TX Sprouts, as well as results from the three-part model, are presented in Table 6. Full summary statistics for the analysis of fruits and vegetables together from the three-part model using a Bayesian approach with reports of posterior density estimates can be found in Table 14 of Appendix A. Transformed and standardized estimates of the posterior density from the three equations being modeled by the three-part method for fruits and vegetables together in girls is shown in Table 8. The mean and standard deviation of the intercepts and covariates are reported as after controlling for age, BMI, and the number of servings as reported in the dietary screener. Full output of posterior means for the analysis of fruits and vegetables together in girls from the thee-part model can be found in Tables 23 and 24 of Appendix B.

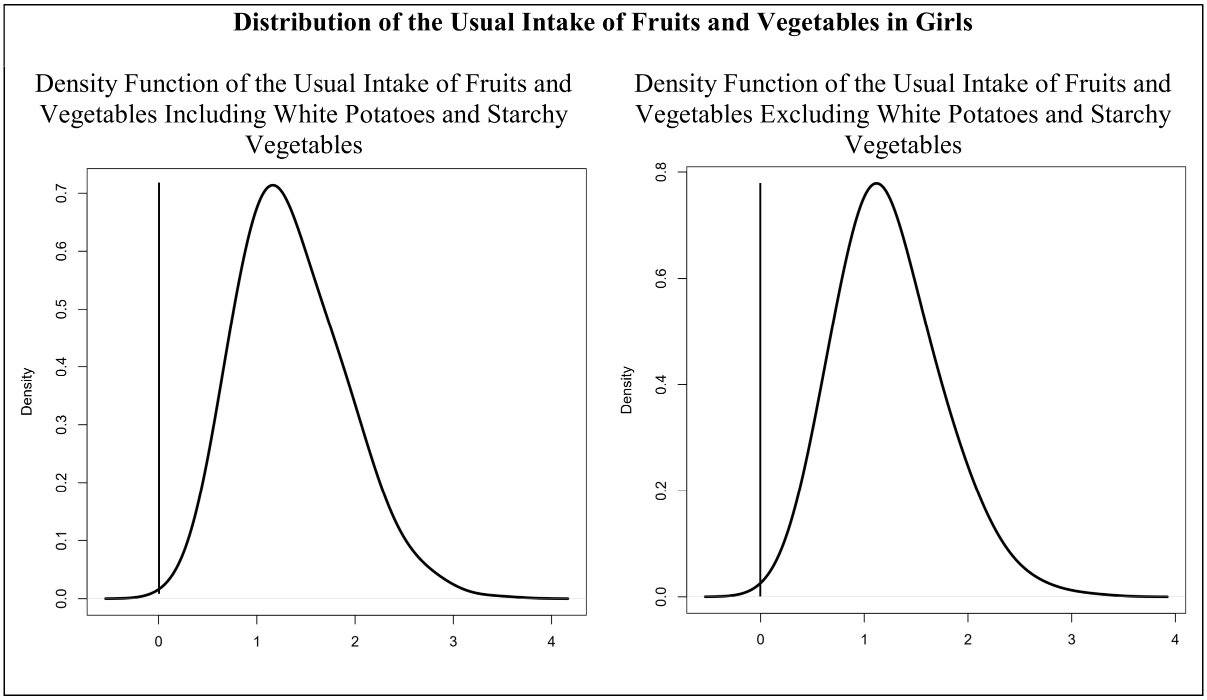
For the analysis of both fruit and vegetable consumption together including white potatoes and starchy vegetables, the Box-Cox transformation parameters were found to be 0.35 for the number of servings of both fruits and vegetables consumed including white potatoes and starchy vegetables as reported from the 24-hour recalls, 0.1 for the energy intake reported from the 24-hour recalls, no transformation parameter was needed for girl's age, -0.6 for BMI, and 0.1 for the number of servings of fruits and vegetables consumed reported in the dietary screener. Figure 6 shows the density plot for the distribution of the usual intake of both fruits and vegetables including white potatoes and starchy vegetables in girls as skewed. The dietary screener showed that a smaller percentage of girls reported consumption of both fruits and vegetables than the percentage at each 24-hour recall. The number of servings of both fruits and vegetables consumed together including white potatoes and starchy vegetables by girls was 2.71 servings at the first 24-hour recall, 2.40 servings at the second 24-hour recall, and 1.36 servings per day was estimated as the usual intake by the three-part model after controlling for age, BMI, and the number of servings of both fruits and vegetables as reported in the dietary screener.

Table 8. Posterior Means of Usual Intake of Fruits and Vegetables Together in Girls (n=402)

Standardized and Transformed Variables	**Fruits and Vegetables Including White Potatoes and Starchy Vegetables**		**Fruits and Vegetables Excluding White Potatoes and Starchy Vegetables**	
	Mean	Standard Deviation	Mean	Standard Deviation
Intercept at Consumption	1.92	0.16	1.74	0.12
Intercept at Consumption Level Given Consumption	0	0.05	0	0.05
Intercept at Energy Intake Level	0	0.05	0	0.06
Age at Consumption	-0.01	0.09	-0.06	0.08
BMI at Consumption	-0.13	0.10	-0.15	0.09
Number of Servings Reported in Dietary Screener at Consumption	0.20	0.07	0.18	0.07
Age at Consumption Level Given Consumption	-0.03	0.05	-0.03	0.06
BMI at Consumption Level Given Consumption	-0.06	0.06	-0.06	0.05
Number of Servings Reported in Dietary Screener at Consumption Level Given Consumption	0.13	0.05	0.15	0.05
Age at Energy Intake Level	0.07	0.05	0.08	0.06
BMI at Energy Intake Level	-0.16	0.06	-0.16	0.05
Number of Servings Reported in Dietary Screener at Energy Intake Level	-0.02	0.05	-0.03	0.06

For the analysis of both fruit and vegetable consumption together excluding white potatoes and starchy vegetables in girls, the Box-Cox transformation parameters found were 0.35 for the number of servings of both fruits and vegetables consumed excluding white potatoes and starchy vegetables as reported from the 24-hour recalls, 0.1 for the energy intake reported from the 24-hour recalls, no transformation parameter was needed for the girl's age, -0.6 for BMI, and 0.1 for the number of servings of fruits and vegetables consumed reported in the dietary screener. Figure 6 displays the density plot of the distribution of the usual intake of both fruits and vegetables excluding white potatoes and starchy vegetables in girls as skewed. The dietary screener showed a smaller percentage of girls reported consumption of both fruits and vegetables than the percentage at each 24-hour recall. The number of servings of both fruits and vegetable consumed by girls excluding white potatoes and starchy vegetables was 2.45 servings at the first 24-hour recall, 2.15 servings at the second 24-hour recall, and 1.24 servings per day was estimated as the usual intake by the three-part model after controlling for age, BMI, and the number of servings of both fruits and vegetables as reported in the dietary screener.

Figure 6. Posterior Density Distribution for Girls Usual Intake of Both Fruits and Vegetables (n=402)



The time it took to run the models using the program Intake_epis_food() in RStudio was recorded. Table 9 reports the approximate time in minutes to completion of the function for each three-part model by food and sex.

Table 9. Completion Times of Intake_epis_food() Function in RStudio

Three-Part Model for Estimating Usual Intake	Sex	Time to Completion of Function in Minutes
Fruit Alone	Boys	54.23
	Girls	45.08
Vegetables Alone Including White Potatoes and Starchy Vegetables	Boys	37.42
	Girls	44.17
Vegetables Alone Excluding White Potatoes and Starchy Vegetables	Boys	38.17
	Girls	45.05
Fruits and Vegetables Together Including White Potatoes and Starchy Vegetables	Boys	39.34
	Girls	45.42
Fruits and Vegetables Together Excluding White Potatoes and Starchy Vegetables	Boys	36.38
	Girls	45.22

Average of Fruits and Vegetables Among Boys

Summary statistics of the dietary intake used for the analysis of the average fruits and vegetables together, as reported from the average of the two 24-hour recalls, by boys in TX Sprouts are presented in Table 6. The summary statistics of the average of the two 24-hour recalls are reported separately for the consumption of fruits and vegetables including white potatoes and starchy vegetables, and excluding white potatoes and starchy vegetables.

For the multiple linear regression to fit the usual intake of the average fruits and vegetables including white potatoes and starchy vegetables in boys, Box-Cox transformation parameters were found to be 0.25 for the number of servings of both fruits and vegetables consumed including white potatoes and starchy vegetables as reported from the average of the two 24-hour recalls, 0.01 for energy intake reported from the average of the two 24-hour recalls, -0.15 for boy’s age, and 0.3 for the number of servings of fruits and vegetables consumed as reported in the dietary screener. The preliminary model for the usual intake of the average fruits and vegetables including white potatoes and starchy vegetables in boys (F-value=7.92, p-value<0.0001, df=(3, 326), R^2=0.0679) is shown in equation 16:

$$\text{Usual Intake} = -0.13 + (0.2)*(\text{Energy Intake}) + (0.17)*(\text{Age}) + (0.33)*(\text{Number of Servings Reported in Dietary Screener}), \tag{16}$$

where

SE(energy intake)=0.05, SE(age)=0.08, and SE(number of servings reported in dietary screener)=0.19.

A scatterplot of the predicted values versus the residuals of the model was used to evaluate that the linearity and independence assumptions were satisfied, and the Breusch-Pagan test indicated that residuals maintained constant variance (p-value=0.3711). Shapiro-Wilk tested for the normality of residuals and found residuals were not normally distributed (p-value=0.005). For this reason, outlier analysis was then performed by fitting a second model after outliers were identified and removed. After removing twenty outliers, the second model was fit to assess the influence. With outliers removed, the model for the usual intake of the average fruits and vegetables including white potatoes and starchy vegetables in boys (F-value=8.11, p-value<0.0001, df=(3, 306), R^2=0.0736) is shown in equation 17:

$$\text{Usual Intake} = -0.21 + (0.19)*(\text{Energy Intake}) + (0.2)*(\text{Age}) + (0.47)*(\text{Number of Servings Reported in the Dietary Screener}, \tag{17}$$

where

SE(energy intake)=0.06, SE(age)=0.08, and SE(number of servings reported in the dietary screener)=0.2.

Diagnostics were again investigated using a scatterplot of the predicted values versus the residuals and found linearity and independence were still satisfied. The Breusch-Pagan test reported that the residuals maintained constant variance (p-value=0.5554), and Shapiro-Wilk found that once outliers were removed the residuals were normally distributed (p-value=0.0633). Since the normality of residuals is only satisfied when outliers are removed the final model will not include outliers. Then the expected average increase in the usual intake of the average fruits and vegetables consumed including white potatoes and starchy vegetables in boys is 0.19 servings per day for every calorie increase in the average energy intake, while controlling for age and the number of servings of both fruits and vegetables as reported in the dietary screener. Additionally, our final model reports the mean of the standardized and transformed usual intake of the average fruits and vegetables including white potatoes and starchy vegetables in boys as -0.21 with a standard error of 0.11.

Another multiple linear regression was used in order to fit the usual intake of the average fruits and vegetables excluding white potatoes and starchy vegetables in boys. For this model the Box-Cox transformation parameters were found to be 0.25 for the number of servings of both fruits and vegetables consumed excluding white potatoes and starchy vegetables as reported from the average of the two 24-hour recalls, 0.01 for energy intake reported from the average of the two 24-hour recalls, -0.15 for children’s age, and 0.2 for the number of servings of fruits and vegetables consumed as reported in the dietary screener.

The preliminary model for the usual intake of the average fruits and vegetables excluding white potatoes and starchy vegetables in boys (F-value=8.02, p-value<0.0001, df=(3, 326), R^2=0.0687) is shown in equation 18:

$$\text{Usual Intake} = -0.2 + (0.2)*(\text{Energy Intake}) + (0.15)*(\text{Age}) + (0.48)*(\text{Number of Servings Reported in the Dietary Screener}), \quad (18)$$

where

SE(energy intake)=0.05, SE(age)=0.08, and SE(number of servings reported in the dietary screener)=0.21.

A scatterplot of the predicted values versus the residuals of the model indicated that linearity and independence assumptions were satisfied, and the Breusch-Pagan test reported that residuals maintained constant variance (p-value=0.2754). The Shapiro-Wilk test was used to diagnose the normality of residuals and found that the residuals were not normally distributed (p-value=0.0113). For this reason, an outlier analysis was performed by fitting a second model after identifying and removing all outliers. After removing twenty outliers, the model for the usual intake of the average fruits and vegetables excluding white potatoes and starchy vegetables in boys (F-value=7.78, p-value<0.0001, df=(3, 306), R^2=0.0708) is shown in equation 19:

$$\text{Usual Intake} = -0.29 + (0.18)*(\text{Energy Intake}) + (0.17)*(\text{Age}) + (0.58)*(\text{Number of Servings Reported in the Dietary Screener}), \quad (19)$$

where

SE(energy intake)=0.06, SE(age)=0.08, and SE(number of servings reported in the dietary screener)=0.21.

Diagnostics were again investigated using a scatterplot of the predicted values versus the residuals and found linearity and independence were still satisfied. The Shapiro-Wilk test for normality reported that the residuals were now normally distributed when outliers were removed from the model (p-value=0.1916), and the Breusch-Pagan test reported that the residuals still maintained constant variance (p-value=0.4203). Since residuals were only normally distributed when outliers were removed, the final model will not include outliers. Then the expected average increase in the usual intake of the average fruits and vegetables excluding white potatoes and starchy vegetables in boys is 0.18 servings per day for every calorie increase in the average energy intake, while controlling for age and the number of servings of both fruits and vegetables as reported in the dietary screener. Additionally, the final model reports the mean of the standardized and transformed usual intake of the average fruits and vegetables consumed excluding white potatoes and starchy vegetables in boys as -0.29 with a standard error of 0.12.

Average of Fruits and Vegetables Among Girls

Summary statistics of the dietary intake used for analysis of the average fruits and vegetables together, as reported from the average of the two 24-hour recalls, by girls in TX Sprouts are presented in Table 6. The summary statistics of the average of the two 24-hour recalls are reported separately for the consumption of fruits and vegetables including white potatoes and starchy vegetables, and excluding white potatoes and starchy vegetables.

For the multiple linear regression model to fit the usual intake of the average fruits and vegetables including white potatoes and starchy vegetables in girls, the Box-Cox transformation parameters found were 0.3 for the number of servings of both fruits and vegetables consumed including white potatoes and starchy vegetables as reported by the average of the two 24-hour recalls, -0.05 for the energy intake reported by the average of the two 24-hour recalls, and 0.1 for the number of servings of fruits and vegetables consumed reported in the dietary screener. The preliminary model for the usual intake of the average fruits and vegetables including white potatoes and starchy vegetables in girls (F-value=22.56, p-value<0.0001, df=(2, 396), R^2=0.1023) is shown in equation 20:

$$\text{Usual Intake} = -0.28 + (0.28)*(\text{Energy Intake}) + (0.64)*(\text{Number of Servings Reported in the Dietary Screener}), \tag{20}$$

where

SE(energy intake)=0.05, and SE(number of servings reported in the dietary screener)=0.23.

A scatterplot of the predicted values versus the residuals of the model was used to evaluate that the linearity and independence assumptions were satisfied, the Breusch-Pagan test reported that residuals maintain constant variance (p-value=0.1112), and the Shapiro-Wilk test reported that the residuals were normally distributed (p-value=0.2999). Outlier analysis was then performed by fitting a second model after identifying and removing twenty-three outliers. With outliers removed, the model for the usual intake of the average fruits and vegetables including white potatoes and starchy vegetables in girls (F-value=11.48, p-value<0.0001, df=(2, 373), R^2=0.0736) is shown in equation 21:

$$\text{Usual Intake} = -0.25 + (0.24)*(\text{Energy Intake}) + (0.59)*(\text{Number of Servings Reported in the Dietary Screener}), \tag{21}$$

where

SE(energy intake)=0.06, and SE(number of servings reported in the dietary screener)=0.24.

Another scatterplot of the predicted values versus the residuals was used to determine that linearity and independence were still satisfied. The Shapiro-Wilk test reported that the residuals were still normally distributed when outliers were removed from the model (p-value=0.4131), and the Breusch-Pagan test reported that the residuals had still maintained constant variance (p-value=0.0518). Since the coefficient of determination value was larger in the model with the outliers included, then the final model will include outliers. Then the expected average increase in the usual intake of the average fruits and vegetables including white potatoes and starchy vegetables in girls is 0.28 servings per day for every calorie increase in the average energy intake, while controlling for the number of servings of both fruits and vegetables as reported in the dietary screener. Additionally, our final model reports the mean of the standardized and transformed usual intake of the average fruits and vegetables consumed including white potatoes and starchy vegetables in girls as -0.28 with a standard error of 0.12.

Another multiple linear regression model was used in order to fit the usual intake of the average fruits and vegetables excluding white potatoes and starchy vegetables in girls. For this model the Box-Cox transformation parameters found were 0.3 for the number of servings of both fruits and vegetables consumed excluding white potatoes and starchy vegetables as reported by the average of the two 24-hour recalls, -0.05 for the energy intake reported by the average of the two 24-hour recalls, and 0.1 for the number of servings of fruits and vegetables consumed reported in the dietary screener. The preliminary model for the usual intake of the average fruits and vegetables including white potatoes and starchy vegetables in girls (F-value=20.97, p-value<0.0001, df=(2, 396), R^2=0.0958) is shown in equation 22:

$$\text{Usual Intake} = -0.36 + (0.25)*(\text{Energy Intake}) + (0.8)*(\text{Number of Servings Reported in the Dietary Screener}), \tag{22}$$

where

SE(energy intake)=0.05, and SE(number of servings reported in the dietary screener)=0.23.

A scatterplot of the predicted values versus the residuals of the model was used to confirm that the linearity and independence assumptions were satisfied, the Breusch-Pagan test reported that the residuals maintained constant variance (p-value=0.0753), and the Shapiro-Wilk test was used to determine that the residuals were normally distributed (p-value=0.6188). Outlier analysis was performed by fitting a second model after identifying and removing twenty-four outliers. With outliers removed, the usual intake of the average fruits and vegetables excluding white potatoes and starchy vegetables in girls (F-value=13.10, p-value<0.0001, df=(2, 373), R^2=0.065) is shown in equation 23:

$$\text{Usual Intake} = -0.38 + (0.22)*(\text{Energy Intake}) + (0.82)*(\text{Number of Servings Reported in the Dietary Screener}), \tag{23}$$

where

SE(energy intake)=0.06, and SE(number of servings reported in the dietary screener)=0.24.

Another scatterplot of the predicted values versus the residuals was used to determine that linearity and independence were still satisfied. The Shapiro-Wilk test again reported that the residuals were normally distributed when outliers were removed from the model (p-value=0.8721), and the Breusch-Pagan test also reported again that the residuals had still maintained constant variance (p-value=0.1150). Since the model including outliers had a stronger coefficient of determination value the final model will include outliers. Then the expected average increase in the usual intake of the average fruits and vegetables excluding white potatoes and starchy vegetables in girls is 0.25 servings per day for every calorie increase in the average energy intake, while controlling for the number of servings of both fruits and vegetables as reported in the dietary screener. Additionally, our final model reports the mean of the standardized and transformed usual intake of the average fruits and vegetables consumed excluding white potatoes and starchy vegetables in girls as -0.36 with a standard error of 0.12.

DISCUSSION

This study was able to estimate the usual intake of fruits and vegetables in children from TX Sprouts using a three-part method previously developed (Pérez, 2012). Our results showed that in our study population, fruits and vegetables were consumed frequently but in very small quantities. The three-part model was initially designed for episodically consumed foods; however, our results show that the model can also be used to estimate the usual intake in foods that are more frequently consumed as well.

The 2015-2020 Dietary Guidelines reported the recommended intake by age-sex groups. For boys aged nine to thirteen years old, the recommended intake per day was 2 to 3 cup equivalents of vegetables and 1.5 to 2 cup equivalents of fruits (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015). For boys in TX Sprouts we found the average usual intake of vegetables including white potatoes and starchy vegetables was 0.91 servings per day, and 0.79 servings per day of vegetables excluding white potatoes and starchy vegetables after controlling for age, BMI, and the number of servings as reported in the dietary screener. We also found for boys the average consumption was 0.74 servings per day of fruit after controlling for age, BMI, and the number of servings as reported in the dietary screener. For girls aged nine to thirteen years old, the recommended intake was 1.5 to 3 cup equivalents of vegetables and 1.5 to 2 cup equivalents of fruits (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015). We found for girls in TX Sprouts the average usual intake of vegetables was 0.94 servings per day including white potatoes and starchy vegetables and 0.82 servings per day of vegetables excluding white potatoes and starchy vegetables after controlling for age, BMI, and the number of servings as reported in the dietary screener. In girls, we also found the average consumption was 0.68 servings per day of fruit after controlling for age, BMI, and the number of servings as reported in the dietary screener. The average usual intake of fruits and vegetables in boys and girls from TX Sprouts was found to be much lower than the recommended daily intake.

From a secondary study of National health and Nutrition Examination Survey from 2007-2010, the total whole fruit and 100% fruit juice consumption in U.S. children and adults was analyzed (Drewnowski, 2015). The goal of the study was to estimate demographic and socioeconomic correlations of whole fruit consumption versus fruit juice consumption. There was a total of 16,628 children, adolescents, and adults over the age of four that were included for analysis. Data was obtained from two dietary recalls, the first of which all participants completed, and the second only 87% of the participants completed (Drewnowski, 2015). There were 3,612 participants aged four to thirteen, 1,834 participants aged fourteen to nineteen, 5,793 participants aged twenty to fifty years old, and 5,389 participants older than the age of fifty-one (Drewnowski, 2015). Episodic models from the National Cancer Institute Method were used in order to evaluate the usual intake distribution of total fruit. They found that the total fruit consumption for the entire study population had an average intake of 1.06 cups, and the average intake for children ages four to thirteen was 1.2 cups (Drewnowski, 2015). Additionally, men were found to have an average total fruit intake of 1.13 cups compared to an average fruit intake of 1 cup in women, and children aged four to thirteen had an average total fruit intake of 1.2 cups compared to an average total fruit intake of 1.06 cups in adolescents aged fourteen to nineteen years (Drewnowski, 2015). In comparison with Drewnowski's study, we found that girls in TX Sprouts on average consumed fewer fruits than boys, which could be contributed to the possibility that men also eat more than women on average. The average consumption of fruit in boys from TX Sprouts was 0.74 servings per day, and 0.68 servings per day in girls, which is much less than recommendations of 1.5 to 2 cup equivalents of fruit for both boys and girls per day set in the 2015-2020 Dietary Guidelines (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015). While the distribution of the usual intake of fruits may appear to be frequently consumed among our population, the number of servings consumed is not in high quantities and still do not meet daily fruit intake recommendations set by the 2015-2020 Dietary Guidelines (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2015).

In a study by the Center for Disease Control and Prevention (CDC), data obtained by a one-day dietary recall from the National Health and Nutrition Examination Surveys from 2003 to 2010 was analyzed (Kim, 2014). The goal of this study was to estimate trends of fruit and vegetable intake in cup-equivalents per 1,000 calories among 12,459 children ages two to eighteen years old by sex, age, race/ethnicity, family income to poverty ratio, and obesity status (Kim, 2014). Intakes were estimated by summing cup-equivalents consumed from each food group, dividing by the caloric intake, and then multiplying by 1,000 so that the mean intakes were calculated overall by sex, age groups (two to five, six to eleven, and twelve to thirteen years), race/ethnicity, family income to poverty ratio, and obesity status (Kim, 2014). This study found that females consumed more vegetables than males with an average intake of 0.56 compared to 0.52 cup-equivalents per 1,000 calories, and that children six to eleven years of age consumed an average of 0.55 cup-equivalents per 1,000 calories of vegetables (Kim, 2014). In comparison to Kim's study, we also found that girls on average had consumed more vegetables than boys. We found that in boys from TX Sprouts after controlling for age, BMI, and the number of servings as reported in the dietary screener the average consumption was 0.91 servings per day of vegetables including white potatoes and starchy vegetables, and 0.79 servings per day of vegetables excluding white potatoes and starchy vegetables. After controlling for age, BMI, and the number of servings as reported in the dietary screener, we found for girls an average consumption of 0.94 servings per day of vegetables including white potatoes and starchy vegetables, and 0.82 servings per day of vegetables excluding white potatoes and starchy vegetables.

A separate study was designed to estimate the usual intake and distribution of dietary foods in a Mexican population by utilizing a two-part method known as the National Cancer Institute (NCI) Method for episodically consumed foods (Batis, 2016). There were 7,983 total participants older than age of five included for analysis from a nationally representative Mexican National Health and Nutrition Survey in 2020. Of the total population 2,753 were age five to eleven years old (Batis, 2016). Measurements were obtained through one 24-hour recall and a repeat 24-hour recall in 9% of the population. Fruits and vegetables together excluding potatoes were included as one of the food groups, and the percentage of participants with intakes as well as the distribution of the intakes including the median, 25th and 75th percentiles were reported. Of the entire population, 94.9% of the population reported that they had consumed fruits and vegetables, and the median estimate of fruits and vegetables reported from the NCI method was 198 grams per day in girls, and 203 grams per day in boys (Batis, 2016). The study also reported, from the NCI method incorporating the 24-hour recalls, the median intake of fruits and vegetables among boys was 8.97 grams per day higher than among girls (Batis, 2016). In our current study, from the first 24-hour recall we found that 93.13% of boys and 93.53% of girls from TX Sprouts had consumed fruits and vegetables excluding white potatoes and starchy vegetables compared to 89.55% of boys and 94.03% of girls at the second recall. Additionally, in boys after controlling for age, BMI, and the number of servings reported in the dietary screener, the average consumption of both fruits and vegetables including white potatoes and starchy vegetables was 1.41 servings per day, and 1.3 servings per day of both fruits and vegetables excluding white potatoes and starchy vegetables. In girls, after controlling for age, BMI, and the number of servings reported in the dietary screener, the average consumption of both fruits and vegetables including white potatoes and starchy vegetables was 1.36 servings per day, and 1.24 servings per day of both fruits and vegetables excluding white potatoes and starchy vegetables.

A secondary analysis was performed by implementing the NCI method with data collected from a 2001-2004 NHANES (Krebs-Smith, 2010). The aim of this study was to determine the percentage of the population, and subgroups of the population, who do not meet dietary recommendations set by the 2005 Dietary Guidelines for Americans (Krebs-

Smith, 2010). Total fruits and total vegetables, measured in cup-equivalents, were included as food groups to be analyzed. Data was obtained from 16,338 participants, 7,295 of which responded to two 24-hour recalls and 9,043 participants responded to only one 24-hour recall (Krebs-Smith, 2010). Covariates in the models included poverty income ratio, a weekend/weekday effect, race/ethnicity, sex, and age (Krebs-Smith, 2010). The intake values were assessed to determine if any outliers present would create an undue influence. The values were Box-Cox transformed and outliers were identified as values below the 25th percentile minus 2.5 multiples of the interquartile range of the transformed values, and values above the 75th percentile plus 2.5 multiples of the interquartile range of the transformed values (Krebs-Smith, 2010). After fitting preliminary models, the study found that by excluding the extreme values their results did not change, so no exclusions or corrections to the final models were nescessary. The Krebs-Smith study found that 31.5% of 1,010 boys age nine to thirteen, and 80.6% of 1,067 girls age nine to thirteen have total fruit intake below daily recommendations (Krebs-Smith, 2010). The study also found that 96.2% of 1,010 boys age nine to thirteen, and 94.6% of 1,067 girls age nine to thirteen have total fruit intake below daily recommendations (Krebs-Smith, 2010). In our current study, the final models for the usual intake of the average fruits and vegetables in boys, both including and excluding white potatoes and starchy vegetables, did improve once outliers were removed since the residuals became normally distributed. On the other hand, the final models for the usual intake of the average fruits and vegetables together in girls, including and excluding white potatoes and starchy vegetables, did include extreme values since the models did not improve with the removal of outliers based on the R-square, and F statistics.

Limitations

The average intake of fruits and vegetables was not episodically consumed but frequently consumed among the children from TX Sprouts. However, the number of servings consumed per day in our population of children is low. In our study, we totaled all fruits and vegetables together instead of focusing on a specific food item such as pomegranates or asparagus. However, in Pérez's study, only the whole grain consumption was analyzed (Pérez, 2012). The sample size of TX Sprouts is also smaller than most studies performed in the past, since the data was only collected from certain elementary schools in Austin, Texas. Previous studies included participants from across the nation which lead to a greater diversity of study subjects and larger sample sizes.

CONCLUSION

We were successful in using the three-part model to estimate the usual intake of fruits alone, vegetables alone, and both fruits and vegetables together in this sample of children ages seven to thirteen from Austin, Texas. The three-part model has previously been used only in adults, and to our knowledge has not been implemented in children. Our research shows the fruits and vegetables were frequently consumed among boys and girls from TX Sprouts, but in small quantities. The average of the two 24-hour recalls of the usual intake controlling for energy, age, and the number of servings reported in the dietary screener report averages much lower than the three-part model. Future studies could examine specific fruits and vegetables, as opposed to the total number of servings of fruits and vegetables, to obtain the specific usual intakes in children.

APPENDICES

Appendix A. Full Summary Statistics of Bayesian Estimates from Three-Part Model

Table 10. Summary Statistics for Usual Intake of Fruit Alone

	Estimates of Posterior Density		
Percentiles	**Usual Food Intake**	**Usual Food Intake per 1000 Calories**	**Energy Usual Intake**
Boys (n=335)			
Mean	0.738181	545.6258	1.477047
S.d.	0.555908	477.2412	0.273179
5th	0.242175	130.737	1.061602
10th	0.297476	168.5388	1.12197
25th	0.397058	252.6461	1.304532
50th	0.567216	391.0549	1.46755
75th	0.889377	647.5606	1.616569
90th	1.389061	1040.436	1.808681
95th	1.848197	1443.864	1.922365
Girls (n=402)			
Mean	0.683675	472.1516	1.432966
S.d.	0.303323	183.2015	0.184314
5th	0.36101	281.4975	1.131555
10th	0.399218	300.357	1.194045
25th	0.47522	346.132	1.314647
50th	0.603328	433.3454	1.428889
75th	0.78031	546.3743	1.534908
90th	1.126467	733.8014	1.669971
95th	1.349389	853.1804	1.720397

Table 11. Summary Statistics for Boys Usual Intake of Vegetables Alone (n=335)

	Estimates of Posterior Density		
Percentiles	**Usual Food Intake**	**Usual Food Intake per 1000 Calories**	**Energy Usual Intake**
Vegetables Including White Potatoes and Starchy Vegetables			
Mean	0.910166	617.8025	1.477682
S.d.	0.454443	281.2546	0.270843
5th	0.307901	232.651	1.042064
10th	0.425529	291.0329	1.143253

25th	0.572881	396.7752	1.305119
50th	0.826817	596.1003	1.47964
75th	1.17221	773.555	1.632284
90th	1.535259	1004.516	1.796232
95th	1.704956	1116.288	1.941129
Vegetables Excluding White Potatoes and Starchy Vegetables			
Mean	0.788795	529.3562	1.478516
S.d.	0.364821	207.7934	0.269099
5th	0.321044	215.8802	1.055353
10th	0.385262	279.0846	1.14973
25th	0.530429	379.9266	1.300743
50th	0.71588	500.6049	1.472359
75th	1.025677	665.2498	1.6329
90th	1.253648	803.3642	1.778193
95th	1.391497	885.7394	1.956592

Table 12. Summary Statistics for Girls Usual Intake of Vegetables Alone (n=402)

	Estimates of Posterior Density		
Percentiles	**Usual Food Intake**	**Usual Food Intake per 1000 Calories**	**Energy Usual Intake**
Vegetables Including White Potatoes and Starchy Vegetables			
Mean	0.935103	663.1632	1.431644
S.d.	0.264877	200.6181	0.188776
5th	0.486162	311.1	1.099653
10th	0.545579	387.0472	1.188272
25th	0.788479	540.943	1.320069
50th	0.917134	665.2947	1.422977
75th	1.090149	781.319	1.54785
90th	1.27212	915.8957	1.656367
95th	1.406551	992.7938	1.758506
Vegetables Excluding White Potatoes and Starchy Vegetables			
Mean	0.820005	582.9486	1.433162
S.d.	0.265684	206.2589	0.188084
5th	0.454094	291.8688	1.105916
10th	0.511236	329.372	1.190138
25th	0.617603	439.4135	1.324539
50th	0.790875	566.3644	1.423861
75th	0.998197	700.4648	1.546907
90th	1.19015	859.0371	1.646394

95th	1.288246	955.0886	1.736118

Table 13. Summary Statistics for Boys Usual Intake of Fruits and Vegetables (n=335)

	Estimates of Posterior Density		
Percentiles	**Usual Food Intake**	**Usual Food Intake per 1000 Calories**	**Energy Usual Intake**
Fruits and Vegetables Including White Potatoes and Starchy Vegetables			
Mean	1.411344	995.7436	1.477813
S.d.	0.782308	591.0047	0.275091
5th	0.376678	227.408	1.045035
10th	0.497795	304.1689	1.13802
25th	0.84783	562.2555	1.278518
50th	1.293682	911.2063	1.480057
75th	1.841684	1277.999	1.641779
90th	2.438653	1790.169	1.798315
95th	2.77594	2138.729	1.934988
Fruits and Vegetables Excluding White Potatoes and Starchy Vegetables			
Mean	1.295788	904.29	1.477255
S.d.	0.739975	532.2952	0.272581
5th	0.361537	219.1433	1.052494
10th	0.46333	312.6085	1.137113
25th	0.760159	525.9083	1.278359
50th	1.184332	800.2658	1.480271
75th	1.710876	1167.5	1.633035
90th	2.22217	1642.907	1.778181
95th	2.512341	1940.999	1.928652

Table 14. Summary Statistics for Girls Usual Intake of Fruits and Vegetables (n=402)

	Estimates of Posterior Density		
Percentiles	**Usual Food Intake**	**Usual Food Intake per 1000 Calories**	**Energy Usual Intake**
Fruits and Vegetables Including White Potatoes and Starchy Vegetables			
Mean	1.35767	939.3561	1.432917
S.d.	0.521593	316.5182	0.180073
5th	0.645496	464.2845	1.117057
10th	0.731072	543.0371	1.212378
25th	0.979724	725.9143	1.316362
50th	1.270896	913.3995	1.427795

75th	1.686999	1133.066	1.544042
90th	2.062009	1334.544	1.643159
95th	2.284098	1479.543	1.738488
Fruits and Vegetables Excluding White Potatoes and Starchy Vegetables			
Mean	1.240484	862.3323	1.432806
S.d.	0.4794	303.1504	0.180679
5th	0.550779	401.6135	1.123092
10th	0.659308	494.5094	1.203909
25th	0.892635	668.392	1.322055
50th	1.165702	845.0801	1.425529
75th	1.523324	1054.68	1.54306
90th	1.883629	1246.308	1.650091
95th	2.099886	1384.013	1.740399

Appendix B. Posterior Means from Three-Part Model

Table 15. Posterior Means for Boys Usual Intake of Fruits Alone (n=335)

			Percentiles				
Standardized and Transformed Variables	**Mean**	**S.d.**	**2.5%**	**25%**	**50%**	**75%**	**97.5%**
Intercept at Consumption	0.1	0.06	-0.02	0.06	0.1	0.14	0.22
Intercept at Consumption Level Given Consumption	-0.1	0.1	-0.3	-0.17	-0.11	-0.03	0.09
Intercept at Energy Intake Level	0	0.06	-0.12	-0.04	0	0.04	0.13
Age at Consumption	0.08	0.06	-0.04	0.04	0.08	0.13	0.21
BMI at Consumption	-0.08	0.07	-0.21	-0.12	-0.08	-0.04	0.05
Number of Servings Reported in Dietary Screener at Consumption	0.1	0.07	-0.03	0.06	0.11	0.15	0.23
Age at Consumption Level Given Consumption	0.01	0.08	-0.14	-0.04	0.01	0.06	0.16
BMI at Consumption Level Given Consumption	-0.06	0.08	-0.22	-0.11	-0.06	-0.01	0.09
Number of Servings Reported in Dietary Screener at Consumption Level Given Consumption	0.19	0.08	0.03	0.14	0.19	0.24	0.35
Age at Energy Intake Level	0.12	0.06	0	0.08	0.12	0.17	0.25
BMI at Energy Intake Level	-0.1	0.07	-0.23	-0.15	-0.1	-0.06	0.03

Number of Servings Reported in Dietary Screener at Energy Intake Level	-0.11	0.06	-0.24	-0.16	-0.11	-0.07	0.01
(1,1) estimate of within person random effects inverse matrix Σ_u^{-1}	4.89	3.01	1.45	2.8	4.05	6.08	12.92
(1,2) estimate of within person random effects inverse matrix Σ_u^{-1}	-2.01	2.23	-8.25	-2.77	-1.4	-0.54	0.5
(1,3) estimate of within person random effects inverse matrix Σ_u^{-1}	-0.31	1.07	-3.07	-0.6	-0.14	0.25	1.11
(2,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-2.01	2.23	-8.25	-2.77	-1.4	-0.54	0.5
(2,2) estimate of within person random effects inverse matrix Σ_u^{-1}	3.42	2.1	1.44	2.08	2.71	4.08	9.5
(2,3) estimate of within person random effects inverse matrix Σ_u^{-1}	0.79	1.07	-0.37	0.2	0.53	1.06	3.55
(3,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-0.31	1.07	-3.07	-0.6	-0.14	0.25	1.11
(3,2) estimate of within person random effects inverse matrix Σ_u^{-1}	0.79	1.07	-0.37	0.2	0.53	1.06	3.55
(3,3) estimate of within person random effects inverse matrix Σ_u^{-1}	1.83	0.75	1.14	1.42	1.65	1.98	3.73
(1,1) estimate of within person random effects variance-covariance matrix Σ_u	0.38	0.16	0.15	0.27	0.36	0.47	0.78
(1,2) estimate of within person random effects variance-covariance matrix Σ_u	0.18	0.13	-0.07	0.1	0.18	0.26	0.44
(1,3) estimate of within person random effects variance-covariance matrix Σ_u	-0.03	0.08	-0.18	-0.08	-0.03	0.02	0.13
(2,1) estimate of within person random effects variance-covariance matrix Σ_u	0.18	0.13	-0.07	0.1	0.18	0.26	0.44
(2,2) estimate of within person random effects variance-covariance matrix Σ_u	0.55	0.16	0.27	0.44	0.54	0.65	0.88
(2,3) estimate of within person random effects variance-covariance matrix Σ_u	-0.15	0.11	-0.36	-0.22	-0.15	-0.07	0.08
(3,1) estimate of within person random effects variance-covariance matrix Σ_u	-0.03	0.08	-0.18	-0.08	-0.03	0.02	0.13
(3,2) estimate of within person random effects variance-covariance matrix Σ_u	-0.15	0.11	-0.36	-0.22	-0.15	-0.07	0.08
(3,3) estimate of within person random effects variance-covariance matrix Σ_u	0.7	0.12	0.49	0.62	0.7	0.78	0.94

Constraint γ estimate in variance-covariance matrix of random errors Σ_ϵ	0.37	0.08	0.21	0.32	0.38	0.43	0.53
Constraint θ estimate in variance-covariance matrix of random errors Σ_ϵ	1.08	0.22	0.63	0.95	1.09	1.22	1.5
(1,3) estimate of day-to-day variation matrix Σ_ϵ	0.19	0.08	0.03	0.13	0.19	0.24	0.34
(2,2) estimate of day-to-day variation matrix Σ_ϵ	1.17	0.16	0.89	1.05	1.15	1.27	1.5
(2,3) estimate of day-to-day variation matrix Σ_ϵ	0.4	0.12	0.16	0.32	0.39	0.47	0.63
(3,1) estimate of day-to-day variation matrix Σ_ϵ	0.19	0.08	0.03	0.13	0.19	0.24	0.34
(3,2) estimate of day-to-day variation matrix Σ_ϵ	0.4	0.12	0.16	0.32	0.39	0.47	0.63
(3,3) estimate of day-to-day variation matrix Σ_ϵ	1.27	0.1	1.09	1.2	1.26	1.34	1.47
(1,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	1.04	0.03	1	1.02	1.03	1.06	1.11
(1,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.06	0.03	0.01	0.04	0.06	0.08	0.14
(1,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.18	0.08	-0.33	-0.23	-0.17	-0.12	-0.03
(2,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.06	0.03	0.01	0.04	0.06	0.08	0.14
(2,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.99	0.14	0.75	0.89	0.99	1.08	1.28
(2,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.32	0.11	-0.54	-0.39	-0.32	-0.25	-0.12
(3,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.18	0.08	-0.33	-0.23	-0.17	-0.12	-0.03
(3,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.32	0.11	-0.54	-0.39	-0.32	-0.25	-0.12
(3,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.93	0.09	0.77	0.87	0.93	0.99	1.13

Table 16. Posterior Means for Girls Usual Intake of Fruits Alone (n=402)

			Percentiles				
Standardized and Transformed Variables	**Mean**	**S.d.**	**2.5%**	**25%**	**50%**	**75%**	**97.5%**
Intercept at Consumption	0.21	0.06	0.1	0.17	0.2	0.24	0.32
Intercept at Consumption Level Given Consumption	-0.06	0.08	-0.21	-0.11	-0.06	-0.01	0.08
Intercept at Energy Intake Level	0	0.05	-0.11	-0.04	0	0.03	0.11
Age at Consumption	-0.06	0.06	-0.17	-0.1	-0.06	-0.02	0.06
BMI at Consumption	-0.05	0.06	-0.16	-0.08	-0.05	-0.01	0.07

Number of Servings Reported in Dietary Screener at Consumption	0.14	0.06	0.04	0.1	0.14	0.18	0.25
Age at Consumption Level Given Consumption	-0.04	0.06	-0.17	-0.08	-0.04	0	0.09
BMI at Consumption Level Given Consumption	-0.06	0.06	-0.18	-0.1	-0.06	-0.02	0.07
Number of Servings Reported in Dietary Screener at Consumption Level Given Consumption	0.04	0.06	-0.08	-0.01	0.04	0.08	0.16
Age at Energy Intake Level	0.07	0.06	-0.03	0.04	0.07	0.11	0.19
BMI at Energy Intake Level	-0.15	0.05	-0.26	-0.19	-0.15	-0.11	-0.04
Number of Servings Reported in Dietary Screener at Energy Intake Level	0.03	0.06	-0.08	-0.01	0.03	0.07	0.13
(1,1) estimate of within person random effects inverse matrix Σ_u^{-1}	8.05	3.93	2.73	5.09	7.38	10.03	17.35
(1,2) estimate of within person random effects inverse matrix Σ_u^{-1}	-4.85	3.03	-11.99	-6.5	-4.31	-2.66	-0.42
(1,3) estimate of within person random effects inverse matrix Σ_u^{-1}	-1.8	2.39	-7.8	-2.76	-1.37	-0.51	2.67
(2,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-4.85	3.03	-11.99	-6.5	-4.31	-2.66	-0.42
(2,2) estimate of within person random effects inverse matrix Σ_u^{-1}	7.7	3.7	2.99	4.94	6.83	9.63	17.64
(2,3) estimate of within person random effects inverse matrix Σ_u^{-1}	-0.26	2.06	-5.55	-1.19	-0.1	0.89	3.66
(3,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-1.8	2.39	-7.8	-2.76	-1.37	-0.51	2.67
(3,2) estimate of within person random effects inverse matrix Σ_u^{-1}	-0.26	2.06	-5.55	-1.19	-0.1	0.89	3.66
(3,3) estimate of within person random effects inverse matrix Σ_u^{-1}	3.72	1.71	1.84	2.54	3.22	4.33	8.3
(1,1) estimate of within person random effects variance-covariance matrix Σ_u	0.34	0.12	0.16	0.25	0.32	0.41	0.6
(1,2) estimate of within person random effects variance-covariance matrix Σ_u	0.2	0.09	0.04	0.14	0.2	0.26	0.39
(1,3) estimate of within person random effects variance-covariance matrix Σ_u	0.15	0.07	0.01	0.1	0.15	0.21	0.3
(2,1) estimate of within person random effects variance-covariance matrix Σ_u	0.2	0.09	0.04	0.14	0.2	0.26	0.39
(2,2) estimate of within person random effects variance-covariance matrix Σ_u	0.32	0.11	0.13	0.24	0.31	0.38	0.55

(2,3) estimate of within person random effects variance-covariance matrix Σ_u	0.1	0.08	-0.07	0.05	0.1	0.16	0.25
(3,1) estimate of within person random effects variance-covariance matrix Σ_u	0.15	0.07	0.01	0.1	0.15	0.21	0.3
(3,2) estimate of within person random effects variance-covariance matrix Σ_u	0.1	0.08	-0.07	0.05	0.1	0.16	0.25
(3,3) estimate of within person random effects variance-covariance matrix Σ_u	0.44	0.11	0.25	0.37	0.44	0.51	0.67
Constraint γ estimate in variance-covariance matrix of random errors Σ_ϵ	0	0.1	-0.18	-0.07	0.01	0.07	0.2
Constraint θ estimate in variance-covariance matrix of random errors Σ_ϵ	0.12	1.82	-2.99	-1.28	0.17	1.69	2.99
(1,3) estimate of day-to-day variation matrix Σ_ϵ	0.07	0.08	-0.05	0.01	0.05	0.12	0.24
(2,2) estimate of day-to-day variation matrix Σ_ϵ	1.32	0.13	1.08	1.24	1.31	1.4	1.57
(2,3) estimate of day-to-day variation matrix Σ_ϵ	0	0.08	-0.17	-0.04	0	0.05	0.18
(3,1) estimate of day-to-day variation matrix Σ_ϵ	0.07	0.08	-0.05	0.01	0.05	0.12	0.24
(3,2) estimate of day-to-day variation matrix Σ_ϵ	0	0.08	-0.17	-0.04	0	0.05	0.18
(3,3) estimate of day-to-day variation matrix Σ_ϵ	1.55	0.12	1.33	1.47	1.55	1.63	1.79
(1,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	1.01	0.01	1	1	1	1.01	1.04
(1,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0	0	-0.01	0	0	0	0.01
(1,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.04	0.05	-0.16	-0.08	-0.03	0	0.03
(2,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0	0	-0.01	0	0	0	0.01
(2,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.77	0.07	0.64	0.72	0.76	0.81	0.93
(2,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0	0.04	-0.08	-0.02	0	0.02	0.08
(3,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.04	0.05	-0.16	-0.08	-0.03	0	0.03
(3,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0	0.04	-0.08	-0.02	0	0.02	0.08
(3,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.66	0.05	0.56	0.62	0.65	0.69	0.76

Table 17. Posterior Means for Boys Usual Intake of Vegetables Including White Potatoes and Starchy Vegetables (n=335)

	Percentiles						
Standardized and Transformed Variables	**Mean**	**S.d.**	**2.5%**	**25%**	**50%**	**75%**	**97.5%**
Intercept at Consumption	1.27	0.1	1.1	1.2	1.26	1.33	1.48
Intercept at Consumption Level Given Consumption	-0.01	0.06	-0.13	-0.05	-0.01	0.03	0.11
Intercept at Energy Intake Level	0	0.07	-0.13	-0.05	0	0.05	0.13
Age at Consumption	0.02	0.08	-0.13	-0.03	0.02	0.07	0.16
BMI at Consumption	-0.02	0.07	-0.17	-0.07	-0.01	0.04	0.12
Number of Servings Reported in Dietary Screener at Consumption	0.11	0.07	-0.03	0.06	0.11	0.15	0.25
Age at Consumption Level Given Consumption	0.12	0.06	0.01	0.08	0.12	0.16	0.24
BMI at Consumption Level Given Consumption	-0.07	0.06	-0.19	-0.11	-0.07	-0.03	0.05
Number of Servings Reported in Dietary Screener at Consumption Level Given Consumption	0.14	0.06	0.02	0.1	0.14	0.18	0.26
Age at Energy Intake Level	0.13	0.07	0	0.09	0.13	0.17	0.26
BMI at Energy Intake Level	-0.07	0.06	-0.19	-0.11	-0.06	-0.03	0.06
Number of Servings Reported in Dietary Screener at Energy Intake Level	-0.12	0.06	-0.24	-0.16	-0.12	-0.08	0
(1,1) estimate of within person random effects inverse matrix Σ_u^{-1}	8.46	4.6	2.35	5.11	7.46	10.69	19.44
(1,2) estimate of within person random effects inverse matrix Σ_u^{-1}	-5.12	3.5	-13.97	-6.9	-4.47	-2.6	-0.32
(1,3) estimate of within person random effects inverse matrix Σ_u^{-1}	-0.24	1.41	-3.3	-0.91	-0.19	0.55	2.51
(2,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-5.12	3.5	-13.97	-6.9	-4.47	-2.6	-0.32
(2,2) estimate of within person random effects inverse matrix Σ_u^{-1}	7.92	3.99	3.14	5	7	9.89	18.12
(2,3) estimate of within person random effects inverse matrix Σ_u^{-1}	-0.87	1.26	-3.99	-1.46	-0.69	-0.15	1.29
(3,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-0.24	1.41	-3.3	-0.91	-0.19	0.55	2.51
(3,2) estimate of within person random effects inverse matrix Σ_u^{-1}	-0.87	1.26	-3.99	-1.46	-0.69	-0.15	1.29
(3,3) estimate of within person random effects inverse matrix Σ_u^{-1}	1.85	0.53	1.25	1.5	1.74	2.03	3.16
(1,1) estimate of within person random effects variance-covariance matrix Σ_u	0.31	0.15	0.11	0.19	0.27	0.39	0.65

(1,2) estimate of within person random effects variance-covariance matrix Σ_u	0.19	0.09	0.03	0.12	0.17	0.25	0.4
(1,3) estimate of within person random effects variance-covariance matrix Σ_u	0.11	0.1	-0.07	0.04	0.11	0.17	0.31
(2,1) estimate of within person random effects variance-covariance matrix Σ_u	0.19	0.09	0.03	0.12	0.17	0.25	0.4
(2,2) estimate of within person random effects variance-covariance matrix Σ_u	0.31	0.1	0.15	0.24	0.3	0.38	0.52
(2,3) estimate of within person random effects variance-covariance matrix Σ_u	0.15	0.08	0	0.1	0.15	0.2	0.3
(3,1) estimate of within person random effects variance-covariance matrix Σ_u	0.11	0.1	-0.07	0.04	0.11	0.17	0.31
(3,2) estimate of within person random effects variance-covariance matrix Σ_u	0.15	0.08	0	0.1	0.15	0.2	0.3
(3,3) estimate of within person random effects variance-covariance matrix Σ_u	0.72	0.12	0.5	0.64	0.72	0.8	0.97
Constraint γ estimate in variance-covariance matrix of random errors Σ_ϵ	0.34	0.08	0.2	0.29	0.34	0.39	0.5
Constraint θ estimate in variance-covariance matrix of random errors Σ_ϵ	0.76	0.22	0.38	0.61	0.74	0.89	1.22
(1,3) estimate of day-to-day variation matrix Σ_ϵ	0.28	0.1	0.09	0.21	0.27	0.34	0.49
(2,2) estimate of day-to-day variation matrix Σ_ϵ	1.54	0.13	1.31	1.46	1.53	1.62	1.8
(2,3) estimate of day-to-day variation matrix Σ_ϵ	0.31	0.08	0.16	0.26	0.31	0.37	0.49
(3,1) estimate of day-to-day variation matrix Σ_ϵ	0.28	0.1	0.09	0.21	0.27	0.34	0.49
(3,2) estimate of day-to-day variation matrix Σ_ϵ	0.31	0.08	0.16	0.26	0.31	0.37	0.49
(3,3) estimate of day-to-day variation matrix Σ_ϵ	1.26	0.1	1.07	1.19	1.25	1.32	1.46
(1,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	1.08	0.06	1.01	1.04	1.07	1.11	1.24
(1,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.05	0.03	0.01	0.03	0.05	0.07	0.12
(1,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.26	0.11	-0.49	-0.32	-0.25	-0.18	-0.08
(2,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.05	0.03	0.01	0.03	0.05	0.07	0.12

(2,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.69	0.06	0.59	0.65	0.69	0.73	0.82
(2,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.19	0.05	-0.3	-0.22	-0.19	-0.15	-0.09
(3,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.26	0.11	-0.49	-0.32	-0.25	-0.18	-0.08
(3,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.19	0.05	-0.3	-0.22	-0.19	-0.15	-0.09
(3,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.91	0.09	0.77	0.85	0.91	0.97	1.1

Table 18. Posterior Means for Boys Usual Intake of Vegetables Excluding White Potatoes and Starchy Vegetables (n=335)

	Percentiles						
Standardized and Transformed Variables	**Mean**	**S.d.**	**2.5%**	**25%**	**50%**	**75%**	**97.5%**
Intercept at Consumption	1.17	0.09	1.01	1.11	1.17	1.23	1.37
Intercept at Consumption Level Given Consumption	-0.02	0.06	-0.14	-0.06	-0.02	0.02	0.11
Intercept at Energy Intake Level	0	0.06	-0.12	-0.04	0	0.04	0.12
Age at Consumption	0.04	0.07	-0.1	-0.01	0.04	0.09	0.18
BMI at Consumption	-0.06	0.07	-0.21	-0.11	-0.06	-0.01	0.07
Number of Servings Reported in Dietary Screener at Consumption	0.14	0.07	0.01	0.09	0.14	0.19	0.28
Age at Consumption Level Given Consumption	0.1	0.06	-0.02	0.06	0.1	0.14	0.22
BMI at Consumption Level Given Consumption	-0.02	0.06	-0.14	-0.06	-0.02	0.02	0.1
Number of Servings Reported in Dietary Screener at Consumption Level Given Consumption	0.16	0.06	0.05	0.12	0.16	0.21	0.28
Age at Energy Intake Level	0.12	0.06	0	0.08	0.12	0.16	0.24
BMI at Energy Intake Level	-0.07	0.06	-0.19	-0.11	-0.07	-0.03	0.06
Number of Servings Reported in Dietary Screener at Energy Intake Level	-0.06	0.06	-0.18	-0.1	-0.06	-0.02	0.07
(1,1) estimate of within person random effects inverse matrix Σ_u^{-1}	8.45	4.18	2.57	5.51	7.68	10.47	19.48
(1,2) estimate of within person random effects inverse matrix Σ_u^{-1}	-4.72	3.06	-11.32	-6.68	-4.41	-2.47	0.21
(1,3) estimate of within person random effects inverse matrix Σ_u^{-1}	-1.01	1.77	-5.28	-1.77	-0.71	0.08	1.7
(2,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-4.72	3.06	-11.32	-6.68	-4.41	-2.47	0.21
(2,2) estimate of within person random effects inverse matrix Σ_u^{-1}	8.79	3.79	3.74	5.98	8.02	10.91	18.52

(2,3) estimate of within person random effects inverse matrix Σ_u^{-1}	-1.01	1.48	-4.26	-1.75	-0.87	-0.12	1.68
(3,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-1.01	1.77	-5.28	-1.77	-0.71	0.08	1.7
(3,2) estimate of within person random effects inverse matrix Σ_u^{-1}	-1.01	1.48	-4.26	-1.75	-0.87	-0.12	1.68
(3,3) estimate of within person random effects inverse matrix Σ_u^{-1}	2.2	0.83	1.29	1.66	1.97	2.52	4.43
(1,1) estimate of within person random effects variance-covariance matrix Σ_u	0.3	0.14	0.11	0.2	0.27	0.37	0.66
(1,2) estimate of within person random effects variance-covariance matrix Σ_u	0.17	0.09	0.01	0.11	0.16	0.22	0.38
(1,3) estimate of within person random effects variance-covariance matrix Σ_u	0.18	0.1	-0.01	0.1	0.18	0.25	0.38
(2,1) estimate of within person random effects variance-covariance matrix Σ_u	0.17	0.09	0.01	0.11	0.16	0.22	0.38
(2,2) estimate of within person random effects variance-covariance matrix Σ_u	0.26	0.08	0.13	0.2	0.26	0.32	0.46
(2,3) estimate of within person random effects variance-covariance matrix Σ_u	0.17	0.08	0.02	0.12	0.17	0.23	0.33
(3,1) estimate of within person random effects variance-covariance matrix Σ_u	0.18	0.1	-0.01	0.1	0.18	0.25	0.38
(3,2) estimate of within person random effects variance-covariance matrix Σ_u	0.17	0.08	0.02	0.12	0.17	0.23	0.33
(3,3) estimate of within person random effects variance-covariance matrix Σ_u	0.72	0.12	0.48	0.64	0.72	0.79	0.96
Constraint γ estimate in variance-covariance matrix of random errors Σ_ϵ	-0.03	0.24	-0.35	-0.24	-0.16	0.22	0.35
Constraint θ estimate in variance-covariance matrix of random errors Σ_ϵ	-0.89	1.57	-2.78	-2.27	-1.75	0.79	1.58
(1,3) estimate of day-to-day variation matrix Σ_ϵ	0.15	0.1	-0.03	0.08	0.15	0.22	0.36
(2,2) estimate of day-to-day variation matrix Σ_ϵ	1.6	0.12	1.38	1.51	1.6	1.68	1.84
(2,3) estimate of day-to-day variation matrix Σ_ϵ	0.24	0.08	0.08	0.19	0.24	0.3	0.41
(3,1) estimate of day-to-day variation matrix Σ_ϵ	0.15	0.1	-0.03	0.08	0.15	0.22	0.36

(3,2) estimate of day-to-day variation matrix Σ_ϵ	0.24	0.08	0.08	0.19	0.24	0.3	0.41
(3,3) estimate of day-to-day variation matrix Σ_ϵ	1.27	0.11	1.08	1.19	1.26	1.34	1.5
(1,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	1.03	0.03	1	1	1.02	1.04	1.12
(1,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.02	0.02	0	0.01	0.02	0.03	0.06
(1,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.13	0.09	-0.33	-0.19	-0.13	-0.07	0.02
(2,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.02	0.02	0	0.01	0.02	0.03	0.06
(2,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.65	0.05	0.56	0.62	0.65	0.68	0.75
(2,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.13	0.05	-0.22	-0.16	-0.13	-0.1	-0.04
(3,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.13	0.09	-0.33	-0.19	-0.13	-0.07	0.02
(3,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.13	0.05	-0.22	-0.16	-0.13	-0.1	-0.04
(3,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.84	0.08	0.7	0.79	0.84	0.9	1

Table 19. Posterior Means for Girls Usual Intake of Vegetables Including White Potatoes and Starchy Vegetables (n=402)

	Percentiles						
Standardized and Transformed Variables	**Mean**	**S.d.**	**2.5%**	**25%**	**50%**	**75%**	**97.5%**
Intercept at Consumption	1.37	0.09	1.21	1.3	1.36	1.43	1.56
Intercept at Consumption Level Given Consumption	0.01	0.05	-0.1	-0.03	0.01	0.04	0.12
Intercept at Energy Intake Level	0	0.06	-0.11	-0.04	-0.01	0.03	0.11
Age at Consumption	-0.03	0.07	-0.17	-0.07	-0.03	0.02	0.1
BMI at Consumption	-0.13	0.07	-0.28	-0.18	-0.13	-0.08	0.01
Number of Servings Reported in Dietary Screener at Consumption	0.16	0.06	0.04	0.11	0.16	0.2	0.28
Age at Consumption Level Given Consumption	0.06	0.05	-0.04	0.02	0.06	0.09	0.17
BMI at Consumption Level Given Consumption	0	0.05	-0.11	-0.04	-0.01	0.03	0.11
Number of Servings Reported in Dietary Screener at Consumption Level Given Consumption	0.16	0.05	0.05	0.12	0.15	0.19	0.26
Age at Energy Intake Level	0.07	0.06	-0.03	0.04	0.07	0.11	0.18
BMI at Energy Intake Level	-0.16	0.06	-0.27	-0.2	-0.16	-0.12	-0.05

Number of Servings Reported in Dietary Screener at Energy Intake Level	-0.03	0.06	-0.14	-0.07	-0.03	0.01	0.08
(1,1) estimate of within person random effects inverse matrix Σ_u^{-1}	8.51	4.45	2.61	4.97	7.63	11.2	18.98
(1,2) estimate of within person random effects inverse matrix Σ_u^{-1}	-2.69	3.21	-10.12	-4.27	-2.08	-0.62	2.59
(1,3) estimate of within person random effects inverse matrix Σ_u^{-1}	-0.93	1.78	-5.23	-1.72	-0.69	0.12	2.08
(2,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-2.69	3.21	-10.12	-4.27	-2.08	-0.62	2.59
(2,2) estimate of within person random effects inverse matrix Σ_u^{-1}	9.4	4.17	3.89	6.5	8.45	11.57	19.42
(2,3) estimate of within person random effects inverse matrix Σ_u^{-1}	-0.35	1.66	-3.96	-1.26	-0.3	0.55	3.34
(3,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-0.93	1.78	-5.23	-1.72	-0.69	0.12	2.08
(3,2) estimate of within person random effects inverse matrix Σ_u^{-1}	-0.35	1.66	-3.96	-1.26	-0.3	0.55	3.34
(3,3) estimate of within person random effects inverse matrix Σ_u^{-1}	2.91	1.09	1.64	2.17	2.63	3.32	5.88
(1,1) estimate of within person random effects variance-covariance matrix Σ_u	0.2	0.1	0.08	0.13	0.18	0.26	0.47
(1,2) estimate of within person random effects variance-covariance matrix Σ_u	0.05	0.05	-0.06	0.02	0.04	0.08	0.16
(1,3) estimate of within person random effects variance-covariance matrix Σ_u	0.05	0.08	-0.11	0	0.05	0.11	0.21
(2,1) estimate of within person random effects variance-covariance matrix Σ_u	0.05	0.05	-0.06	0.02	0.04	0.08	0.16
(2,2) estimate of within person random effects variance-covariance matrix Σ_u	0.16	0.06	0.07	0.12	0.15	0.19	0.3
(2,3) estimate of within person random effects variance-covariance matrix Σ_u	0.03	0.07	-0.1	-0.01	0.03	0.08	0.16
(3,1) estimate of within person random effects variance-covariance matrix Σ_u	0.05	0.08	-0.11	0	0.05	0.11	0.21
(3,2) estimate of within person random effects variance-covariance matrix Σ_u	0.03	0.07	-0.1	-0.01	0.03	0.08	0.16
(3,3) estimate of within person random effects variance-covariance matrix Σ_u	0.46	0.11	0.27	0.39	0.46	0.53	0.67

Constraint γ estimate in variance-covariance matrix of random errors Σ_ϵ	0.34	0.07	0.2	0.29	0.34	0.39	0.47
Constraint θ estimate in variance-covariance matrix of random errors Σ_ϵ	0.62	0.2	0.28	0.48	0.6	0.74	1.09
(1,3) estimate of day-to-day variation matrix Σ_ϵ	0.34	0.1	0.13	0.27	0.34	0.41	0.53
(2,2) estimate of day-to-day variation matrix Σ_ϵ	1.72	0.11	1.52	1.65	1.71	1.79	1.96
(2,3) estimate of day-to-day variation matrix Σ_ϵ	0.31	0.09	0.14	0.25	0.31	0.37	0.48
(3,1) estimate of day-to-day variation matrix Σ_ϵ	0.34	0.1	0.13	0.27	0.34	0.41	0.53
(3,2) estimate of day-to-day variation matrix Σ_ϵ	0.31	0.09	0.14	0.25	0.31	0.37	0.48
(3,3) estimate of day-to-day variation matrix Σ_ϵ	1.52	0.12	1.31	1.44	1.52	1.59	1.76
(1,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	1.1	0.06	1.01	1.05	1.09	1.13	1.23
(1,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.05	0.02	0.01	0.03	0.04	0.06	0.09
(1,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.26	0.09	-0.44	-0.32	-0.26	-0.19	-0.09
(2,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.05	0.02	0.01	0.03	0.04	0.06	0.09
(2,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.61	0.04	0.53	0.58	0.61	0.64	0.69
(2,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.14	0.04	-0.21	-0.16	-0.14	-0.11	-0.06
(3,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.26	0.09	-0.44	-0.32	-0.26	-0.19	-0.09
(3,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.14	0.04	-0.21	-0.16	-0.14	-0.11	-0.06
(3,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.75	0.07	0.63	0.71	0.75	0.8	0.92

Table 20. Posterior Means for Girls Usual Intake of Vegetables Excluding White Potatoes and Starchy Vegetables (n=402)

			Percentiles				
Standardized and Transformed Variables	**Mean**	**S.d.**	**2.5%**	**25%**	**50%**	**75%**	**97.5%**
Intercept at Consumption	1.22	0.08	1.07	1.17	1.22	1.27	1.38
Intercept at Consumption Level Given Consumption	0.01	0.06	-0.1	-0.02	0.01	0.05	0.12
Intercept at Energy Intake Level	0	0.06	-0.1	-0.04	0.01	0.04	0.12

Age at Consumption	-0.07	0.06	-0.2	-0.12	-0.07	-0.03	0.05
BMI at Consumption	-0.13	0.07	-0.27	-0.18	-0.13	-0.09	0
Number of Servings Reported in Dietary Screener at Consumption	0.18	0.07	0.06	0.14	0.18	0.23	0.31
Age at Consumption Level Given Consumption	0.08	0.05	-0.02	0.05	0.08	0.12	0.19
BMI at Consumption Level Given Consumption	-0.02	0.05	-0.13	-0.06	-0.02	0.01	0.08
Number of Servings Reported in Dietary Screener at Consumption Level Given Consumption	0.17	0.05	0.07	0.13	0.17	0.2	0.28
Age at Energy Intake Level	0.07	0.06	-0.04	0.03	0.07	0.11	0.18
BMI at Energy Intake Level	-0.15	0.06	-0.26	-0.19	-0.15	-0.12	-0.05
Number of Servings Reported in Dietary Screener at Energy Intake Level	-0.04	0.05	-0.14	-0.07	-0.03	0	0.07
(1,1) estimate of within person random effects inverse matrix Σ_u^{-1}	9.23	4.74	2.82	5.63	8.35	11.72	21.03
(1,2) estimate of within person random effects inverse matrix Σ_u^{-1}	-4.61	3.81	-13.85	-6.46	-3.9	-2.06	1.07
(1,3) estimate of within person random effects inverse matrix Σ_u^{-1}	-1.07	1.81	-5.5	-1.89	-0.88	-0.04	2.24
(2,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-4.61	3.81	-13.85	-6.46	-3.9	-2.06	1.07
(2,2) estimate of within person random effects inverse matrix Σ_u^{-1}	10.85	4.79	4.32	7.22	10.02	13.27	22.43
(2,3) estimate of within person random effects inverse matrix Σ_u^{-1}	0.35	1.84	-3.45	-0.68	0.32	1.38	4.13
(3,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-1.07	1.81	-5.5	-1.89	-0.88	-0.04	2.24
(3,2) estimate of within person random effects inverse matrix Σ_u^{-1}	0.35	1.84	-3.45	-0.68	0.32	1.38	4.13
(3,3) estimate of within person random effects inverse matrix Σ_u^{-1}	2.84	0.98	1.67	2.2	2.59	3.25	5.62
(1,1) estimate of within person random effects variance-covariance matrix Σ_u	0.21	0.1	0.09	0.14	0.18	0.26	0.44
(1,2) estimate of within person random effects variance-covariance matrix Σ_u	0.07	0.05	-0.03	0.04	0.07	0.1	0.19
(1,3) estimate of within person random effects variance-covariance matrix Σ_u	0.06	0.07	-0.09	0.01	0.06	0.1	0.2
(2,1) estimate of within person random effects variance-covariance matrix Σ_u	0.07	0.05	-0.03	0.04	0.07	0.1	0.19
(2,2) estimate of within person random effects variance-covariance matrix Σ_u	0.16	0.06	0.07	0.11	0.15	0.19	0.29

(2,3) estimate of within person random effects variance-covariance matrix Σ_u	0.01	0.07	-0.12	-0.04	0.01	0.05	0.13
(3,1) estimate of within person random effects variance-covariance matrix Σ_u	0.06	0.07	-0.09	0.01	0.06	0.1	0.2
(3,2) estimate of within person random effects variance-covariance matrix Σ_u	0.01	0.07	-0.12	-0.04	0.01	0.05	0.13
(3,3) estimate of within person random effects variance-covariance matrix Σ_u	0.46	0.1	0.26	0.39	0.46	0.53	0.67
Constraint γ estimate in variance-covariance matrix of random errors Σ_ϵ	0.27	0.07	0.14	0.23	0.27	0.31	0.4
Constraint θ estimate in variance-covariance matrix of random errors Σ_ϵ	0.77	0.25	0.33	0.58	0.75	0.94	1.33
(1,3) estimate of day-to-day variation matrix Σ_ϵ	0.23	0.09	0.05	0.17	0.23	0.3	0.42
(2,2) estimate of day-to-day variation matrix Σ_ϵ	1.73	0.11	1.51	1.65	1.73	1.8	1.95
(2,3) estimate of day-to-day variation matrix Σ_ϵ	0.28	0.09	0.11	0.23	0.28	0.34	0.46
(3,1) estimate of day-to-day variation matrix Σ_ϵ	0.23	0.09	0.05	0.17	0.23	0.3	0.42
(3,2) estimate of day-to-day variation matrix Σ_ϵ	0.28	0.09	0.11	0.23	0.28	0.34	0.46
(3,3) estimate of day-to-day variation matrix Σ_ϵ	1.52	0.11	1.31	1.45	1.52	1.6	1.76
(1,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	1.05	0.04	1	1.02	1.04	1.06	1.14
(1,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.03	0.02	0	0.02	0.03	0.04	0.07
(1,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.17	0.07	-0.33	-0.22	-0.17	-0.12	-0.03
(2,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.03	0.02	0	0.02	0.03	0.04	0.07
(2,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.6	0.04	0.53	0.58	0.6	0.63	0.69
(2,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.12	0.04	-0.19	-0.14	-0.12	-0.09	-0.05
(3,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.17	0.07	-0.33	-0.22	-0.17	-0.12	-0.03
(3,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.12	0.04	-0.19	-0.14	-0.12	-0.09	-0.05
(3,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.71	0.06	0.61	0.67	0.71	0.75	0.84

Table 21. Posterior Means for Boys Usual Intake of Fruits and Vegetables Including White Potatoes and Starchy Vegetables (n=335)

	Percentiles						
Standardized and Transformed Variables	**Mean**	**S.d.**	**2.5%**	**25%**	**50%**	**75%**	**97.5%**
Intercept at Consumption	1.59	0.1	1.41	1.52	1.58	1.65	1.78
Intercept at Consumption Level Given Consumption	-0.01	0.06	-0.12	-0.05	-0.01	0.04	0.12
Intercept at Energy Intake Level	0	0.06	-0.12	-0.04	0	0.04	0.12
Age at Consumption	0	0.08	-0.16	-0.05	0	0.06	0.17
BMI at Consumption	-0.03	0.08	-0.19	-0.08	-0.03	0.03	0.13
Number of Servings Reported in Dietary Screener at Consumption	0.06	0.08	-0.11	0	0.06	0.11	0.2
Age at Consumption Level Given Consumption	0.16	0.06	0.04	0.12	0.16	0.2	0.28
BMI at Consumption Level Given Consumption	-0.15	0.06	-0.27	-0.19	-0.15	-0.11	-0.03
Number of Servings Reported in Dietary Screener at Consumption Level Given Consumption	0.15	0.06	0.03	0.11	0.15	0.2	0.27
Age at Energy Intake Level	0.12	0.07	-0.01	0.08	0.12	0.17	0.25
BMI at Energy Intake Level	-0.06	0.06	-0.18	-0.11	-0.07	-0.02	0.05
Number of Servings Reported in Dietary Screener at Energy Intake Level	-0.11	0.06	-0.22	-0.15	-0.11	-0.07	0.01
(1,1) estimate of within person random effects inverse matrix Σ_u^{-1}	10.54	5.21	3.47	6.67	9.57	13.21	24.01
(1,2) estimate of within person random effects inverse matrix Σ_u^{-1}	-4.48	3.22	-12.55	-6	-3.94	-2.25	0.08
(1,3) estimate of within person random effects inverse matrix Σ_u^{-1}	-1.56	1.92	-6.73	-2.33	-1.24	-0.37	1.3
(2,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-4.48	3.22	-12.55	-6	-3.94	-2.25	0.08
(2,2) estimate of within person random effects inverse matrix Σ_u^{-1}	5.35	2.68	2.11	3.5	4.77	6.39	12.63
(2,3) estimate of within person random effects inverse matrix Σ_u^{-1}	0.69	1.1	-0.91	-0.01	0.47	1.17	3.48
(3,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-1.56	1.92	-6.73	-2.33	-1.24	-0.37	1.3
(3,2) estimate of within person random effects inverse matrix Σ_u^{-1}	0.69	1.1	-0.91	-0.01	0.47	1.17	3.48
(3,3) estimate of within person random effects inverse matrix Σ_u^{-1}	1.91	0.82	1.12	1.44	1.7	2.07	4.46
(1,1) estimate of within person random effects variance-covariance matrix Σ_u	0.23	0.09	0.09	0.16	0.22	0.28	0.44

(1,2) estimate of within person random effects variance-covariance matrix Σ_u	0.15	0.08	0	0.09	0.15	0.21	0.33
(1,3) estimate of within person random effects variance-covariance matrix Σ_u	0.1	0.1	-0.09	0.04	0.1	0.16	0.3
(2,1) estimate of within person random effects variance-covariance matrix Σ_u	0.15	0.08	0	0.09	0.15	0.21	0.33
(2,2) estimate of within person random effects variance-covariance matrix Σ_u	0.38	0.1	0.2	0.31	0.37	0.44	0.59
(2,3) estimate of within person random effects variance-covariance matrix Σ_u	0.01	0.08	-0.16	-0.04	0.01	0.06	0.16
(3,1) estimate of within person random effects variance-covariance matrix Σ_u	0.1	0.1	-0.09	0.04	0.1	0.16	0.3
(3,2) estimate of within person random effects variance-covariance matrix Σ_u	0.01	0.08	-0.16	-0.04	0.01	0.06	0.16
(3,3) estimate of within person random effects variance-covariance matrix Σ_u	0.73	0.12	0.5	0.64	0.72	0.81	0.97
Constraint γ estimate in variance-covariance matrix of random errors Σ_ϵ	0.42	0.06	0.31	0.37	0.41	0.46	0.55
Constraint θ estimate in variance-covariance matrix of random errors Σ_ϵ	1.11	0.22	0.74	0.95	1.08	1.25	1.57
(1,3) estimate of day-to-day variation matrix Σ_ϵ	0.21	0.11	0	0.14	0.21	0.28	0.42
(2,2) estimate of day-to-day variation matrix Σ_ϵ	1.5	0.12	1.27	1.41	1.49	1.58	1.74
(2,3) estimate of day-to-day variation matrix Σ_ϵ	0.5	0.08	0.33	0.44	0.49	0.56	0.66
(3,1) estimate of day-to-day variation matrix Σ_ϵ	0.21	0.11	0	0.14	0.21	0.28	0.42
(3,2) estimate of day-to-day variation matrix Σ_ϵ	0.5	0.08	0.33	0.44	0.49	0.56	0.66
(3,3) estimate of day-to-day variation matrix Σ_ϵ	1.26	0.1	1.08	1.19	1.26	1.32	1.48
(1,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	1.06	0.05	1	1.02	1.04	1.08	1.18
(1,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.07	0.04	0	0.04	0.07	0.09	0.17
(1,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.21	0.12	-0.44	-0.28	-0.21	-0.12	0
(2,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.07	0.04	0	0.04	0.07	0.09	0.17

(2,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.78	0.07	0.66	0.74	0.78	0.83	0.93
(2,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.32	0.06	-0.46	-0.36	-0.32	-0.28	-0.22
(3,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.21	0.12	-0.44	-0.28	-0.21	-0.12	0
(3,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.32	0.06	-0.46	-0.36	-0.32	-0.28	-0.22
(3,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.97	0.09	0.81	0.91	0.97	1.03	1.16

Table 22. Posterior Means for Boys Usual Intake of Fruits and Vegetables Excluding White Potatoes and Starchy Vegetables (n=335)

	Percentiles						
Standardized and Transformed Variables	**Mean**	**S.d.**	**2.5%**	**25%**	**50%**	**75%**	**97.5%**
Intercept at Consumption	1.53	0.1	1.35	1.46	1.52	1.58	1.74
Intercept at Consumption Level Given Consumption	-0.01	0.06	-0.13	-0.05	-0.01	0.04	0.1
Intercept at Energy Intake Level	0	0.06	-0.13	-0.05	0	0.05	0.12
Age at Consumption	0.02	0.08	-0.16	-0.03	0.02	0.08	0.18
BMI at Consumption	-0.07	0.08	-0.22	-0.12	-0.07	-0.01	0.1
Number of Servings Reported in Dietary Screener at Consumption	0.08	0.08	-0.08	0.03	0.08	0.14	0.24
Age at Consumption Level Given Consumption	0.13	0.06	0.01	0.09	0.13	0.17	0.25
BMI at Consumption Level Given Consumption	-0.12	0.06	-0.25	-0.16	-0.12	-0.08	0
Number of Servings Reported in Dietary Screener at Consumption Level Given Consumption	0.18	0.06	0.06	0.13	0.17	0.22	0.29
Age at Energy Intake Level	0.13	0.06	0	0.08	0.12	0.17	0.25
BMI at Energy Intake Level	-0.06	0.06	-0.19	-0.11	-0.06	-0.02	0.06
Number of Servings Reported in Dietary Screener at Energy Intake Level	-0.08	0.07	-0.2	-0.12	-0.08	-0.03	0.05
(1,1) estimate of within person random effects inverse matrix Σ_u^{-1}	9.33	4.97	2.81	5.7	8.3	11.77	21.79
(1,2) estimate of within person random effects inverse matrix Σ_u^{-1}	-3.89	3.09	-11.12	-5.6	-3.46	-1.7	0.86
(1,3) estimate of within person random effects inverse matrix Σ_u^{-1}	-1.03	1.73	-5.59	-1.71	-0.69	0.01	1.46
(2,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-3.89	3.09	-11.12	-5.6	-3.46	-1.7	0.86
(2,2) estimate of within person random effects inverse matrix Σ_u^{-1}	4.95	2.48	1.94	3.17	4.39	6.06	11.05

(2,3) estimate of within person random effects inverse matrix Σ_u^{-1}	0.26	0.95	-1.21	-0.3	0.1	0.61	2.78
(3,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-1.03	1.73	-5.59	-1.71	-0.69	0.01	1.46
(3,2) estimate of within person random effects inverse matrix Σ_u^{-1}	0.26	0.95	-1.21	-0.3	0.1	0.61	2.78
(3,3) estimate of within person random effects inverse matrix Σ_u^{-1}	1.77	0.63	1.14	1.4	1.6	1.95	3.42
(1,1) estimate of within person random effects variance-covariance matrix Σ_u	0.25	0.12	0.09	0.17	0.23	0.31	0.53
(1,2) estimate of within person random effects variance-covariance matrix Σ_u	0.16	0.1	-0.04	0.1	0.16	0.23	0.37
(1,3) estimate of within person random effects variance-covariance matrix Σ_u	0.09	0.1	-0.11	0.02	0.09	0.16	0.3
(2,1) estimate of within person random effects variance-covariance matrix Σ_u	0.16	0.1	-0.04	0.1	0.16	0.23	0.37
(2,2) estimate of within person random effects variance-covariance matrix Σ_u	0.4	0.11	0.2	0.32	0.4	0.47	0.64
(2,3) estimate of within person random effects variance-covariance matrix Σ_u	0.05	0.08	-0.12	-0.01	0.05	0.11	0.21
(3,1) estimate of within person random effects variance-covariance matrix Σ_u	0.09	0.1	-0.11	0.02	0.09	0.16	0.3
(3,2) estimate of within person random effects variance-covariance matrix Σ_u	0.05	0.08	-0.12	-0.01	0.05	0.11	0.21
(3,3) estimate of within person random effects variance-covariance matrix Σ_u	0.73	0.12	0.49	0.65	0.73	0.81	0.98
Constraint γ estimate in variance-covariance matrix of random errors Σ_ϵ	0.37	0.06	0.25	0.32	0.37	0.41	0.49
Constraint θ estimate in variance-covariance matrix of random errors Σ_ϵ	1.16	0.26	0.72	0.97	1.14	1.34	1.74
(1,3) estimate of day-to-day variation matrix Σ_ϵ	0.16	0.11	-0.06	0.09	0.17	0.24	0.38
(2,2) estimate of day-to-day variation matrix Σ_ϵ	1.48	0.13	1.25	1.39	1.47	1.55	1.75
(2,3) estimate of day-to-day variation matrix Σ_ϵ	0.44	0.09	0.28	0.38	0.44	0.49	0.62
(3,1) estimate of day-to-day variation matrix Σ_ϵ	0.16	0.11	-0.06	0.09	0.17	0.24	0.38

(3,2) estimate of day-to-day variation matrix Σ_ϵ	0.44	0.09	0.28	0.38	0.44	0.49	0.62
(3,3) estimate of day-to-day variation matrix Σ_ϵ	1.26	0.1	1.08	1.19	1.25	1.32	1.49
(1,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	1.04	0.04	1	1.01	1.03	1.06	1.15
(1,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.05	0.04	-0.02	0.02	0.04	0.07	0.13
(1,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.16	0.11	-0.39	-0.23	-0.15	-0.08	0.05
(2,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.05	0.04	-0.02	0.02	0.04	0.07	0.13
(2,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.77	0.07	0.65	0.72	0.76	0.81	0.91
(2,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.28	0.06	-0.39	-0.31	-0.28	-0.24	-0.18
(3,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.16	0.11	-0.39	-0.23	-0.15	-0.08	0.05
(3,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.28	0.06	-0.39	-0.31	-0.28	-0.24	-0.18
(3,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.93	0.08	0.77	0.88	0.93	0.98	1.12

Table 23. Posterior Means for Girls Usual Intake of Fruits and Vegetables Including White Potatoes and Starchy Vegetables (n=402)

			Percentiles				
Standardized and Transformed Variables	**Mean**	**S.d.**	**2.5%**	**25%**	**50%**	**75%**	**97.5%**
Intercept at Consumption	1.92	0.16	1.68	1.81	1.9	2.01	2.3
Intercept at Consumption Level Given Consumption	0	0.05	-0.1	-0.03	0	0.04	0.1
Intercept at Energy Intake Level	0	0.05	-0.1	-0.04	0	0.04	0.1
Age at Consumption	-0.01	0.09	-0.19	-0.07	-0.01	0.05	0.18
BMI at Consumption	-0.13	0.1	-0.32	-0.2	-0.13	-0.06	0.05
Number of Servings Reported in Dietary Screener at Consumption	0.2	0.07	0.05	0.14	0.2	0.24	0.33
Age at Consumption Level Given Consumption	-0.03	0.05	-0.14	-0.07	-0.04	0	0.07
BMI at Consumption Level Given Consumption	-0.06	0.06	-0.18	-0.1	-0.06	-0.03	0.05
Number of Servings Reported in Dietary Screener at Consumption Level Given Consumption	0.13	0.05	0.03	0.09	0.13	0.16	0.23
Age at Energy Intake Level	0.07	0.05	-0.03	0.04	0.07	0.11	0.18
BMI at Energy Intake Level	-0.16	0.06	-0.27	-0.19	-0.15	-0.12	-0.05

Number of Servings Reported in Dietary Screener at Energy Intake Level	-0.02	0.05	-0.13	-0.06	-0.02	0.02	0.08
(1,1) estimate of within person random effects inverse matrix Σ_u^{-1}	7.26	4.42	1.82	4.1	6.18	9.09	18.65
(1,2) estimate of within person random effects inverse matrix Σ_u^{-1}	-0.97	3.01	-7.62	-2.57	-0.47	0.82	4
(1,3) estimate of within person random effects inverse matrix Σ_u^{-1}	-1.4	2.53	-8.18	-2.38	-0.98	0.15	2.65
(2,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-0.97	3.01	-7.62	-2.57	-0.47	0.82	4
(2,2) estimate of within person random effects inverse matrix Σ_u^{-1}	6.47	3.26	2.77	4.29	5.68	7.58	14.39
(2,3) estimate of within person random effects inverse matrix Σ_u^{-1}	-2.12	1.69	-6.12	-3.05	-1.83	-1.02	0.65
(3,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-1.4	2.53	-8.18	-2.38	-0.98	0.15	2.65
(3,2) estimate of within person random effects inverse matrix Σ_u^{-1}	-2.12	1.69	-6.12	-3.05	-1.83	-1.02	0.65
(3,3) estimate of within person random effects inverse matrix Σ_u^{-1}	4.21	2.06	1.93	2.77	3.71	4.9	9.01
(1,1) estimate of within person random effects variance-covariance matrix Σ_u	0.29	0.18	0.09	0.16	0.23	0.35	0.79
(1,2) estimate of within person random effects variance-covariance matrix Σ_u	0.04	0.09	-0.14	-0.01	0.05	0.1	0.22
(1,3) estimate of within person random effects variance-covariance matrix Σ_u	0.1	0.12	-0.11	0.02	0.08	0.17	0.36
(2,1) estimate of within person random effects variance-covariance matrix Σ_u	0.04	0.09	-0.14	-0.01	0.05	0.1	0.22
(2,2) estimate of within person random effects variance-covariance matrix Σ_u	0.28	0.09	0.11	0.21	0.28	0.33	0.46
(2,3) estimate of within person random effects variance-covariance matrix Σ_u	0.14	0.07	0.01	0.09	0.14	0.19	0.29
(3,1) estimate of within person random effects variance-covariance matrix Σ_u	0.1	0.12	-0.11	0.02	0.08	0.17	0.36
(3,2) estimate of within person random effects variance-covariance matrix Σ_u	0.14	0.07	0.01	0.09	0.14	0.19	0.29
(3,3) estimate of within person random effects variance-covariance matrix Σ_u	0.44	0.11	0.23	0.36	0.43	0.51	0.66

Constraint γ estimate in variance-covariance matrix of random errors Σ_ϵ	0.35	0.09	0.17	0.28	0.34	0.41	0.53
Constraint θ estimate in variance-covariance matrix of random errors Σ_ϵ	0.61	0.25	0.25	0.44	0.57	0.74	1.25
(1,3) estimate of day-to-day variation matrix Σ_ϵ	0.35	0.13	0.07	0.26	0.36	0.45	0.61
(2,2) estimate of day-to-day variation matrix Σ_ϵ	1.63	0.12	1.41	1.55	1.63	1.71	1.86
(2,3) estimate of day-to-day variation matrix Σ_ϵ	0.29	0.09	0.13	0.23	0.29	0.35	0.45
(3,1) estimate of day-to-day variation matrix Σ_ϵ	0.35	0.13	0.07	0.26	0.36	0.45	0.61
(3,2) estimate of day-to-day variation matrix Σ_ϵ	0.29	0.09	0.13	0.23	0.29	0.35	0.45
(3,3) estimate of day-to-day variation matrix Σ_ϵ	1.54	0.12	1.33	1.46	1.54	1.62	1.78
(1,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	1.11	0.08	1	1.05	1.09	1.16	1.32
(1,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.05	0.03	0.01	0.03	0.04	0.06	0.12
(1,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.27	0.12	-0.54	-0.35	-0.26	-0.19	-0.05
(2,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.05	0.03	0.01	0.03	0.04	0.06	0.12
(2,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.64	0.05	0.56	0.61	0.64	0.67	0.74
(2,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.13	0.04	-0.22	-0.16	-0.13	-0.1	-0.06
(3,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.27	0.12	-0.54	-0.35	-0.26	-0.19	-0.05
(3,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.13	0.04	-0.22	-0.16	-0.13	-0.1	-0.06
(3,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.75	0.08	0.62	0.69	0.74	0.8	0.92

Table 24. Posterior Means for Girls Usual Intake of Fruits and Vegetables Excluding White Potatoes and Starchy Vegetables (n=402)

	Percentiles						
Standardized and Transformed Variables	**Mean**	**S.d.**	**2.5%**	**25%**	**50%**	**75%**	**97.5%**
Intercept at Consumption	1.74	0.12	1.53	1.66	1.73	1.81	2.01
Intercept at Consumption Level Given Consumption	0	0.05	-0.1	-0.03	0.01	0.04	0.11
Intercept at Energy Intake Level	0	0.06	-0.11	-0.04	0	0.04	0.11
Age at Consumption	-0.06	0.08	-0.22	-0.11	-0.06	-0.01	0.1
BMI at Consumption	-0.15	0.09	-0.33	-0.21	-0.15	-0.09	0.01

Number of Servings Reported in Dietary Screener at Consumption	0.18	0.07	0.04	0.13	0.18	0.22	0.31
Age at Consumption Level Given Consumption	-0.03	0.06	-0.14	-0.07	-0.03	0	0.07
BMI at Consumption Level Given Consumption	-0.06	0.05	-0.17	-0.1	-0.06	-0.03	0.04
Number of Servings Reported in Dietary Screener at Consumption Level Given Consumption	0.15	0.05	0.04	0.11	0.15	0.18	0.25
Age at Energy Intake Level	0.08	0.06	-0.04	0.03	0.08	0.11	0.18
BMI at Energy Intake Level	-0.16	0.05	-0.27	-0.19	-0.15	-0.12	-0.06
Number of Servings Reported in Dietary Screener at Energy Intake Level	-0.03	0.06	-0.14	-0.06	-0.03	0.01	0.08
(1,1) estimate of within person random effects inverse matrix Σ_u^{-1}	9.63	5.28	2.56	6.03	8.64	11.98	22.64
(1,2) estimate of within person random effects inverse matrix Σ_u^{-1}	-1.37	3.42	-8.84	-3.24	-0.78	0.79	3.96
(1,3) estimate of within person random effects inverse matrix Σ_u^{-1}	-2.29	2.66	-8.45	-3.73	-1.91	-0.57	2.38
(2,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-1.37	3.42	-8.84	-3.24	-0.78	0.79	3.96
(2,2) estimate of within person random effects inverse matrix Σ_u^{-1}	6.35	3.03	2.72	4.2	5.63	7.73	14.46
(2,3) estimate of within person random effects inverse matrix Σ_u^{-1}	-1.43	1.73	-5.39	-2.28	-1.25	-0.47	1.87
(3,1) estimate of within person random effects inverse matrix Σ_u^{-1}	-2.29	2.66	-8.45	-3.73	-1.91	-0.57	2.38
(3,2) estimate of within person random effects inverse matrix Σ_u^{-1}	-1.43	1.73	-5.39	-2.28	-1.25	-0.47	1.87
(3,3) estimate of within person random effects inverse matrix Σ_u^{-1}	4.1	1.78	2.05	2.85	3.67	4.83	8.71
(1,1) estimate of within person random effects variance-covariance matrix Σ_u	0.22	0.12	0.07	0.14	0.19	0.26	0.51
(1,2) estimate of within person random effects variance-covariance matrix Σ_u	0.05	0.08	-0.11	0	0.05	0.1	0.21
(1,3) estimate of within person random effects variance-covariance matrix Σ_u	0.12	0.09	-0.06	0.05	0.12	0.18	0.3
(2,1) estimate of within person random effects variance-covariance matrix Σ_u	0.05	0.08	-0.11	0	0.05	0.1	0.21
(2,2) estimate of within person random effects variance-covariance matrix Σ_u	0.27	0.09	0.11	0.2	0.26	0.33	0.45

(2,3) estimate of within person random effects variance-covariance matrix Σ_u	0.12	0.08	-0.03	0.07	0.12	0.17	0.27
(3,1) estimate of within person random effects variance-covariance matrix Σ_u	0.12	0.09	-0.06	0.05	0.12	0.18	0.3
(3,2) estimate of within person random effects variance-covariance matrix Σ_u	0.12	0.08	-0.03	0.07	0.12	0.17	0.27
(3,3) estimate of within person random effects variance-covariance matrix Σ_u	0.44	0.1	0.25	0.36	0.44	0.51	0.64
Constraint γ estimate in variance-covariance matrix of random errors Σ_ϵ	0.25	0.07	0.12	0.2	0.25	0.3	0.4
Constraint θ estimate in variance-covariance matrix of random errors Σ_ϵ	0.84	0.34	0.29	0.6	0.79	1.02	1.71
(1,3) estimate of day-to-day variation matrix Σ_ϵ	0.21	0.12	-0.03	0.13	0.21	0.29	0.44
(2,2) estimate of day-to-day variation matrix Σ_ϵ	1.62	0.12	1.41	1.54	1.61	1.7	1.87
(2,3) estimate of day-to-day variation matrix Σ_ϵ	0.27	0.09	0.1	0.21	0.26	0.33	0.46
(3,1) estimate of day-to-day variation matrix Σ_ϵ	0.21	0.12	-0.03	0.13	0.21	0.29	0.44
(3,2) estimate of day-to-day variation matrix Σ_ϵ	0.27	0.09	0.1	0.21	0.26	0.33	0.46
(3,3) estimate of day-to-day variation matrix Σ_ϵ	1.55	0.11	1.34	1.47	1.54	1.62	1.78
(1,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	1.04	0.04	1	1.01	1.03	1.06	1.14
(1,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.03	0.02	0	0.01	0.02	0.04	0.07
(1,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.15	0.09	-0.33	-0.21	-0.14	-0.09	0.02
(2,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.03	0.02	0	0.01	0.02	0.04	0.07
(2,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.64	0.05	0.56	0.61	0.64	0.67	0.73
(2,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.12	0.04	-0.2	-0.14	-0.11	-0.09	-0.05
(3,1) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.15	0.09	-0.33	-0.21	-0.14	-0.09	0.02
(3,2) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	-0.12	0.04	-0.2	-0.14	-0.11	-0.09	-0.05
(3,3) estimate of day-to-day variation inverse matrix Σ_ϵ^{-1}	0.7	0.06	0.6	0.66	0.7	0.74	0.81

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