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The Relationship Between Vitamin D and Calcium/Dairy Intake and Obesity in Children

Jason Barry

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ABSTRACT
THE RELATIONSHIP BETWEEN VITAMIN D AND CALCIUM/DAIRY INTAKE AND OBESITY IN CHILDREN

By

Jason Barry

**Background:** Obesity rates are increasing at an epidemic rate, not only in the United States, but also worldwide. Some research has shown a positive association between weight loss or maintenance with increased vitamin D and calcium intake (particularly dairy products, in adults) while other research has found a negative association.

**Objective:** The aim of this study is to examine the relationship between vitamin D and calcium intake and obesity in a population of young adolescents who participated in a Vitamin D and Sunlight Exposure study in Pittsburgh, PA.

**Participants/setting:** 252 healthy 6 to 14.9 year old young adolescents (54% male, 69% African American) were recruited between June 2006 and December 2009.

**Main outcome measures:** Weight status, BMI, vitamin D intake, calcium intake, vitamin D and calcium rich food intake.

**Statistical analysis:** Frequency analysis was used to determine demographic proportions, mean anthropometric values and median intake of vitamin D and calcium. Differences in weight status by gender and race were calculated using the Chi-square test. Differences in intake by weight status were assessed using the Kruskal-Wallis Test. The Spearman’s rho correlation statistic was used to determine the association between BMI and calcium and vitamin D intake.
**Results:** 59.3% of the population was normal weight, 17.7% was overweight and 23% was obese. A significant difference by race was observed with 30.1% of African Americans and 8.5% of Caucasians being obese (P<0.01). No difference was found by gender. Median (25%, 75%) vitamin D intake in the total population was 254.9 IU (146.8, 407.3) which is below the level recommended by the Institute of Medicine. Median calcium intake in the total population was 1193.6 mg (752.8, 1161.1) which met recommended guidelines. Median milk intake was reported at 2 servings/day and did not differ by race. Intake of additional foods rich in vitamin D and calcium differed by race, with African Americans consuming more cheese than Caucasians (1 serving/day vs. 0.5 servings/day, respectively; \(P=0.014\)) and orange juice (0.1 servings/day vs. 0 servings/day, respectively; \(P=0.045\)) but less yogurt (0 servings/day vs. 0.5 servings/day, respectively; \(P=0.031\)). Median vitamin D intake differed by weight status (normal, overweight, obese) in the total population (259.5 IU, 325.2 IU and 181.9 IU, respectively; \(P=0.015\)). A similar pattern was observed for calcium (1193.4 mg, 1416.3 mg and 911.6 mg, respectively; \(P=0.016\)). No correlation was found between vitamin D or calcium intake and BMI in the total population or by race and gender.

**Conclusion:** Although no correlation was found with BMI and calcium and vitamin D intake, vitamin D and calcium intake was significantly different based on weight status, particularly in obese and African American subjects. Vitamin D intake in the population was reportedly below recommended guidelines. Further research is necessary to determine the ideal vitamin D and calcium intake in children for optimal health status, including longitudinal studies to better assess the relationship between vitamin D and calcium intake and weight status.
THE RELATIONSHIP BETWEEN VITAMIN D AND CALCIUM/DAIRY INTAKE
AND OBESITY IN CHILDREN

By

JASON BARRY

A Thesis

Presented in Partial Fulfillment of Requirements for the Degree of

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The College of Health and Human Sciences

Division of Nutrition

Georgia State University

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2011
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<table>
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<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>25 (OH)D</td>
<td>25-hydroxyvitamin D</td>
</tr>
<tr>
<td>AAP</td>
<td>American Academy of Pediatrics</td>
</tr>
<tr>
<td>AI</td>
<td>Adequate Intake</td>
</tr>
<tr>
<td>BMI</td>
<td>Body Mass Index</td>
</tr>
<tr>
<td>CMP</td>
<td>Casein Macro-Peptides</td>
</tr>
<tr>
<td>CCK</td>
<td>Cholecystokinin</td>
</tr>
<tr>
<td>cm</td>
<td>centimeter</td>
</tr>
<tr>
<td>CSFII</td>
<td>Continuing Survey of Food Intakes by Individuals</td>
</tr>
<tr>
<td>DRI</td>
<td>Dietary Reference Intake</td>
</tr>
<tr>
<td>EAR</td>
<td>Estimated Average Requirement</td>
</tr>
<tr>
<td>f</td>
<td>Female</td>
</tr>
<tr>
<td>FFQ</td>
<td>Food Frequency Questionnaire</td>
</tr>
<tr>
<td>FNB</td>
<td>Food and Nutrition Board</td>
</tr>
<tr>
<td>FFQ</td>
<td>Food Frequency Questionnaire</td>
</tr>
<tr>
<td>GA</td>
<td>Georgia</td>
</tr>
<tr>
<td>GLP-1</td>
<td>Glucagon-Like Peptide-1</td>
</tr>
<tr>
<td>IOM</td>
<td>Institute of Medicine</td>
</tr>
<tr>
<td>IU</td>
<td>International Units</td>
</tr>
<tr>
<td>kg</td>
<td>kilogram</td>
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<tr>
<td>L</td>
<td>liter</td>
</tr>
<tr>
<td>LFFQ</td>
<td>Long Food Frequency Questionnaire</td>
</tr>
<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>--------------</td>
<td>-----------</td>
</tr>
<tr>
<td>m</td>
<td>Male</td>
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<tr>
<td>mg</td>
<td>milligram</td>
</tr>
<tr>
<td>mL</td>
<td>milliliter</td>
</tr>
<tr>
<td>ng</td>
<td>nanogram</td>
</tr>
<tr>
<td>NHANES</td>
<td>National Health and Nutrition Examination Survey</td>
</tr>
<tr>
<td>nmoL</td>
<td>nanomole</td>
</tr>
<tr>
<td>PA</td>
<td>Pennsylvania</td>
</tr>
<tr>
<td>PTH</td>
<td>Parathyroid Hormone</td>
</tr>
<tr>
<td>RCT</td>
<td>Randomized Controlled Trial</td>
</tr>
<tr>
<td>RDA</td>
<td>Recommended Dietary Allowance</td>
</tr>
<tr>
<td>SD</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>SFFQ</td>
<td>Short Food Frequency Questionnaire</td>
</tr>
<tr>
<td>UPMC</td>
<td>University of Pittsburgh Medical Center</td>
</tr>
<tr>
<td>US</td>
<td>United States of America</td>
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<tr>
<td>USDA</td>
<td>United States Department of Agriculture</td>
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CHAPTER I

INTRODUCTION

Obesity rates are increasing at an epidemic rate, not only in the United States, but worldwide (1). Obesity has been found to increase the likelihood of poor health and increases all-cause mortality (1). Approximately one out of three children in the U.S. is now considered to be overweight or obese (2). Over the past few decades, research has shown positive and negative associations between weight loss and maintenance with increased vitamin D and calcium intake (particularly with dairy products) in adults (3, 4, 5, 6, 7, 8). Additionally, studies have demonstrated links between high body mass indices (BMI) and decreased sun exposure, as well as decreased vitamin D levels (9). However, there is a discrepancy in data with children, as fewer studies have been done and findings have been inconclusive (2, 4). Further complicating the issue, with increased soda/juice consumption as opposed to vitamin D fortified milk, increasingly westernized lifestyles, and decreased frequency of meals eaten at home, vitamin D production/intake and calcium intake are at all-time lows among children (9, 10). The research base concerning vitamin D and calcium intake and weight is conflicting in both children and adults, as it is not clear whether calcium alone affects weight status or whether the associations found between obesity and vitamin D deficiency are causal, among others (11). Factors such as race and sex in relation to calcium and vitamin D intake and weight status have not been explored thoroughly, particularly in children. The purpose of this study is to examine the relationship between vitamin D and calcium intake and childhood weight status and

Hypothesis: 1. Vitamin D and calcium intake differ by weight status in young adolescents.
2. Vitamin D and calcium intake based on weight status differs between young adolescent males and females.
3. Vitamin D and calcium intake based on weight status differs between young adolescent Caucasians and African Americans.
CHAPTER II

LITERATURE REVIEW

Current Intake Recommendations For Vitamin D and Calcium

According to the Food and Nutrition Board (FNB) at the Institute of Medicine (IOM), the most recent Recommended Dietary Allowances (RDA) for vitamin D intake in male and female children 1 to 18 years of age is 600 IU per day, assuming minimal sun exposure (13). For calcium, the RDA is 700 mg/day for 1 to 3 year olds, 1000 mg/day

<table>
<thead>
<tr>
<th>Life Stage Group</th>
<th>Estimated Average Requirement (mg/day)</th>
<th>Recommended Dietary Allowance (mg/day)</th>
<th>Upper Level Intake (mg/day)</th>
<th>Estimated Average Requirement (IU/day)</th>
<th>Recommended Dietary Allowance (IU/day)</th>
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<tr>
<td>Infants 0 to 6 months</td>
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<td>Infants 6 to 12 months</td>
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<td>**</td>
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<tr>
<td>1-3 years old</td>
<td>500</td>
<td>700</td>
<td>2,500</td>
<td>400</td>
<td>600</td>
<td>2,500</td>
</tr>
<tr>
<td>4-6 years old</td>
<td>800</td>
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<td>2,500</td>
<td>400</td>
<td>600</td>
<td>3,000</td>
</tr>
<tr>
<td>9-13 years old</td>
<td>1,100</td>
<td>1,300</td>
<td>3,000</td>
<td>400</td>
<td>600</td>
<td>4,000</td>
</tr>
<tr>
<td>14-18 years old</td>
<td>1,100</td>
<td>1,300</td>
<td>3,000</td>
<td>400</td>
<td>600</td>
<td>4,000</td>
</tr>
<tr>
<td>19-30 years old</td>
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<td>2,500</td>
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<td>600</td>
<td>4,000</td>
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<tr>
<td>31-50 years old</td>
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<td>2,500</td>
<td>400</td>
<td>600</td>
<td>4,000</td>
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<tr>
<td>51-70 year old males</td>
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<td>2,000</td>
<td>400</td>
<td>600</td>
<td>4,000</td>
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<td>51-70 year old females</td>
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<td>1,200</td>
<td>2,000</td>
<td>400</td>
<td>600</td>
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<td>&gt;70 years old</td>
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<td>2,000</td>
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<tr>
<td>14-18 years old, pregnant/lactating</td>
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<td>1,300</td>
<td>3,000</td>
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<td>600</td>
<td>4,000</td>
</tr>
<tr>
<td>19-50 years old, pregnant/lactating</td>
<td>800</td>
<td>1,000</td>
<td>2,500</td>
<td>400</td>
<td>600</td>
<td>4,000</td>
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</table>

*For infants, Adequate Intake is 200 mg/day for 0 to 6 months of age and 260 mg/day for 6 to 12 months of age.
**For infants, Adequate Intake is 400 IU/day for 0 to 6 months of age and 400 IU/day for 6 to 12 months of age.
for 4 to 8 year olds, and 1300mg/day for those aged 9 to 18 (13). Although both calcium and vitamin D recommendations were recently changed, debate has primarily surrounded the changes to vitamin D intakes, as some researchers in the nutrition field believe levels should be raised well beyond the current RDAs (14). Toxicity is thought to be a risk at intakes over 10,000 IU/day over prolonged periods, but this value serves more as a conservative measure until more data are available (15). The IOM recommendations on calcium and vitamin D are based primarily on bone health studies and may not necessarily apply to intakes impacting weight status (16). Researchers also question whether to lower calcium recommendations if vitamin D recommendations are increased further (14). When supplemented with 400 IU vitamin D, a decrease in non-vertebral fracture risk was observed independent of calcium intake, suggesting parathyroid hormone (PTH) suppression and hip bone density only require higher calcium intakes if 25 (OH)D levels are low (14). As evidence emerges on mechanisms behind the interplay of vitamin D and calcium in the body, future research (and reflection on past research) in relation to Dietary Reference Intakes for Calcium and Vitamin D (13)

Measuring Vitamin D Status: Serum Vitamin D Levels

A standard measure of vitamin D status is serum 25 (OH)D levels (16, 17). Although influenced by sun exposure, the measure gives researchers insight into dietary intake of vitamin D (16). Although controversial, it is generally agreed upon that healthy serum 25 (OH)D levels should be greater than 50 nmol/L (16, 18). Levels below 30 nmol/L have been associated with a wide range of diseases and conditions including rickets, secondary hyperparathyroidism, fractures, obesity, diabetes, heart disease, and
inflammatory bowel disease (14, 17, 18). In adults, there is evidence that levels above 50 nmol/L reflect more optimal measures of health including increased bone density among others (18), and levels from 75 nmol/L – 100 nmol/L reflect best for overall health (18). If these standards were applied to children in the US, two out of three have serum 25 (OH)D levels below 75 nmol/L, with nearly all African American children falling into this category (15). If adjusted to 50 nmol/L, half of African American children in the US have low 25 (OH)D levels (15).

On average, 80-90% of serum 25 (OH)D is produced endogenously from sunlight exposure (15). However, westernized lifestyles around the globe are contributing to decreased sunlight exposure, and more definitive dietary recommendations are necessary to compensate (18, 19). Evidence of optimal serum levels for children coincide with reference ranges for adults, but fewer studies have addressed 25 (OH)D levels in younger populations (15). Populations with darker skin tones also have increased need for vitamin D intake as sunlight exposure decreases (15, 17). For instance, African Americans require higher intakes of vitamin D than Caucasians, and significant differences in average 25 (OH)D levels have been documented (14, 18). Populations in northern latitudes receiving less sunlight also require more vitamin D through diet, such as Inuits who traditionally relied on fish and whale blubber as a primary source of vitamin D (although dependence on fishing decreased and lower 25 (OH)D levels have resulted) (18). Inverse relationships have been observed between serum 25 (OH)D levels and higher body fat percentages, BMI, and total body fat in overweight and obese populations (18). Lower serum 25 (OH)D levels may be due, at least in part, to increased vitamin D storage in fat cells, reducing bioavailability (18). When a control versus obese
group was exposed to sunlight, similar amounts of vitamin D were produced, but blood concentrations 24 hours post sunlight exposure were 57% lower in the obese group (20). It may be that the subcutaneous fat cells hold onto serum 25 (OH)D synthesized in the skin. When the groups were compared with oral vitamin D2 intake versus sunlight exposure, similar results were found. However, vitamin D was more bioavailable through the oral intake method perhaps due to a delay in release of vitamin D into the bloodstream (20). Possible explanations for 25 (OH)D levels in relation to obesity have been explored, but more research is necessary.

Measuring Calcium Status: Diet

Serum levels of calcium are tightly regulated and are not impacted by dietary intake (16) as the body depends on bone resorption (if necessary) to regulate blood, muscular, and intracellular calcium levels. As such, measuring calcium intake status primarily relies on data from dietary assessment methods like food frequency questionnaires and food records. Not all calcium from the diet is bioavailable, as typically only 30% is absorbed (16) in the gut. Other factors impact calcium absorption such as competitive inhibition with other foods, the amount consumed, age, vitamin D intake, and calcitriol levels (16, 21).

Current Intake Status

Intakes of vitamin D and calcium fail to reach recommended levels for children in the US. It is estimated that only 30% of American children consume the recommended amounts of calcium per day (22). Dairy products such as milk are the primary source of
calcium and vitamin D for most children in the US, contributing greater than 50% of daily calcium intake (23). With the rise of sweetened beverage intakes, milk consumption has significantly declined in children (23, 24). Young girls between 9 and 18 are significantly less likely to consume adequate amounts of calcium (16, 25). Lower dairy intakes accompany this statistic, and may be due to the belief amongst young females that dairy products cause unwanted weight gain (16, 25). From 1978 to 1998, milk consumption decreased by 36% among female adolescents (23). Meanwhile, sweetened beverage consumption increased by 127% in 11 – 13 year old girls, and by 93% in 14-17 year old girls (23).

Similar to calcium, vitamin D intakes are below recommended levels in US children (23). And as with calcium intakes, young girls are at risk as only 50% of those aged 9-13, and 32% of those aged 14-18 consume the recommended levels of vitamin D in their diets (23). According to an NHANES 2001-2005 analysis of serum 25 (OH)D levels in children, 9% were considered vitamin D deficient (<37 nmol/L), and 61% were considered vitamin D insufficient (37-72 nmol/L) (26, 27). Vulnerable populations in the study were minorities with darker skin, those who spent more time indoors, and those who drank <1 serving of milk per week. In an NHANES 2001-2006 analysis of children aged 1-11, 1% had 25 OHD levels <25nmol/L, 18% had levels below 50 nmol/L, and 69% were below 75nmol/L (15). When applied to the general population, the data represents millions of children with inadequate vitamin D levels.

Supplementation: Vitamin D
The most efficient way to increase vitamin D levels in deficient individuals is through supplementation, particularly in the obese (20). Supplemental forms of vitamin D are typically available as vitamin D2 and D3 (16). The two forms are considered metabolically equivalent based on their ability to cure rickets (16). Although vitamin D2 and D3 follow similar metabolic pathways, large doses of vitamin D2 may be less effective than equivalent doses of D3 (16). However, only one in three children in the US report taking a vitamin D supplement or supplement containing vitamin D (15). And of those consuming supplements (typically 100 – 400 IUs), 1 in 10 had 25 (OH)D levels below 50 nmol/L and more than half were below 75 nmol/L. Supplementation of 400 IU/day appears to raise 25 (OH)D levels by 10 nmol/L on average in most populations, and increases of 25 nmol/L are observed with intakes of 1000 IU/day, depending on vitamin D status before supplementation (14). However, as research continues to shed light on definitive 25 (OH)D levels for optimal health, recommendations for supplementation will need to be reconsidered.

Supplementation: Calcium

An estimated 43% of the US population consumes calcium in the form of a supplement (28). The two primary forms of calcium supplementation are calcium carbonate and calcium citrate (28). Both forms are absorbed similarly well, but those with more acidic stomachs may absorb citrate more efficiently. Calcium citrate can be absorbed equally with or without food, while calcium carbonate is better absorbed with food (28). The amount of calcium absorbed depends on several factors including what the calcium was taken with (calcium binding foods, medicines), how much elemental
calcium is taken in at one time (more taken in at once results in decreased absorption), and current calcium status of the individual (28).

**Dietary Assessment Methods**

The most common methods used for dietary assessment of vitamin D and calcium intake are 3-day dietary records, food frequency questionnaires, 24 hour recall, and 7 day weighted food inventories. Each method has advantages and disadvantages. A 24-hour recall and 3-day dietary records are fast, relatively inexpensive, and can be executed with minimal effort (29). On the other hand, the two methods may not accurately reflect long term eating habits. A 7-day weighed food inventory is more accurate, but invasive and sometimes difficult to execute. Differing weighed food methods may require dietitians to weigh foods at the beginning and end of studies, and/or for all foods eaten to be weighed by the participants themselves (30). Food frequency questionnaires (FFQ) are subject to faulty recall and may lack validity when compared to 3-day dietary records and 24 hour recalls (29, 31). Of the studies reviewed, a mix of these methods was used, some alone, and others in combination.

**Association between Vitamin D status, Dairy, and Calcium Intake and Weight Status**

A 2003 study followed children from ages 2 months to 8 years to assess calcium intake and body fat in children (32). Researchers found that higher mean longitudinal calcium intakes and daily servings of dairy products (approximately 300 mg higher than the lower group) were associated with lower body fat, independent of caloric intake. The higher mean calcium group had approximately 1 kg less total body fat than the lower
group. When body fat was examined in relation to diet and hereditary obesity patterns, low calcium intake consistently predicted a 2-9% higher body fat in the cohort. A similar cross sectional study was performed on 9-14 year old girls in Hawaii from 2000-2001, and associated higher dairy intakes with lower iliac skin-fold thickness, in addition to lower variance in body weight (33).

A study of 107 adolescents (69 f, 39 m) analyzing 3 day dietary recalls found an inverse relationship \((r = -.488)\) between calcium intake and fat tissue amount in males, although females in the study showed no significant correlations (34). A negative correlation was found in a study published in 2005, when researchers gathering statistics from the Framingham Children’s Study examined children 3-5 years of age through adolescence, from 1996 to 1999. Researchers concluded that over time, higher mean calcium intakes correlated with lower weight gain and body fat percentage (35). The correlation was stronger in children who consumed more dairy as a source of calcium versus children with similar calcium intakes from other sources (35).

A study of 196 normal weight pre-menarchal girls (8-12 years) followed subjects 4 years post menarche and analyzed their percent body fat, BMI, and intake of dairy (questionnaire). The researchers found no relation between BMI, body fat percentage and dairy intake after adjustment for energy intake (10). A 2006 study, using a seven-day food inventory for measures of calcium intake, followed 85 children between 7-10 years in London (25). The study found 48% of boys and 38% of the girls were overweight, despite girls having significantly lower mean calcium intakes. There was also no association between BMI or body weight and calcium intake. In 2008, overweight children (ages 8-10) were randomly assigned to either a high milk consumption group (4
servings) or low milk consumption group (1 serving). For 16 weeks, tests for glucose tolerance insulin, lipids, body weight measurements and body composition were monitored. Although the study did not show any significant body weight changes between the two groups, there was a trend toward reduced insulin output with the high milk consumption group (36).

Surveys of 12,829 children between the ages of 9 and 14 were collected over a 3 year period (4). A food frequency questionnaire as well as anthropometric measures were completed and returned annually by mail between 1996-1999. The study found that children who reportedly drank 3+ servings of milk daily had a significantly greater increase in BMI over time than those who only drank 1-2 glasses per day (4). However, after adjusting for calories, dairy fat, and total fat intake, the relationship between dairy servings and calcium in relation to BMI were not significant.

Mechanisms

A suggested hypothesis as to why calcium intake may help with weight loss and maintenance is through potential effects on appetite and food intake (37). Calcium may have acted as an indicator of food availability in the ancestral environment (37). When food is plentiful (high calcium intake), fat accumulation is halted, and when food is scarce (low calcium intake), fat accumulation is increased (37). A mechanism by which higher calcium intake may influence fat loss is through dietary calcium’s ability to suppress calcitriol (the active form of vitamin D), which exerts genomic and non-genomic effects on adipocyte metabolism (38). Increased calcitriol levels up regulate genes that promote adipocyte proliferation, inflammatory factors, and inhibit adipocyte
apoptosis (21). A strong research base seems to indicate vitamin D status is negatively correlated with weight status and BMI, but a conclusive relationship (as well as mechanisms) has not been determined. Of the few studies that have investigated both vitamin D and calcium, conclusions are mixed, and clinical trials are limited. Meanwhile, dairy contributes greater than 50% of daily calcium intake among adults and children (3). However, there are complicating factors involved with drawing conclusions from dairy intake as it has high satiety properties independent of its calcium and vitamin D content (37). Some constituents of dairy, such as casein macro peptides (CMP), may help regulate food intake, body composition, and body weight (37). Calcium and dairy may also have differing effects on gut hormones that regulate satiety, food intake, and gastric emptying like cholecystokinin (CCK), ghrelin, and glucagon-like peptide-1 (GLP-1) (37). However, research is limited and more studies are necessary to reach conclusions.
REFERENCES


36. St-Onge MP, Goree LLT, Gower B. High milk supplementation with healthy diet counseling does not affect weight loss but ameliorates insulin action compared with low milk supplementation in overweight children. *J Nutr.* 2008; 139: 933-938.


CHAPTER III

MANUSCRIPT IN STYLE OF JOURNAL
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Abstract

Background: Obesity rates are increasing at an epidemic rate, not only in the United States, but also worldwide. Some research has shown a positive association between weight loss or maintenance with increased vitamin D and calcium intake (particularly dairy products, in adults) while other research has found a negative association. The aim of this study is to examine the relationship between vitamin D and calcium intake and obesity in a population of young adolescents who participated in a Vitamin D and Sunlight Exposure study in Pittsburgh, PA.

Methods: 252 healthy 6 to 14.9 year old young adolescents (54% male, 69% African American) were recruited between June 2006 and December 2009. Weight status was determined, BMI was calculated and intake of vitamin D, calcium and vitamin D and calcium rich foods was self-reported.

Results: 59.3% of the population was normal weight, 17.7% overweight and 23% obese. A significant difference by race was observed with 30.1% of African Americans and 8.5% of Caucasians being obese (P<0.01). No difference was found by gender. Median (25%, 75%) vitamin D intake in the total population was 254.9 IU (146.8, 407.3) which is below the level recommended by the Institute of Medicine. Median calcium intake in the total population was 1193.6 mg (752.8, 1161.1) which met recommended guidelines. Median milk intake was reported at 2 servings/day and did not differ by race. Intake of additional foods rich in vitamin D and calcium differed by race, with African Americans consuming more cheese than Caucasians (1 serving/day vs. 0.5 servings/day, respectively; P=0.014) and orange juice (0.1 servings/day vs. 0 servings/day, respectively; P=0.045) but less yogurt (0 servings/day vs. 0.5 servings/day, respectively; P=0.031). Median vitamin D intake differed by weight status (normal, overweight,
obese) in the total population (259.5 IU, 325.2 IU and 181.9 IU, respectively; $P=0.015$).
A similar pattern was observed for calcium (1193.4 mg, 1416.3 mg and 911.6 mg, respectively; $P=0.016$). No correlation was found between vitamin D or calcium intake and BMI in the total population or by race and gender. Conclusion: Although no correlation was found with BMI and calcium and vitamin D intake, vitamin D and calcium intake was significantly different based on weight status, particularly in obese and African American subjects. Vitamin D intake in our population was reportedly below recommended guidelines. Further research is necessary to determine the ideal vitamin D and calcium intake in children, as well as longitudinal studies to better assess the relationship between vitamin D and calcium intake and weight status.

Introduction

Obesity rates are increasing at an epidemic rate, not only in the United States, but worldwide (1). Obesity has been found to increase the likelihood of poor health and increases all-cause mortality (1). Approximately one out of three children in the U.S. is now considered to be overweight or obese (2). Over the past few decades, research has shown positive and negative associations between weight loss and maintenance with increased vitamin D and calcium intake (particularly with dairy products) in adults (3, 4, 5, 6, 7, 8). Additionally, studies have demonstrated links between high body mass indices (BMI) and decreased sun exposure, as well as decreased vitamin D levels (9). However, there is a discrepancy in data with children, as fewer studies have been done and findings have been inconclusive (2, 4). Further complicating the issue, with increased soda/juice consumption as opposed to vitamin D
fortified milk, increasingly westernized lifestyles, and decreased frequency of meals
eaten at home, vitamin D production/intake and calcium intake are at all-time lows
among children (9, 10). The research base concerning vitamin D and calcium intake and
weight is conflicting in both children and adults, as it is not clear whether calcium alone
affects weight status or whether the associations found between obesity and vitamin D
deficiency are causal, among others (11). Factors such as race and sex in relation to
calcium and vitamin D intake and weight status have not been explored thoroughly,
particularly in children. The purpose of this study is to examine the relationship between
vitamin D and calcium intake and childhood weight status and obesity in a population of
young adolescents who participated in a Vitamin D and Sunlight Exposure study (2006-

Hypothesis: Vitamin D and calcium intake differ based on weight status in young
adolescents.

Methods
Participants

The population for this study was healthy 6-14.9 year old pre- and early
adolescent African American and Caucasian children residing in Pittsburgh, PA. Subjects
were participants in Dr. Rajakumar’s (12) National Institutes of Health-funded (R03 and
K23 grants) vitamin D clinical research protocols designed to assess seasonal variation
and racial differences in vitamin D status of African American and Caucasian children
(short longitudinal observational study, n=140) and refine the serum 25(OH)D thresholds
for defining vitamin D insufficiency in children (randomized controlled trial [RCT] of
1000 IU of vitamin D3 vs. placebo for 6 months, n=116). Subjects were recruited from the Primary Care Center of the Children’s Hospital of Pittsburgh between June 2006 and December 2009. Children with hepatic or renal disease, metabolic rickets, malabsorptive disorders, cancer, or those on treatment with anticonvulsants or systemic glucocorticoids were excluded. Subjects enrolled in the RCT were either not taking multivitamins for at least 1 month prior to enrollment or willing to stop the multivitamin for a 1 month washout period prior to study entry. Children on oral contraceptives or depot medoroxyprogesterone were also excluded from the clinical trial. There were a total of 252 children with a mean age of 10.4 ± 2.2 years. African American children represented 68% of the group. Phase 1 of the Vitamin D and Sunlight Exposure Study occurred between 2006 and 2008. Participants were monitored for vitamin D intake and sunlight exposure. Phase II of the study, which occurred between 2008 and 2009, included randomization to a vitamin D supplement or placebo. The Vitamin D and Sunlight Exposure study protocol was approved by the University of Pittsburgh Institutional Review Board and all participants provided written informed consent. The current study protocol was approved by the Georgia State University Institutional Review Board.

Diet Analysis

In both phases of the study, parents of all subjects were asked to complete both a long food frequency questionnaire (LFFQ; Appendix B) and a short vitamin D intake and sunlight exposure questionnaire (SFFQ, Appendix A) at two time points, 6 months apart. The LFFQ was a semiquantitative food frequency questionnaire with 7 food groups and 152 questions. Completed SFFQs were analyzed using Food Processor (version 10.4,
The LFFQ, titled Eating Survey, K-95-1, (Harvard Medical School, © 1995 Brigham and Women’s Hospital) was analyzed at Brigham and Women’s Hospital. Vitamin D and calcium intake values were analyzed from the LFFQ as it was previously validated for use in children. The SFFQ included 21 questions to identify intake of foods high in vitamin D and calcium (e.g. cod liver oil, milk, cheese, yogurt, vitamin D and calcium fortified orange juice, fish and dried mushrooms) and had been validated against the LFFQ. After processing and analysis, nutrient intake data comprised 17 nutrients including total calories, dietary calcium, and vitamin D.

**Research Design**

The study was a cross sectional secondary quantitative data analysis of completed food frequency questionnaires from the Vitamin D and Sunlight Exposure study. Anthropometric data including height, weight, and BMI were calculated. Weight status was defined using Center for Disease Control growth charts. Subjects were classified as normal/underweight (<85th%ile), overweight (85th-95th%ile), or obese (>95%ile). Data were used to assess the correlation between vitamin D and calcium and BMI.

**Data Analysis**

All demographic, anthropometric and dietary intake data was entered into SPSS® (version 18, 2010, IBM Corp, Armonk, NY). Demographic characteristics and nutrient intake variables for the entire cohort as well as by gender and race were determined.
Normality statistics were run, with height, weight, age, and BMI being normally distributed. Vitamin D and calcium rich food sources were skewed, as well as vitamin D and calcium intake levels. Frequency analysis was used to ascertain proportions, anthropometric measures were analyzed, and median daily intake of vitamin D, calcium, and food servings were assessed. Differences in weight status by gender and race were assessed using the Chi-square test with Kendall’s tau c to measure the strength of the association. Differences in intake by weight status were assessed using the Kruskal-Wallis Test; pairwise comparisons were assessed using the Mann-Whitney U test. The Spearman’s rho correlation statistic was used to determine the association between BMI and calcium and vitamin D intake.

Results

A total of 252 adolescents participated in the study. Of these, 174 were self-reported as African American (55% male) and 78 as Caucasian (54% male). Participant age ranged from 6 to 14.9 years, with an average age of 10.4 ± 2.2 years (+SD). Body mass index (BMI) ranged from 13.78 to 46 kg/m², with an average of 20.2 ± 5.1 kg/m². Height and weight measures by gender and race are shown in Table 1. There were no significant differences between anthropometric values by race or gender (weight status by race and gender are in Table 2). Of the total population, 59.3% were classified as normal, 17.7% as overweight, and 23% as obese. There were no significant differences between weight status by gender. African Americans had a significantly higher proportion of obese participants (30.1%) than Caucasians (8.5%) (P=.001). Caucasian females had a significantly (P=.006) lower proportion of obese participants (2.9%) than African
American females who had the highest proportion overall (31.2%). A similar pattern was found in African American and Caucasian males (29.2% and 12.8% obesity, respectively), although the difference was not significant.

Median intake of vitamin D, calcium, and food sources were used in this analysis due to the skewed distribution of the data. For the total population, median daily intake (25%, 75%) of vitamin D and calcium was 254.9 IU (146.8, 407.3) and 1193.6 mg (752.8, 1161.1), respectively (Table 3). Males reported a higher median intake of vitamin D and calcium than did females, and African Americans reported higher intakes versus Caucasians. However, these differences were not statistically significant. Reported vitamin D and calcium intake by Caucasian females was the lowest among all subgroups. Caucasian males had the highest median daily intake of vitamin D (273.3 IU), while African American females reported the highest median daily intake of calcium (1237.4 mg). The primary sources of vitamin D and calcium intake for the total population were milk and cheese (Table 4). There were no significant differences in food intakes by gender (Table 5). In both African American and Caucasian adolescents, milk was the primary source of vitamin D and calcium, with both groups consuming a median of 2 servings of milk per day. Significant differences existed by race, as African Americans consumed more cheese (P=0.014) less yogurt (P=0.031) than did Caucasians (Table 6). Significant differences were seen in vitamin D and calcium fortified orange juice consumption as well, with African Americans consuming more orange juice than Caucasians (P=.045). When stratified by race and then gender, there were no significant differences in intake by vitamin D and calcium rich food source between males and females (Table 7).
Median vitamin D and calcium intakes by weight status for the total population, by race, and by gender are shown in Tables 8 and 9. For the total population, median vitamin D intake differed significantly by weight status (259.5 IU for normal weight subjects, 325.2 IU for overweight subjects, and 181.9 IU for obese subjects; P=0.015). Overweight subjects had the highest median vitamin D intake in the total population and most demographic groups, while obese subjects had the lowest intake in the total population and all demographic categories except Caucasian females (who also had the smallest sample size). Significant differences in vitamin D intake between weight classes were seen in African Americans (P=0.006), which may explain the differences in the total population vitamin D intake as it was majority African American (68%). When looking at differences between weight classes for vitamin D intake in African Americans and the total population, no differences were observed between those in the normal and overweight classifications. However, significant differences in intake were found between overweight and obese, and normal and obese weight classes in both the total population (P=0.005 and 0.032, respectively) and African Americans (P=0.005 and 0.033, respectively).

Median calcium intakes by weight class were similar to vitamin D, with significant differences between classes seen in the total population (P=0.016) and African Americans (P=0.013) (Table 9). In the total population, median daily calcium intake was reported for normal, overweight and obese subjects at 1193.4 mg, 1416.3 mg and 911.6 mg, respectively. The obese weight class had the lowest median intake across all demographic subgroups except Caucasian females, and overweight subjects had the highest median calcium intake in the total population and most demographic groups.
Significant differences were seen in African Americans and the total population between normal and overweight subjects (P=0.023 and 0.011, respectively), and overweight and obese subjects (P=0.006 and 0.006, respectively). No significant correlation was found between vitamin D or calcium intake and BMI in the total population (Figures 1 and 2), by race, or by gender, when tested both with and without outliers.

Discussion

Although no correlation was found with BMI and calcium and vitamin D intake, vitamin D and calcium intake was significantly different based on weight status, particularly in obese and African American subjects. Vitamin D and calcium intake in this population was below recommended guidelines, with obese children consuming less than overweight and normal/underweight groups. The proportion of obese subjects was significantly different by race, with more African Americans being obese than Caucasians (30.1% vs 8.5%, respectively). However, median intake of vitamin D and calcium did not differ by race or gender.

Currently, the RDA for vitamin D in children ages 1 to 18 is 600 IU/day (13). For calcium, the current RDA is 1000 mg/day for 4 to 8 year olds, and 1300 mg/day for those 9 to 18 years (13). The median vitamin D intake for the total population was 254.9 IU, well below the RDA value and the Estimated Average Requirement (EAR) of 400 IU/day (the amount necessary to meet the needs of 50% of the population). The median value for calcium intake for the total population was 1193.6 mg, which is above the RDA for 4-8 year olds, but below the RDA for 9-18 year olds. More information continues to
emerge regarding optimal 25 (OH)D levels, which has driven some researchers in the nutrition community to push for the RDA for vitamin D to be increased. Some of these researchers are also calling for a decrease in calcium intake as vitamin D intake rises (15). If raised further (some suggest to 2000 IU/day) (14), vitamin D intake in nearly the entire study population would be considered insufficient. Previous research has shown decreased vitamin D intake in children and adolescents, as only 50% of those aged 9-13 years and 32% of those aged 14-18 years consume sufficient vitamin D (23). Of the 252 subjects in our study, only 15 (6%) received at least the RDA of 600 IU, and only 66 (26.1%) consumed the EAR of >400 IU. The results from this study are consistent with previous findings of low/inadequate vitamin D and calcium intake among adolescents (9, 10, 15, 22, 23, 26).

It has been estimated that only 30% of American children consume the recommended amounts of calcium (22). 42.8% of participants in the current study consumed 1300mg or more calcium per day, which is well above national estimates, although still low. Previous studies have found milk to be the primary source of vitamin D and calcium in children's diets in the US, often contributing to more than 50% of daily calcium intakes (23). Data in this study are consistent for the most part, as milk was the most commonly consumed of the five vitamin D and calcium rich foods analyzed. When analyzed by race and gender, milk remained the most consumed product amongst the sources surveyed.

Generally speaking, experts consider healthy serum 25 (OH)D levels to be >50nmol/L, with greater than 75 nmol/L considered best for overall health (14, 17, 18). Considering the reduced sunlight exposure in westernized lifestyles (19), the vitamin D
intakes reported by early-adolescents in this study are alarming, particularly among African Americans. Nearly half of all African American children have 25 (OH)D levels below 50 nmol/L, as minorities with darker skin tone require more direct sunlight for vitamin D production (15, 17), as well as higher dietary intakes to reach similar serum levels to Caucasians (14, 18). Although no significant differences in intakes of calcium or vitamin D were found across races, the relatively low median vitamin D intakes of African Americans were well below the RDA and EAR, and could be linked to increased incidences of diseases and conditions in African Americans such as obesity, diabetes, and heart disease (14, 17, 18), as well as partially explain the significantly higher proportion of obese subjects in the group. Research has shown that populations with <1 serving per week of milk are at increased risk of vitamin D deficiency (26). However, African Americans and Caucasians in this study consumed approximately 14 servings of milk per week (Table 6).

The USDA Dietary Guidelines (39) recommends children 4 – 8 years old should consume 2.5 servings of dairy or more, and children over 8 should consume at least 3 servings per day. Participants in this study consumed a median of 2 servings of milk per day, along with 1.3 servings of other dairy and vitamin D fortified foods per day (Table 4). Although consistent with USDA recommendations, when analyzed for calcium and vitamin D intake, nearly all in the study were below RDAs for vitamin D and a majority below the RDA’s for calcium intake. One serving of fortified milk (1 cup) typically contains 120 IU vitamin D and 280 mg calcium. When considering vitamin D and calcium levels in dairy foods, three servings of dairy (milk in this case) do not meet RDA values. Alternate dairy sources are typically lower in calcium and vitamin D than milk,
and help explain some of the subpar intakes seen in subjects in the study. Considering the sub-par levels of vitamin D and calcium intake in subjects in this study and in the general population, clearer guidelines may be necessary for recommended servings of dairy per day.

Males consumed more dairy servings per day than females, and although there was no significant difference in intakes by gender, females fell below the recommended 3 servings per day. African American subjects consumed significantly more cheese, and fortified orange juice, but less yogurt than Caucasians. Although significant differences were observed in intakes of these food sources, if total servings of vitamin D and calcium rich food sources are counted, African Americans consumed 3.1 servings of dairy, versus 3 servings for Caucasians.

When subjects were separated by weight classification, significant differences in vitamin D and calcium intake in African Americans and in the total population were observed. No significant differences were observed in other demographic groups. Obese subjects in all demographic groups reported the lowest vitamin D and calcium intakes, except for Caucasian females. Normal weight Caucasian females had the lowest vitamin D intake. An explanation for low intakes amongst Caucasian females could be lower overall energy intake, partially explained by low dairy consumption, as this group associates increased dairy consumption with weight gain (16, 25). Higher overall vitamin D and calcium intake was observed in overweight subjects. This finding may be partially explained by increased dairy servings and energy intake overall, resulting in higher weights as well as vitamin D and calcium intake. Although this group may have an overall higher energy intake, the increased vitamin D and calcium intakes may have a
protective effect against obesity. Further analysis of this data could investigate vitamin D sources by weight class. Eighty to ninety percent of vitamin D production is endogenous (15). However, sunlight exposure in modern times is limited with western lifestyles (19), and alternate methods of vitamin D intake must be considered for low intake populations. The most efficient way to increase vitamin D intake is through supplementation (20). Given their low intakes, and the latitude of subjects in the study, supplementation would be the most efficient method for the population to reach adequate intakes of vitamin D. African Americans and other dark skinned minorities in higher latitudes could potentially benefit from vitamin D supplements, as they require more sunlight exposure and dietary intake to reach 25 (OH)D levels similar to Caucasians (14, 18). Currently, only 1 in 3 American children consume vitamin D supplements (15). And of those supplementing (typically 100-400 IU vitamin D2 or D3), 1 in 10 had 25 (OH)D levels below 50 nmol/L and 1 in 2 below 75 nmol/L (15). Higher calcium intakes can be encouraged through increases in calcium rich sources in the diet. However, additional calcium intake may not be necessary as the increased vitamin D may lower the need for dietary calcium (14). More research is necessary to determine the influence of increased dietary vitamin D intake and 25 (OH)D levels on calcium needs.

The prevalence of decreased calcium and vitamin D intake among obese subjects in the population is consistent with previous research (9, 10, 11). Inverse relationships have been observed between 25 (OH)D levels and body fat percentage, BMI, and total body fat (18). Although not analyzed, 25(OH)D levels would be assumed to be low in obese subjects due to the groups low intake levels and possible increased storage in adipocytes (20). The question then goes to why would low vitamin D intake contribute to
obesity? Some believe it may be due to vitamin D rich food sources such as dairy, which are rich in calcium. Increased intakes of calcium have been associated with decreased BMI and body fat levels (37). A mechanism for this association may be explained through calcium’s inhibition of the conversion of 25 (OH)D to calcitriol (21). Calcitriol has been shown to promote adipocyte proliferation, inflammatory factors, and inhibit adipocyte apoptosis (21). Higher calcium intakes have proven to be effective in stimulating weight loss and weight control (32, 33), so it may be possible that with increased vitamin D comes more efficient use of calcium by the body, and therefore decreased fat stores (21). It is speculated that calcium rich foods may be associated with increased satiety due to the presence of casein macro-peptides and through regulation of gut hormones (37). Taking into account skin color and its influence on vitamin D production, racial differences in proportions of obesity may be partially explained via vitamin D and calcium's synergistic mechanisms regulating fat deposition, despite relative the insignificance of intake levels between races.

This study has both strengths and limitations. The strengths of this study include the large sample size and the use of a validated and comprehensive FFQ. However, the FFQ is subject to recall bias as well as error, given that it was completed by parents of subjects in the study. Ideally, a combination of methods for dietary data collection should be used, as validated FFQs sometimes lack validity when compared to 3 day food diaries and 24 hour recalls (29, 31). Participants were recruited via convenience sample from a single pediatric healthcare clinic in Pittsburgh, Pennsylvania, and may not be representative of the general population. Other factors that can influence vitamin D
status in an individual, such as amount of sunlight received, were not included in this
analysis. Statistical software cannot account for variations in vitamin D and calcium
content of different food sources, and may not accurately reflect intakes. Subjects were
classified as being normal weight, overweight or obese. We do not know if any of the
subjects in the normal weight category were underweight. In addition, given that this was
a cross sectional secondary data analysis, it is possible to suggest an association between
vitamin D and calcium intake and obesity, but impossible to determine cause and effect
between the two variables. Future research is needed to draw sound conclusions.
Sources of vitamin D and calcium intake by weight classification as well as the impact of
total daily caloric intake on the association between nutrient intake and BMI should be
determined. Phase II of Dr. Rajakumar’s study is a randomized clinical trial which aims
to determine the impact of vitamin D supplementation on serum vitamin D status.
Secondary analysis of the impact of diet and supplementation will then be possible in this
population.

Conclusion

The studies’ findings were consistent with previous literature regarding
inadequate vitamin D and calcium intake in children. Weight status, but not BMI was
negatively associated with vitamin D and calcium intake in young adolescents,
particularly in African Americans. Significant differences were not seen by gender. The
proportion of obese subjects was significantly different by race, with more African
Americans classified obese than Caucasians (30.1% vs 8.5%). However, median intake
of vitamin D and calcium did not differ by race or gender. Future research is necessary to
determine the complex interactions of vitamin D and calcium intakes/status in obese children.
References


Table 1. Mean Anthropometric Values at Baseline by Gender and Race*

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*Mean ± SD
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<td>Total Population</td>
<td>252</td>
<td>59.3%</td>
<td>17.7%</td>
<td>23.0%</td>
</tr>
<tr>
<td>Male</td>
<td>137</td>
<td>61.0%</td>
<td>15.4%</td>
<td>23.5%</td>
</tr>
<tr>
<td>Female</td>
<td>115</td>
<td>57.1%</td>
<td>20.5%</td>
<td>22.3%</td>
</tr>
<tr>
<td>African American</td>
<td>174</td>
<td>53.0%</td>
<td>16.9%</td>
<td>30.1%*</td>
</tr>
<tr>
<td>Male</td>
<td>95</td>
<td>55.1%</td>
<td>15.7%</td>
<td>29.2%</td>
</tr>
<tr>
<td>Female</td>
<td>78</td>
<td>50.6%</td>
<td>18.2%</td>
<td>31.2%*</td>
</tr>
<tr>
<td>Caucasian</td>
<td>78</td>
<td>72.0%</td>
<td>19.5%</td>
<td>8.5%</td>
</tr>
<tr>
<td>Male</td>
<td>42</td>
<td>72.3%</td>
<td>14.9%</td>
<td>12.8%</td>
</tr>
<tr>
<td>Female</td>
<td>36</td>
<td>71.4%</td>
<td>25.7%</td>
<td>2.9%</td>
</tr>
</tbody>
</table>

*P<0.01
Table 3. Median Vitamin D and Calcium Intake by Race and Gender

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Vitamin D (IU)</th>
<th>Calcium (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(25%, 75%)</td>
<td>(25%, 75%)</td>
</tr>
<tr>
<td>Total Population</td>
<td>252</td>
<td>254.9 (146.8, 407.3)</td>
<td>1193.6 (752.8, 1161.1)</td>
</tr>
<tr>
<td>Male</td>
<td>137</td>
<td>272 (146.8, 422.7)</td>
<td>1196.3 (736.5, 1686.6)</td>
</tr>
<tr>
<td>Female</td>
<td>115</td>
<td>229.8 (147.4, 387.8)</td>
<td>1154.6 (789.4, 1158.5)</td>
</tr>
<tr>
<td>African American</td>
<td>174</td>
<td>259 (150.7, 407.7)</td>
<td>1211.9 (751, 1674.1)</td>
</tr>
<tr>
<td>Male</td>
<td>95</td>
<td>270.7 (143.8, 414.1)</td>
<td>1180.3 (699.7, 1725.3)</td>
</tr>
<tr>
<td>Female</td>
<td>79</td>
<td>244.3 (166.5, 395)</td>
<td>1237.4 (837.4, 1600.9)</td>
</tr>
<tr>
<td>Caucasian</td>
<td>78</td>
<td>222.6 (133.1, 410.8)</td>
<td>1188 (762.2, 1556.5)</td>
</tr>
<tr>
<td>Male</td>
<td>42</td>
<td>273.3 (163.1, 428.1)</td>
<td>1236.1 (770.9, 1631.4)</td>
</tr>
<tr>
<td>Female</td>
<td>36</td>
<td>182.3 (143.8, 414.1)</td>
<td>927.4 (695.2, 1444.4)</td>
</tr>
</tbody>
</table>

*Median (25%, 75%)
Table 4. Median Daily Food Intake for the Total Population

<table>
<thead>
<tr>
<th>Servings Per Day</th>
<th>N</th>
<th>Median (25%, 75%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>245</td>
<td>2 (1, 3)</td>
</tr>
<tr>
<td>Special Milk*</td>
<td>200</td>
<td>0 (0, 1)</td>
</tr>
<tr>
<td>Cheese</td>
<td>232</td>
<td>1 (1, 2)</td>
</tr>
<tr>
<td>Vitamin D &amp; Calcium Fortified Orange Juice</td>
<td>200</td>
<td>0 (0, 1)</td>
</tr>
<tr>
<td>Yogurt</td>
<td>226</td>
<td>0.03 (0, 1)</td>
</tr>
</tbody>
</table>

*Special milk – chocolate milk, soy milk, Lactaid®; **Median (25%, 75%)
Table 5. Median Daily Food Intake by Gender

<table>
<thead>
<tr>
<th>Servings Per Day</th>
<th>Male (25%, 75%)</th>
<th>Female (25%, 75%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>2 (1, 3)</td>
<td>1.5 (1, 2.5)</td>
<td>0.336</td>
</tr>
<tr>
<td>Special Milk*</td>
<td>0 (0, 1.38)</td>
<td>0 (0, 1)</td>
<td>0.891</td>
</tr>
<tr>
<td>Cheese</td>
<td>1 (1, 2)</td>
<td>1 (1, 2)</td>
<td>0.766</td>
</tr>
<tr>
<td>Vitamin D &amp; Calcium</td>
<td>0 (0, 1)</td>
<td>0.1 (0, 1)</td>
<td>0.560</td>
</tr>
<tr>
<td>Fortified Orange Juice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yogurt</td>
<td>0.1 (0, 1)</td>
<td>0 (0, 1)</td>
<td>0.813</td>
</tr>
</tbody>
</table>

*Special milk – chocolate milk, soy milk, Lactaid®; **Median (25%, 75%)
Table 6. Median Daily Food Intake by Race*

<table>
<thead>
<tr>
<th>Servings per day</th>
<th>African American</th>
<th>Caucasian</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Median</td>
<td>N</td>
</tr>
<tr>
<td>Milk</td>
<td>164</td>
<td>2 (1, 3)</td>
<td>81</td>
</tr>
<tr>
<td>Special Milk*</td>
<td>133</td>
<td>0 (0, 1.5)</td>
<td>67</td>
</tr>
<tr>
<td>Cheese</td>
<td>152</td>
<td>1 (1, 2)</td>
<td>80</td>
</tr>
<tr>
<td>Vitamin D &amp; Calcium Fortified</td>
<td>137</td>
<td>0.1 (0, 1)</td>
<td>63</td>
</tr>
<tr>
<td>Orange Juice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yogurt</td>
<td>150</td>
<td>0 (0, 1)</td>
<td>76</td>
</tr>
</tbody>
</table>

*Special milk – chocolate milk, soy milk, Lactaid®; **Median (25%, 75%)
<table>
<thead>
<tr>
<th>Servings per day</th>
<th>African American (N=174)</th>
<th>Caucasian (N=78)</th>
<th>P-value</th>
<th>African American (N=174)</th>
<th>Caucasian (N=78)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>(25%, 75%)</td>
<td>Male</td>
<td>Female</td>
<td>(25%, 75%)</td>
</tr>
<tr>
<td>Milk</td>
<td>2</td>
<td>1.5</td>
<td>0.234</td>
<td>2</td>
<td>1.5</td>
<td>0.969</td>
</tr>
<tr>
<td></td>
<td>(1, 3)</td>
<td>(1, 2.5)</td>
<td></td>
<td>(1, 2.5)</td>
<td>(1, 3)</td>
<td></td>
</tr>
<tr>
<td>Special Milk*</td>
<td>0</td>
<td>0.5</td>
<td>0.733</td>
<td>0</td>
<td>0</td>
<td>0.960</td>
</tr>
<tr>
<td></td>
<td>(0, 1.5)</td>
<td>(0, 1)</td>
<td></td>
<td>(0, 1.25)</td>
<td>(0, 1.5)</td>
<td></td>
</tr>
<tr>
<td>Cheese</td>
<td>1.25</td>
<td>1</td>
<td>0.564</td>
<td>1</td>
<td>1</td>
<td>0.964</td>
</tr>
<tr>
<td></td>
<td>(1, 3)</td>
<td>(1, 2)</td>
<td></td>
<td>(0.5, 2)</td>
<td>(0.88, 1.63)</td>
<td></td>
</tr>
<tr>
<td>Vitamin D &amp; Calcium</td>
<td>0</td>
<td>0.35</td>
<td>0.710</td>
<td>0</td>
<td>0</td>
<td>0.856</td>
</tr>
<tr>
<td>Fortified Orange Juice</td>
<td>(0, 1)</td>
<td>(0, 1)</td>
<td>(0, 0.5)</td>
<td>(0, 1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yogurt</td>
<td>1</td>
<td>0</td>
<td>0.793</td>
<td>0.3</td>
<td>1</td>
<td>0.830</td>
</tr>
<tr>
<td></td>
<td>(0, 1)</td>
<td>(0, 1)</td>
<td></td>
<td>(0, 1)</td>
<td>(0, 1)</td>
<td></td>
</tr>
</tbody>
</table>

*Special milk chocolate milk, soy milk, Lactaid®; **Median (25%, 75%)
<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Normal Weight (n=148)</th>
<th>Overweight (n=45)</th>
<th>Obese (n=59)</th>
<th>P - Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Population</strong></td>
<td>252</td>
<td>259.5 (150.7, 407.5)†</td>
<td>325.2 (205.9, 497.6)‡</td>
<td>181.9 (118.3, 330.1)</td>
<td>0.015</td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td>137</td>
<td>323.2 (163.5, 431.1)</td>
<td>307.2 (207.6, 440.3)</td>
<td>184.4 (124.4, 396.7)</td>
<td>0.203</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>115</td>
<td>210.5 (132.8, 348)</td>
<td>342 (188.1, 532.7)</td>
<td>166.9 (104.4, 327.6)</td>
<td>0.127</td>
</tr>
<tr>
<td><strong>African American</strong></td>
<td>174</td>
<td>254.9 (162.4, 411.5)†</td>
<td>342 (224.2, 460.5)‡</td>
<td>177.1 (120, 329.5)</td>
<td>0.006</td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td>95</td>
<td>289.9 (161.4, 421.7)</td>
<td>307.2 (245.5, 415.3)</td>
<td>186.9 (131.9, 407.7)</td>
<td>0.294</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>78</td>
<td>215.4 (159.8, 382)</td>
<td>359.3 (215, 502.5)</td>
<td>166.9 (107.5, 324.6)</td>
<td>0.155</td>
</tr>
<tr>
<td><strong>Caucasian</strong></td>
<td>78</td>
<td>273.3 (132.4, 406.1)</td>
<td>244.4 (141.2, 645.8)</td>
<td>181.9 (107.1, 444.3)</td>
<td>0.486</td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td>42</td>
<td>344.8 (163.1, 445.8)</td>
<td>293.7 (163.8, 603.1)</td>
<td>181.9 (114.5, 490.9)</td>
<td>0.352</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>36</td>
<td>198.8 (125.5, 344.2)</td>
<td>230.2 (135.7, 686)</td>
<td>264.6 (**)</td>
<td>1</td>
</tr>
</tbody>
</table>

*Median (25%, 75%); (**)= Sample too small for percentile rank; †=Difference between normal and obese (P<0.05)
‡=Difference between overweight and obese (P<0.01)
Table 9. Median Calcium Intake (mg) by Weight Classification, Race and Gender*

<table>
<thead>
<tr>
<th></th>
<th>Normal Weight (N=148)</th>
<th>Overweight (N=45)</th>
<th>Obese (N=59)</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total Population</strong></td>
<td>1193.4 (758.1, 1586.8)†</td>
<td>1416.3 (938.8, 1925.6)‡</td>
<td>911.6 (598, 1580.7)</td>
<td>0.016</td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td>1229.7 (754.6, 1651.4)</td>
<td>1444.8 (937.8, 1777.3)</td>
<td>905.5 (563.3, 1506.2)</td>
<td>0.107</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>1020.5 (765.9, 1483.3)</td>
<td>1407.6 (938.8, 2188.1)</td>
<td>911.7 (626.2, 1580.8)</td>
<td>0.063</td>
</tr>
<tr>
<td><strong>African American</strong></td>
<td>1202.5 (771.8, 1661.5)†</td>
<td>1534 (1128.3, 1865.1)‡</td>
<td>903.2 (601.1, 1570.3)</td>
<td>0.013</td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td>1225 (751, 1674.1)</td>
<td>1535.5 (1074.6, 1806.9)</td>
<td>751.5 (538.3, 1538.9)</td>
<td>0.139</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>1111.9 (793.6, 1426.6)</td>
<td>1505.5 (1169.8, 2188.1)</td>
<td>911.7 (645.7, 1580.8)</td>
<td>0.060</td>
</tr>
<tr>
<td><strong>Caucasian</strong></td>
<td>1193.4 (745.8, 1506)</td>
<td>1088.9 (796.9, 2028.6)</td>
<td>1049.6 (552.4, 1697.7)</td>
<td>0.486</td>
</tr>
<tr>
<td><strong>Male</strong></td>
<td>1236.1 (758.1, 1528.1)</td>
<td>1114.4 (832.9, 1840.6)</td>
<td>1049.6 (583.9, 1847.4)</td>
<td>0.352</td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td>939.1 (694.5, 1500.6)</td>
<td>1073.1 (780.2, 2588.7)</td>
<td>1104.9 (***)</td>
<td>1.000</td>
</tr>
</tbody>
</table>

*Median (25%, 75%); (***)= Sample too small for percentile rank; †=Difference between normal and overweight (P<0.05); ‡=Difference between overweight and obese (P<0.01)
Figure 1. Correlation between BMI and Calcium Intake for the Total Population
Figure 2. Correlation between BMI and Vitamin D Intake for the Total Population
APPENDIX A

VITAMIN D & SUNLIGHT EXPOSURE QUESTIONNAIRE

Subject ID: 564201  Subject Initials: AC  Interview Date: 5-4-09

1. DOB: 9-19-85
2. Age: 13
3. Height (cm): 154.5cm
4. Weight: (kg): 46

5. Ethnic Group:
   ☐ Hispanic or Latino  ☑ Not Hispanic or Latino  ☐ Unknown/Declined

6. Race:
   ☐ American Indian/Alaskan Native  ☐ Asian American
   ☐ Native Hawaiian/Pacific Islander  ☐ Black or African American
   ☑ White or Caucasian  ☐ More than one race

7. Does your child take a multivitamin?
   ☑ Yes  ☐ No
   If yes, Specify brand: Flintstones
   How often does he/she take the Multivitamin: Daily

8. Does your child take a calcium supplement?
   ☐ Yes  ☐ No
   If yes, Specify brand: 
   How often does he/she take the Calcium supplement: 

9. Does your child take a vitamin D supplement?
   ☐ Yes  ☐ No
   If yes, Specify brand: 
   How often does he/she take the Vitamin D supplement: 

10. Does your child take Cod Liver Oil?
    ☐ Yes  ☐ No
    If yes, specify how much per day: 

11. On average, how many glasses (8 ounce/glass) of milk does your child drink per day?

12. Besides milk, does your child take other dairy foods that may have been fortified with vitamin D?
   If yes, how many glasses (8 ounce/glass) of Soy milk or Lactaid milk or Chocolate milk does your child drink per day? __________
   How many servings of cheese (1 ounce per serving or slice) does your child eat per day? __________
   How many servings (1 cup/serving) of yogurt does your child eat per day? __________

13. Does your child take vitamin D-fortified orange juice?
   If yes, how many glasses (8 ounce/glass) of vitamin D fortified orange juice does your child drink per day? __________

14. On average, how many times per month does your child eat the following foods?

<table>
<thead>
<tr>
<th></th>
<th>None (0)</th>
<th>1x/month</th>
<th>2x/month</th>
<th>3x/month</th>
<th>&gt;4x/month, if &gt;4, write in #</th>
</tr>
</thead>
<tbody>
<tr>
<td>14a</td>
<td>Baked/fried fish</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14b</td>
<td>Lox</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14c</td>
<td>Herrings</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14d</td>
<td>Salmon</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14e</td>
<td>White fish</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14f</td>
<td>Sardines</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14g</td>
<td>Mackerel</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14h</td>
<td>Dried Mushrooms</td>
<td>✗</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

15. Does your child drink a nutrition supplement like Ensure, Pediasure or Carnation Instant Breakfast?
   □ Yes  □ No
   If yes, how many times per day: ______________________
   Specify brand: ______________________

16. Does your child eat breakfast cereal?
   □ Yes    □ No
   If yes, how many bowels per week:
   Specify brand(s): Cheetos Puffs, Shredded Wheat
17. Does your child take breakfast bars or protein bars?
☐ Yes ☐ No
If yes:
   How many servings (1 bar/serving) per week: 
   Specify brand (s):

18. On average, in the summer how many hours per day does your child spend outside in the sun each day?
☐ 2 hours or less ☑ More than 2 hours
If more than 2 hours specify the number of hours: 6

19. When your child spends time outside, which of the following body parts are usually exposed?

<table>
<thead>
<tr>
<th>No (0)</th>
<th>Yes (1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>19a Face</td>
<td></td>
</tr>
<tr>
<td>19b Hands</td>
<td></td>
</tr>
<tr>
<td>19c Arms</td>
<td></td>
</tr>
<tr>
<td>19d Legs</td>
<td></td>
</tr>
</tbody>
</table>

20. Do you apply sunscreen on your child when he or she goes outside?
☐ Yes ☐ No
If yes,
   20a. What brand do you use?
   20b. What SPF (Sun Protection Factor) do you use?
   20c. How often do you use sunscreen on your child?
      ☐ Often ☐ Sometimes ☑ Seldom

21. Did your child travel to a sunny location for a holiday?
☐ Yes ☐ No
If yes,
   21a. Where did your child visit?
   21b. When did your child travel?
   21c. How many days did your child spend in the sunny location:

*Adapted from Dr. Michael Holick’s vitamin D questionnaire*
**APPENDIX B**

**MARKING INSTRUCTIONS**
- Use a NO. 2 PENCIL only.
- Do not use ink or ballpoint pen.
- Darken in the circle completely.
- Erase cleanly any marks you wish to change.
- Do not make any stray marks on this form.

The RIGHT way to mark your answer!

The WRONG way to mark your answers!

**EATING SURVEY**

**PAGE ONE**

**The 56**

**EATING SURVEY**

**K-95-1 HARVARD MEDICAL SCHOOL**

**MARKING INSTRUCTIONS**
- Use a NO. 2 PENCIL only.
- Do not use ink or ballpoint pen.
- Darken in the circle completely.
- Erase cleanly any marks you wish to change.
- Do not make any stray marks on this form.

**Questionnaire refers to what you ate over the past year.**

1. **What is your AGE?**
   - Less than 9
   - 9
   - 10
   - 11
   - 12
   - 18 or older

2. **Are you:**
   - Male
   - Female

3. **Your Height:**
   - 4
   - 5
   - 6
   - 7
   - 8
   - 9
   - 10
   - 11
   - 12
   - 13
   - 14
   - 15
   - 16
   - 17
   - 18
   - 19
   - 20
   - 21
   - 22
   - 23
   - 24
   - 25
   - 26
   - 27
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   - 46
   - 47
   - 48
   - 49
   - 50
   - 51
   - 52
   - 53
   - 54
   - 55
   - 56
   - 57
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   - 97
   - 98
   - 99
   - 100

4. **Your Weight (lb):**
   - 40
   - 50
   - 60
   - 70
   - 80
   - 90
   - 100
   - 110
   - 120
   - 130
   - 140
   - 150
   - 160
   - 170
   - 180
   - 190
   - 200
   - 210
   - 220
   - 230
   - 240
   - 250
   - 260
   - 270
   - 280
   - 290
   - 300
   - 310
   - 320
   - 330
   - 340
   - 350
   - 360
   - 370
   - 380
   - 390
   - 400
   - 410
   - 420
   - 430
   - 440
   - 450
   - 460
   - 470
   - 480
   - 490
   - 500
   - 510
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   - 590
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   - 610
   - 620
   - 630
   - 640
   - 650
   - 660
   - 670
   - 680
   - 690
   - 700
   - 710
   - 720
   - 730
   - 740
   - 750
   - 760
   - 770
   - 780
   - 790
   - 800
   - 810
   - 820
   - 830
   - 840
   - 850
   - 860
   - 870
   - 880
   - 890
   - 900
   - 910
   - 920
   - 930
   - 940
   - 950
   - 960
   - 970
   - 980
   - 990
   - 1000

5. **Do you now take vitamins (like Flintstones, One-A-Day, etc.)?**
   - No
   - Yes

6. **How many teaspoons of sugar do you ADD to your beverages or food each day?**
   - None/less than 1 teaspoon per day
   - 1 - 2 teaspoons per day
   - 3 - 4 teaspoons per day
   - 5 or more teaspoons per day

7. **Which cold breakfast cereal do you usually eat?**
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6
   - 7
   - 8
   - 9
   - 10
   - 11
   - 12
   - 13

8. **Where do you usually eat breakfast?**
   - At home
   - At school
   - Don't eat breakfast
   - Other

9. **How many times each week (including weekdays and weekends) do you usually eat breakfast prepared away from home?**
   - Never or almost never
   - 1 - 2 times per week
   - 3 - 4 times per week
   - 5 or more times per week

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10. How many times each week (including weekdays and weekends) do you usually eat lunch prepared away from home?
   - Never or almost never
   - 1 - 2 times per week
   - 3 - 4 times per week
   - 5 or more times per week

11. How many times each week do you usually eat after-school snacks or foods prepared away from home?
   - Never or almost never
   - 1 - 2 times per week
   - 3 - 4 times per week
   - 5 or more times per week

12. How many times each week (weekdays and weekends) do you usually eat dinner prepared away from home?
   - Never or almost never
   - 1 - 2 times per week
   - 3 - 4 times per week
   - 5 or more times per week

13. How many times per week do you prepare dinner for yourself (and/or others in your house)?
   - Never or almost never
   - Less than once per week
   - 1 - 2 times per week
   - 3 - 4 times per week
   - 5 or more times per week

14. How often do you have dinner that is ready made, like frozen dinners, Spaghetti-O's, microwave meals, etc.
   - Never/less than once per month
   - 1 - 2 times per week
   - 3 - 4 times per week
   - 5 or more times per week

15. How many times each week (including weekdays and weekends) do you eat late night snacks prepared away from home?
   - Never/less than once per month
   - 1 - 2 times per week
   - 3 - 4 times per week
   - 5 or more times per week

16. How often do you eat food that is fried at home, like fried chicken?
   - Never/less than once per week
   - 1 - 3 times per week
   - 4 - 6 times per week
   - Daily

17. How often do you eat fried food away from home (like french fries, chicken nuggets)?
   - Never/less than once per week
   - 1 - 3 times per week
   - 4 - 6 times per week
   - Daily

**Dietary Intake**

How often do you eat the following foods:

**Example:** If you drink one can of diet soda 2 - 3 times per week, then your answer should look like this:

E1. Diet soda (1 can or glass)
   - Never
   - 1 - 3 cans per month
   - 1 can per week
   - 2 - 6 cans per week
   - 1 can per day
   - 2 or more cans per day
### Beverages

**18. Diet soda (1 can or glass)**
- Never or less than 1 per month
- 1 - 3 cans per month
- 1 can per week
- 2 - 6 cans per week
- 1 can per day
- 2 or more cans per day

**19. Sodas - not diet (1 can or glass)**
- Never or less than 1 per month
- 1 - 3 cans per month
- 1 can per week
- 2 - 6 cans per week
- 1 can per day
- 2 or more cans per day

**20. Hawaiian Punch, lemonade, Koolaid or other non-carbonated fruit drink (1 glass)**
- Never or less than 1 per month
- 1 - 3 glasses per month
- 1 glass per week
- 2 - 4 glasses per week
- 3 - 6 glasses per week
- 1 glass per day
- 2 or more glasses per day

**21. Iced Tea - sweetened (1 glass, can or bottle)**
- Never or less than 1 per month
- 1 - 3 glasses per month
- 1 - 4 glasses per week
- 5 - 6 glasses per week
- 1 or more glasses per day

**22. Tea (1 cup)**
- Never or less than 1 per month
- 1 - 3 cups per month
- 1 - 2 cups per week
- 3 - 6 cups per week
- 1 or more cups per day

**23. Coffee - not decaf. (1 cup)**
- Never or less than 1 per month
- 1 - 3 cups per month
- 1 - 2 cups per week
- 3 - 6 cups per week
- 1 or more cups per day

**24. Beer (1 glass, bottle or can)**
- Never or less than 1 per month
- 1 - 3 cans per month
- 1 can per week
- 2 or more cans per week

**25. Wine or wine coolers (1 glass)**
- Never or less than 1 per month
- 1 - 3 glasses per month
- 1 glass per week
- 2 or more glasses per week

**26. Liquor, like vodka or rum (1 drink or shot)**
- Never or less than 1 per month
- 1 - 3 drinks per month
- 1 drink per week
- 2 - 6 drinks per week
- 1 drink per day
- 2 - 4 drinks per day
- 5 or more drinks per day

### Dairy Products

**27. What type of milk do you usually drink?**
- Whole milk
- 2% milk
- 1% milk
- Skim/horrible milk
- Don't know
- Don't drink milk

**28. Milk (glass or with cereal)**
- Never or less than 1 per month
- 1 glass per week or less
- 2 - 6 glasses per week
- 1 glass per day
- 2 - 3 glasses per day
- 4 or more glasses per day

**29. Chocolate milk (glass)**
- Never or less than 1 per month
- 1 - 3 glasses per month
- 1 glass per week
- 2 - 6 glasses per week
- 1 - 2 glasses per day
- 3 or more glasses per day
<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
</tr>
</thead>
</table>
| 30. Instant Breakfast Drink | ○ Never/less than 1 per month  
○ 1 - 3 times per month  
○ Once per week  
○ 2 - 4 times per week  
○ 5 or more times per week |
| 31. Whipped cream | ○ Never/less than 1 per month  
○ 1 - 3 times per month  
○ Once per week  
○ 2 - 4 times per week  
○ 5 or more times per week |
| 32. Yogurt (1 cup) - Not frozen | ○ Never/less than 1 per month  
○ 1 - 3 cups per month  
○ 1 cup per week  
○ 2 - 6 cups per week  
○ 1 cup per day  
○ 2 or more cups per day  
○ 2 or more times per week |
| 33. Cottage or ricotta cheese | ○ Never/less than 1 per month  
○ 1 - 3 times per month  
○ Once per week  
○ 2 or more times per week  
○ 1 slice per day  
○ 2 or more slices per day |
| 34. Cheese (1 slice) | ○ Never/less than 1 per month  
○ 1 - 3 slices per month  
○ 1 slice per week  
○ 2 - 6 slices per week  
○ 1 slice per day  
○ 2 or more slices per day |
| 35. Cream cheese | ○ Never/less than 1 per month  
○ 1 - 3 times per month  
○ Once per week  
○ 2 or more times per week |
| 36. What TYPE of yogurt, cottage cheese & dairy products (besides milk) do you use mostly? | ○ Nonfat  
○ Lowfat  
○ Regular  
○ Don't know |
| 37. Butter (1 pat) - NOT margarine | ○ Never/less than 1 per month  
○ 1 - 3 pats per month  
○ 1 pat per week  
○ 2 - 6 pats per week  
○ 1 pat per day  
○ 2 - 4 pats per day  
○ 5 or more pats per day |
| 38. Margarine (1 pat) - NOT butter | ○ Never/less than 1 per month  
○ 1 - 3 pats per month  
○ 1 pat per week  
○ 2 - 6 pats per week  
○ 1 pat per day  
○ 2 - 4 pats per day  
○ 5 or more pats per day |
| 39. What FORM and BRAND of margarine does your family usually use? | ○ None  
○ Stick  
○ Tub  
○ Squeeze (liquid) |
| 40. What TYPE of oil does your family use at home? | ○ Canola oil  
○ Corn oil  
○ Safflower oil  
○ Olive oil  
○ Vegetable oil  
○ Don't know |

**Main Dishes**

<table>
<thead>
<tr>
<th>Question</th>
<th>Options</th>
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</thead>
</table>
| 41. Cheeseburger (1) | ○ Never/less than 1 per month  
○ 1 - 3 per month  
○ One per week  
○ 2 - 4 per week  
○ 5 or more per week |
| 42. Hamburger (1) | ○ Never/less than 1 per month  
○ 1 - 3 per month  
○ One per week  
○ 2 - 4 per week  
○ 5 or more per week |
| 43. Pizza (2 slices) | ○ Never/less than 1 per month  
○ 1 - 3 times per month  
○ Once per week  
○ 2 - 4 times per week  
○ 5 or more times per week |
| 44. Tacos/Burritos (1) | ○ Never/less than 1 per month  
○ 1 - 3 per month  
○ One per week  
○ 2 - 4 per week  
○ 5 or more per week |
| 45. Which taco filling do you usually have: | ○ Beef  
○ Chicken  
○ Beans  
○ beef & beans  
○ beef  
○ chicken |
| 46. Chicken nuggets (8) | ○ Never/less than 1 per month  
○ 1 - 3 times per month  
○ Once per week  
○ 2 - 4 times per week  
○ 5 or more times per week |
<table>
<thead>
<tr>
<th></th>
<th>Questionnaire refers to what you ate over the past year.</th>
</tr>
</thead>
<tbody>
<tr>
<td>47. Hot dogs (1)</td>
<td>48. Peanut butter sandwich (1) (plain or with jelly, fluff, etc.)</td>
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<tr>
<td></td>
<td>- Never less than 1 per month</td>
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<td>- 1 - 3 times per month</td>
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<td>- One per week</td>
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<td>- 2 - 4 times per week</td>
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<td>- 5 or more times per week</td>
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<tr>
<td>50. Roast beef or ham sandwich (1)</td>
<td>51. Salami, bologna, or other deli meat sandwich (1)</td>
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<tr>
<td></td>
<td>- Never less than 1 per month</td>
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<td>- 1 - 3 times per month</td>
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<td>- One per week</td>
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<td>- 2 or more times per week</td>
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<tr>
<td>53. Chicken or turkey as main dish (1 serving)</td>
<td>54. Fish sticks, fish cakes or fish sandwich (1 serving)</td>
</tr>
<tr>
<td></td>
<td>- Never less than 1 per month</td>
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<td>- 1 - 3 times per month</td>
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<td>- 2 - 4 times per week</td>
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<td>- 5 or more times per week</td>
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<tr>
<td>56. Beef (steak, roast) or lamb as main dish (1 serving)</td>
<td>57. Pork or ham as main dish (1 serving)</td>
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<tr>
<td></td>
<td>- Never less than 1 per month</td>
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<td>- 1 - 3 times per month</td>
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<td>- 5 or more times per week</td>
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<tr>
<td>59. Lasagna/baked ziti (1 serving)</td>
<td>60. Macaroni and cheese (1 serving)</td>
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<td>- Never less than 1 per month</td>
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<td>- 1 - 3 times per month</td>
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<td>- Once per week</td>
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<td>- 2 or more times per week</td>
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<tr>
<td>62. Eggs (1)</td>
<td>63. Liver, beef, sausage, chicken or pork (1 serving)</td>
</tr>
<tr>
<td></td>
<td>- Never less than 1 per month</td>
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<td></td>
<td>- 1 - 3 eggs per month</td>
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<td>- One egg per week</td>
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<td>- 2 - 4 eggs per week</td>
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<td>- 5 or more eggs per week</td>
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<td>Question</td>
<td>Options</td>
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<tr>
<td>65. French toast (2 slices)</td>
<td>Never/less than 1 per month, 1 - 3 times per month, Once per week, 2 or more times per week</td>
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<tr>
<td>66. Grilled cheese (1)</td>
<td>Never/less than 1 per month, 1 - 3 times per month, Once per week, 2 or more times per week</td>
</tr>
<tr>
<td>67. Eggrolls (1)</td>
<td>Never/less than 1 per month, 1 - 3 times per month, Once per week, 2 or more times per week</td>
</tr>
<tr>
<td>68. Brown gravy</td>
<td>Never/less than 1 per month, Once per week or less, 2 - 5 times per week, Once per day, 2 or more times per day</td>
</tr>
<tr>
<td>69. Ketchup</td>
<td>Never/less than 1 per month, 1 - 3 times per month, Once per week, 2 - 4 times per week, 5 or more times per week</td>
</tr>
<tr>
<td>70. Clear soup (with rice, noodles, vegetables) 1 bowl</td>
<td>Never/less than 1 per month, 1 - 3 bowls per month, 1 bowl per week, 2 or more bowls per week</td>
</tr>
<tr>
<td>71. Cream (milk) soups or chowder (1 bowl)</td>
<td>Never/less than 1 per month, 1 - 3 bowls per month, 1 bowl per week, 2 - 5 bowls per week, 1 or more bowls per day</td>
</tr>
<tr>
<td>72. Mayonnaise</td>
<td>Never/less than 1 per month, 1 - 3 times per month, Once per week, 2 - 6 times per week, Once per day</td>
</tr>
<tr>
<td>73. Low calorie/fat salad dressing</td>
<td>Never/less than 1 per month, 1 - 3 times per month, Once per week, 2 - 6 times per week, Once or more per day</td>
</tr>
<tr>
<td>74. Salad dressing (not low calorie)</td>
<td>Never/less than 1 per month, 1 - 3 times per month, Once per week, 2 - 5 times per week, Once or more per day</td>
</tr>
<tr>
<td>75. Salsa</td>
<td>Never/less than 1 per month, 1 - 3 times per month, Once per week, 2 - 6 times per week, Once or more per day</td>
</tr>
<tr>
<td>76. How much fat on your beef, pork, or lamb do you eat?</td>
<td>Eat all, Eat some, Eat none, Don't eat meat</td>
</tr>
<tr>
<td>77. When you have chicken or turkey, do you eat the skin?</td>
<td>Yes, No, Sometimes</td>
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<tr>
<td>BREADS &amp; CEREALS</td>
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<tr>
<td><strong>78. Cold breakfast cereal (1 bowl)</strong></td>
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<tr>
<td>- Never/less than 1 per month</td>
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<td>- 1 - 3 bowls per month</td>
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<td>- 1 bowl per week</td>
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<td>- 2 - 4 bowls per week</td>
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<td>- 5 - 7 bowls per week</td>
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<td>- 2 or more bowls per day</td>
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<tr>
<td><strong>79. Hot breakfast cereal, like oatmeal, grits (1 bowl)</strong></td>
<td></td>
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<tr>
<td>- Never/less than 1 per month</td>
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<td>- 1 - 3 bowls per month</td>
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<td>- 1 bowl per week</td>
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<td>- 5 - 7 bowls per week</td>
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<tr>
<td>- 2 or more bowls per day</td>
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<tr>
<td><strong>80. White bread, pita bread, or toast (1 slice)</strong></td>
<td></td>
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<tr>
<td>- Never/less than 1 per month</td>
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<tr>
<td>- 1 slice per week or less</td>
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<tr>
<td>- 2 - 4 slices per week</td>
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<tr>
<td>- 5 - 7 slices per week</td>
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<td>- 2 - 3 slices per day</td>
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<tr>
<td>- 4+ slices per day</td>
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<tr>
<td><strong>81. Dark bread (1 slice)</strong></td>
<td></td>
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<tr>
<td>- Never/less than 1 per month</td>
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<td>- 1 slice per week or less</td>
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<td>- 2 - 4 slices per week</td>
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<td>- 5 - 7 slices per week</td>
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<td>- 2 - 3 slices per day</td>
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<tr>
<td>- 4 slices per day</td>
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<tr>
<td><strong>82. English muffins or bagels (1)</strong></td>
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<tr>
<td>- Never/less than 1 per month</td>
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<td>- 1 - 3 per month</td>
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<td>- 1 per week</td>
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<td>- 2 - 4 per week</td>
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<td>- 5 or more per week</td>
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<td><strong>83. Muffin (1)</strong></td>
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<td>- Never/less than 1 per month</td>
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<tr>
<td>- 1 - 3 muffins per month</td>
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<tr>
<td>- 1 muffin per week</td>
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<td>- 2 - 4 muffins per week</td>
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<tr>
<td>- 5 or more muffins per week</td>
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<tr>
<td><strong>84. Cornbread (1 square)</strong></td>
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<tr>
<td>- Never/less than 1 per month</td>
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<td>- 1 - 3 times per month</td>
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<td>- Once per week</td>
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<td>- 2 - 4 times per week</td>
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<td>- 5 or more per week</td>
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<tr>
<td><strong>85. Biscuit/roll (1)</strong></td>
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<td>- Never/less than 1 per month</td>
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<td>- 1 - 3 per month</td>
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<td>- 2 - 4 per week</td>
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<td>- 5 or more per week</td>
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<td><strong>86. Rice</strong></td>
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<td>- Never/less than 1 per month</td>
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<td>- 1 - 3 times per month</td>
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<td>- Once per week</td>
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<td>- 2 - 4 times per week</td>
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<td>- 5 or more times per week</td>
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<tr>
<td><strong>87. Noodles, pasta</strong></td>
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<tr>
<td>- Never/less than 1 per month</td>
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<tr>
<td>- 1 - 3 times per month</td>
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<td>- Once per week</td>
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<td>- 2 - 4 times per week</td>
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<tr>
<td>- 5 or more times per week</td>
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<tr>
<td><strong>88. Tortilla - no filling (1)</strong></td>
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<tr>
<td>- Never/less than 1 per month</td>
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<td>- 1 - 3 per month</td>
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<td>- 2 - 4 per week</td>
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<tr>
<td>- 5 or more per week</td>
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<tr>
<td><strong>89. Other grains, like kasha, couscous, bulgur</strong></td>
<td></td>
</tr>
<tr>
<td>- Never/less than 1 per month</td>
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<tr>
<td>- 1 - 3 times per month</td>
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<td>- Once per week</td>
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<td>- 2 - 4 times per week</td>
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<td>- 5 or more times per week</td>
<td></td>
</tr>
<tr>
<td><strong>90. Pancakes (2) or waffles (1)</strong></td>
<td></td>
</tr>
<tr>
<td>- Never/less than 1 per month</td>
<td></td>
</tr>
<tr>
<td>- 1 - 3 times per month</td>
<td></td>
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<tr>
<td>- Once per week</td>
<td></td>
</tr>
<tr>
<td>- 2 or more times per week</td>
<td></td>
</tr>
<tr>
<td><strong>91. French fries (large order)</strong></td>
<td></td>
</tr>
<tr>
<td>- Never/less than 1 per month</td>
<td></td>
</tr>
<tr>
<td>- 1 - 3 orders per month</td>
<td></td>
</tr>
<tr>
<td>- 1 order per week</td>
<td></td>
</tr>
<tr>
<td>- 2 - 4 orders per week</td>
<td></td>
</tr>
<tr>
<td>- 5 or more orders per week</td>
<td></td>
</tr>
<tr>
<td><strong>92. Potatoes - baked, boiled, mashed</strong></td>
<td></td>
</tr>
<tr>
<td>- Never/less than 1 per month</td>
<td></td>
</tr>
<tr>
<td>- 1 - 3 times per month</td>
<td></td>
</tr>
<tr>
<td>- Once per week</td>
<td></td>
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<tr>
<td>- 2 - 4 times per week</td>
<td></td>
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<tr>
<td>- 5 or more times per week</td>
<td></td>
</tr>
<tr>
<td>Question</td>
<td>Options</td>
</tr>
<tr>
<td>----------</td>
<td>---------</td>
</tr>
<tr>
<td>93. Raisins (small pack)</td>
<td>Neverless than 1 per month, 1 - 3 times per month, 1 per week, 2 - 4 times per week, 5 or more times per week</td>
</tr>
<tr>
<td>94. Grapes (bunch)</td>
<td>Neverless than 1 per month, 1 - 3 times per month, Once per week, 2 - 4 times per week, 5 or more times per week</td>
</tr>
<tr>
<td>95. Bananas (1)</td>
<td>Neverless than 1 per month, 1 - 3 per month, 1 per week, 2 - 4 per week, 5 or more per week</td>
</tr>
<tr>
<td>96. Cantaloupe, melons (1/4)</td>
<td>Neverless than 1 per month, 1 - 3 times per month, 1 per week, 2 or more times per week</td>
</tr>
<tr>
<td>97. Apples (1) or applesauce</td>
<td>Neverless than 1 per month, 1 - 3 times per month, 1 per week, 2 - 4 times per week, 5 or more times per week</td>
</tr>
<tr>
<td>98. Pears (1)</td>
<td>Neverless than 1 per month, 1 - 3 per month, 1 per week, 2 - 6 per week, 5 or more per week</td>
</tr>
<tr>
<td>99. Oranges (1), grapefruit (1/2)</td>
<td>Neverless than 1 per month, 1 - 3 times per month, 1 per week, 2 - 6 per week, 1 or more per day</td>
</tr>
<tr>
<td>100. Strawberries</td>
<td>Neverless than 1 per month, 1 - 3 times per month, Once per week, 2 or more times per week</td>
</tr>
<tr>
<td>101. Peaches, plums, apricots (1)</td>
<td>Neverless than 1 per month, 1 - 3 per month, 1 per week, 2 or more per week</td>
</tr>
<tr>
<td>102. Orange juice (1 glass)</td>
<td>Neverless than 1 per month, 1 glass per week, 2 - 6 glasses per week, 1 glass per day, 2 or more glasses per day</td>
</tr>
<tr>
<td>103. Apple juice and other fruit juices (1 glass)</td>
<td>Neverless than 1 per month, 1 - 3 glasses per month, 1 glass per week, 2 - 6 glasses per week, 1 glass per day, 2 or more glasses per day</td>
</tr>
<tr>
<td>104. Tomatoes (1)</td>
<td>Neverless than 1 per month, 1 - 3 per month, 1 per week, 2 - 6 per week, 1 or more per day</td>
</tr>
<tr>
<td>105. Tomato/spaghetti sauce</td>
<td>Neverless than 1 per month, 1 - 3 times per month, Once per week, 5 or more times per week</td>
</tr>
<tr>
<td>106. Tofu</td>
<td>Neverless than 1 per month, 1 - 3 times per month, Once per week, 5 or more times per week</td>
</tr>
<tr>
<td>107. String beans</td>
<td>Neverless than 1 per month, 1 - 3 times per month, Once per week, 5 or more times per week</td>
</tr>
</tbody>
</table>
### 108. Beans/lima/soy/peas
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 109. Broccoli
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 110. Beets (not greens)
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 111. Cress
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 112. Peas or lima beans
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 113. Mixed vegetables
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 114. Spinach
- Never/less than 1 per month
- 1 - 3 times per month
- Once a week
- 2 - 4 times per week
- 5 or more times per week

### 115. Greens/kale
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 116. Green/red peppers
- Never/less than 1 per month
- 1 - 3 times per month
- Once a week
- 2 - 4 times per week
- 5 or more times per week

### 117. Yams/sweet potatoes (1)
- Never/less than 1 per month
- 1 - 3 times per month
- Once a week
- 2 - 4 times per week
- 5 or more times per week

### 118. Zucchini, summer squash, eggplant
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 119. Carrots, cooked
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 120. Carrots, raw
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 121. Celery
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 122. Lettuce/tossed salad
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 123. Coleslaw
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
- 5 or more times per week

### 124. Potato salad
- Never/less than 1 per month
- 1 - 3 times per month
- Once per week
- 2 - 4 times per week
Think about your usual snacks. How often do you eat each type of snack food?

Example: If you eat pop-tarts rarely about 6 per year then your answer should look like this:

E3. Pop-tarts (1)
- Never less than 1 per month
- 1 - 3 per month
- 1 - 5 per week
- 1 or more per day

### Snack Foods/Desserts

> 125. Fill in the number of snacks (food or drinks) eaten on school days and weekends/vacation days.

<table>
<thead>
<tr>
<th>Snacks</th>
<th>School Days</th>
<th>Vacation/Weekend Days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MORE</td>
<td>1</td>
</tr>
<tr>
<td>Between breakfast and lunch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After lunch, before dinner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>After dinner</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>126. Potato chips (1 small bag)</th>
<th>127. Corn chips/Doritos (small bag)</th>
<th>128. Nachos with cheese (1 serving)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never less than 1 per month</td>
<td>Never less than 1 per month</td>
<td>Never less than 1 per month</td>
</tr>
<tr>
<td>1 - 3 small bags per month</td>
<td>1 - 3 small bags per month</td>
<td>1 - 3 times per month</td>
</tr>
<tr>
<td>One small bag per week</td>
<td>One small bag per week</td>
<td>Once per week</td>
</tr>
<tr>
<td>2 - 5 small bags per week</td>
<td>2 - 6 small bags per week</td>
<td>2 or more times per week</td>
</tr>
<tr>
<td>1 or more small bags per day</td>
<td>1 or more small bags per day</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>129. Popcorn (1 small bag)</th>
<th>130. Pretzels (1 small bag)</th>
<th>131. Peanuts, nuts (1 small bag)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never less than 1 per month</td>
<td>Never less than 1 per month</td>
<td>Never less than 1 per month</td>
</tr>
<tr>
<td>1 - 3 small bags per month</td>
<td>1 - 3 small bags per month</td>
<td>1 - 3 small bags per month</td>
</tr>
<tr>
<td>1 - 4 small bags per week</td>
<td>1 small bag per week</td>
<td>1 - 4 small bags per week</td>
</tr>
<tr>
<td>5 or more small bags per week</td>
<td>2 or more small bags per week</td>
<td>5 or more small bags per week</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>132. Fun fruit or fruit rollups (1 pack)</th>
<th>133. Graham crackers</th>
<th>134. Crackers, like saltines or wheat thins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never less than 1 per month</td>
<td>Never less than 1 per month</td>
<td>Never less than 1 per month</td>
</tr>
<tr>
<td>1 - 3 packs per month</td>
<td>1 - 3 times per month</td>
<td>1 - 3 times per month</td>
</tr>
<tr>
<td>1 - 4 packs per week</td>
<td>1 - 4 times per week</td>
<td>1 - 4 times per week</td>
</tr>
<tr>
<td>5 or more packs per week</td>
<td>5 or more times per week</td>
<td>5 or more times per week</td>
</tr>
<tr>
<td><strong>PAGE ELEVEN</strong></td>
<td><strong>Questionnaire refers to what you ate over the past year.</strong></td>
<td><strong>HARVARD MEDICAL SCHOOL</strong></td>
</tr>
<tr>
<td>-----------------</td>
<td>----------------------------------------------------------</td>
<td>----------------------------</td>
</tr>
</tbody>
</table>
| **135. Poptarts (1)** | - Never/less than 1 per month  
- 1 - 3 poptarts per month  
- 1 - 6 poptarts per week  
- 1 or more poptarts per day | **138. Danish, sweetrolls, pastry (1)** | - Never/less than 1 per month  
- 1 - 3 per month  
- 1 per week  
- 2 - 4 per week  
- 5 or more per week |
| **136. Cake (1 slice)** | - Never/less than 1 per month  
- 1 - 3 slices per month  
- 1 slice per week  
- 2 or more slices per week | **139. Donuts (1)** | - Never/less than 1 per month  
- 1 - 3 donuts per month  
- 1 donut per week  
- 2 - 6 donuts per week  
- 1 or more donuts per day |
| **137. Snack cakes, Twinkies (1 package)** | - Never/less than 1 per month  
- 1 - 3 per month  
- Once per week  
- 2 - 5 per week  
- 1 or more per day | **140. Cookies (1)** | - Never/less than 1 per month  
- 1 - 3 cookies per month  
- 1 cookie per week  
- 2 - 6 cookies per week  
- 1 - 3 cookies per day  
- 4 or more cookies per day |
| **141. Brownies (1)** | - Never/less than 1 per month  
- 1 - 3 per month  
- 1 per week  
- 2 - 4 per week  
- 5 or more per week | **142. Pie (1 slice)** | - Never/less than 1 per month  
- 1 - 3 slices per month  
- 1 slice per week  
- 2 or more slices per week |
| **143. Chocolate (1 bar or packet) like Hershey's or M & M's** | - Never/less than 1 per month  
- 1 - 3 per month  
- 1 per week  
- 2 - 5 per week  
- 1 or more per day | **144. Other candy bars (Milky Way, Snickers) (1 bar)** | - Never/less than 1 per month  
- 1 - 3 candy bars per month  
- 1 candy bar per week  
- 2 - 4 candy bars per week  
- 5 or more candy bars per week |
| **145. Other candy without chocolate (Skittles) (1 pack)** | - Never/less than 1 per month  
- 1 - 3 times per month  
- Once per week  
- 2 - 4 times per week  
- 5 or more times per week | **146. Jello** | - Never/less than 1 per month  
- 1 - 3 times per month  
- Once per week  
- 2 - 4 times per week  
- 5 or more times per week |
| **147. Pudding** | - Never/less than 1 per month  
- 1 - 3 times per month  
- Once per week  
- 2 - 4 times per week  
- 5 or more times per week | **148. Frozen yogurt** | - Never/less than 1 per month  
- 1 - 3 times per month  
- Once per week  
- 2 - 4 times per week  
- 5 or more times per week |
| **Ice cream** | - Never/less than 1 per month  
- 1 - 3 times per month  
- Once per week  
- 2 - 4 times per week  
- 5 or more times per week | **149. Milkshake or frappe (1)** | - Never/less than 1 per month  
- 1 - 3 per month  
- 1 per week  
- 2 or more per week |
| **151. Popsicles** | - Never/less than 1 per month  
- 1 - 3 popsicles per month  
- 1 popsicle per week  
- 2 - 4 popsicles per week  
- 5 or more popsicles per week | **150. Milkshake or frappe (1)** | - Never/less than 1 per month  
- 1 - 3 per month  
- 1 per week  
- 2 or more per week |
152. Please list any other foods that you usually eat at least once per week that are not listed (for example, coconut, hummus, tahini, chili, plantains, mangos, etc.)

<table>
<thead>
<tr>
<th>FOODS</th>
<th>HOW OFTEN?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td></td>
</tr>
<tr>
<td>b)</td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td></td>
</tr>
<tr>
<td>d)</td>
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</tr>
</tbody>
</table>

- a) ____________
- b) ____________
- c) ____________
- d) ____________

THANK YOU FOR COMPLETING THIS SURVEY!