I, Lindsey Faber, hereby submit this original work as part of the requirements for the degree of Master of Science in Nutrition.

It is entitled:
Development of Questionnaires to Assess Vegetable Intake Concordance between Mother/Infant Pairs: Case Study Findings

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Development of Questionnaires to Assess Vegetable Intake Concordance between Mother/Infant Pairs: Case Study Findings

A thesis submitted to the Graduate School of the University of Cincinnati in partial fulfillment of the requirements for the degree of Masters of Science

in the Department of Nutritional Sciences
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by

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Abstract

*Purpose:* Develop a set of questionnaires that focus on obtaining data regarding vegetable intake frequency, vegetable preference of six target vegetables (carrots, sweet potatoes, winter squash, peas, broccoli and spinach) and determinants of food intake in a subset of postpartum women and their infants. *Background:* Over two-thirds of adults in the United States are clinically overweight. The number of adults who are overweight and obese was on the rise and has remained steady since 2004. The number of children who are overweight and obese continues to rise. While the causes of obesity are largely varied, three main areas that contribute to obesity are nutrition, physical activity and genetics. Habits and preferences that contribute to obesity are formed early in life, possibly during pregnancy. Nutrition status during pregnancy and lactation can have life-long effects. *Methods:* Three mother/infant pairs, a subset from a larger study, completed a set of questionnaires related to vegetable intake frequency, vegetable preference, infant feeding patterns and food determinants, during a nine month nutrition education session. *Results:* Results showed that the mothers’ consumption may be based more on familiarity than preference and that the infants’ consumption is related to availability. All three infants were reported as accepting the target vegetables the first time they were exposed, which is significantly fewer exposures than is expected based on literature reviews. *Discussion:* The questionnaires provided insight into the most frequently consumed and most preferred vegetables of the mothers and infants. The results, though limited by sample size, showed that breastfeeding might impact an infants’ acceptance of vegetables. The mothers’ results, which showed that vegetable acceptance and preference does not necessarily lead to consumption, were not in line with previous research.
Acknowledgments

I would like to thank all of the staff and faculty in the Nutritional Sciences Department at the University of Cincinnati for their direction and assistance. I would especially like to thank Dr. Grace Falciglia for her encouragement and guidance during this process. Also, a special thanks to my family and friends for your support and love through the years.
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Introduction

According to the World Health Organization (WHO, 2006), there are more than 1 billion overweight adults worldwide and approximately 400 million are obese. This health issue is considered to be an epidemic. The number of children who are considered to be overweight and obese is also on the rise. Worldwide, at least 22 million children are overweight.

The short and long-term health effects due to excess weight are well documented. Adults who are overweight or obese are more likely to suffer from heart disease, Type II diabetes, hypertension, stroke, arthritis and other joint problems and cancer (Centers for Disease Control and Prevention [CDC], 2009). Children and adolescents who are overweight or obese are more likely to suffer from Type II diabetes, hormonal problems, high cholesterol, high blood pressure and depression. Children and adolescents who are overweight are also more likely to retain the weight into adulthood (CDC, 2009).

As the numbers of people who are overweight and obese have risen to epidemic proportions, more research is being done to look in-depth at the causes, the effects on overall health and the possible interventions and treatments for this disease. Obesity is a multi-factorial disease. Nutrition, physical activity, genetics and environment all play a role in overweight and obesity. Recent areas of study are researching the impact of the intrauterine environment, breastfeeding and vegetable preference and acceptance and how these effects may continue into adulthood. This thesis focuses on three pairs of post-partum women and their infants who are a subset of a larger study.
Literature Review

The number of children and adults who are overweight or obese is continuing to rise. In the adult population, overweight is defined as having a Body Mass Index greater than 25. Obesity is defined as having a Body Mass Index greater than 30 (WHO, 2006). Body Mass Index (BMI) uses weight and height to assess weight status. In children and adolescents, BMI is assessed and then plotted on a growth chart to determine BMI-for-age percentile. Overweight is defined as having a BMI between the 85th and 95th percentile. Obesity is defined as having a BMI above the 95th percentile (CDC, 2009).

According to Weight-control Information Network (WIN), which is associated with the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), 68% of all adults (age 20 and above) are overweight or obese. From 1960 to 2006, the percentage of adults who are obese increased from 13.4 to 35.1 percent. From 2004 to 2008, however, the prevalence of overweight adults has remained steady (Weight-control Information Network [WIN], 2010).

The Center for Disease Control (CDC) along with National Health and Nutrition Examination Survey (NHANES) estimates that in 2005-2006 11% of children between the ages of 2 and 5 were overweight, 15% of children aged 6 to 11 were overweight, and 18% of adolescents aged 12 to 19 were overweight (Ogden, Carroll, Curtin, Lamb & Flegal, 2010). The CDC also reports that the prevalence of obesity in children aged 6 to 11 increased from 6.5% in 1980 to 19.6% in 2008. The prevalence of obesity in adolescents aged 12 to 19 also increased from 5% in 1980 to 18.1% in 2008 (Ogden, Carroll, Curtin, Lamb & Flegal, 2010).
Health Effects

Excess weight causes known health problems both in children and adults. Adults who are overweight or obese may suffer from cardiovascular problems, diabetes, hypertension, renal problems and cancer (CDC, 2009). Children and adolescents who are overweight or obese are now being afflicted with diseases that were typically only seen in adults. Type II Diabetes used to be called Adult-onset Diabetes because it seemed to only affect adults. Now, however, adolescents are being diagnosed with Type II diabetes. Diabetes that occurs at such a young age can cause negative long-term effects such as renal issues and circulation problems (Hannon, Rao & Arslanian, 2005). Children who are overweight or obese are at an increased risk of developing metabolic syndrome. Metabolic syndrome can lead to diabetes and cardiovascular disease (Weiss et al, 2004).

Children and adolescents who are overweight or obese are also more likely to retain the excess weight and become overweight and obese adults. Overweight and obese children are also more likely to suffer from psychological issues caused by low self-esteem and bullying (Janssen, Craig, Boyce & Pickett, 2004). One study showed an association between adiposity and victimization and that the ramifications of being bullied can last into adulthood. School-aged girls who are obese are less likely to finish school and have lower household incomes compared with their normal weight peers (Janssen et al, 2004). Physical and psychological problems from being overweight or obese can reduce quality of life as well as reduce lifespan.

Due to the increasing numbers of childhood obesity, researchers have begun to examine what may be causing children to become overweight and obese at such a young age. This literature review will consider three focus areas that examine the relationship between mother
Maternal Influence

The Institute of Medicine has established guidelines for weight gain during pregnancy according to pre-pregnancy BMI. The following chart outlines the recommended weight gain for pregnant women (Institute of Medicine [IOM], 2009).

<table>
<thead>
<tr>
<th>Pre-pregnancy BMI</th>
<th>Recommended weight gain (lbs) during pregnancy</th>
<th>Rate of Weight Gain (lbs/wk) for 2\textsuperscript{nd} and 3\textsuperscript{rd} Trimester</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight (&lt;18.5)</td>
<td>28-40</td>
<td>1</td>
</tr>
<tr>
<td>Normal Weight (18.5-24.9)</td>
<td>25-35</td>
<td>1</td>
</tr>
<tr>
<td>Overweight (25-29.9)</td>
<td>15-25</td>
<td>0.6</td>
</tr>
<tr>
<td>Obese (≥ 30)</td>
<td>11-19</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Due to the amount of attention that has focused on childhood obesity, health professionals are now looking at the mother’s influence during pregnancy. When in utero, all nutrients consumed by the mother are transferred to the fetus through the placenta. The effects of substances like caffeine, alcohol and prescription/recreational drugs have been well documented. Women of childbearing age are encouraged to obtain adequate amounts of folic acid and consume a well-balanced diet (American Dietetic Association [ADA], 2008). Research
on the changes in offspring gene expression associated with maternal nutrition is still relatively new; however, startling results have been documented. The placental transfer of an inadequate or excessive amount of nutrients can cause restricted or excessive growth of the fetus. Over-nutrition (excessive glucose, fatty acids and amino acids) of the fetus caused by a maternal high-fat, high-calorie diet can change the metabolism and appetite of the fetus. These changes are associated with increased risk of obesity in adulthood (Reynolds, Osmond, Phillips & Godfrey, 2010). The fetal environment (particularly the substances ingested by the fetus) has the ability to change gene expression (Wu, Bazer, Cudd, Meininger & Spencer, 2004). These changes can have lifelong consequences (Wu et al, 2004). Maternal nutrient intake (whether inadequate or excessive) has the power to effect weight set point, calorie regulation, response to stress and the predisposition for metabolic disorders (Sullivan, Smith & Grove, 2010). The overall health and nutrition status of the mother during pregnancy and lactation may have the power to influence behavior on the offspring throughout life. This phenomenon is known as metabolic imprinting (Sullivan et al, 2010). The suspected purpose of metabolic imprinting is to regulate energy metabolism, allowing the fetus to effectively use the fuel (glucose, amino acids, protein) that is accessible (Sullivan et al, 2010).

In addition to the influence mothers have on their infants through their diet, the pre-pregnancy weight and BMI of the mother may also have the ability to influence the body composition of the infant throughout their life. Several studies have found that pre-pregnancy weight and BMI was associated with increased offspring weight and BMI and adiposity (Fraser et al, 2009; Reynolds et al, 2010; Svensson et al, 2009). Most of these studies were longitudinal studies that followed offspring into childhood and then into adulthood (Fraser et al, 2009; Reynolds et al, 2010; Svensson et al, 2009). Parity and increased body fat percentage were
positively correlated with primiparous mothers being more likely to have offspring with higher levels of body fat (Reynolds et al, 2009).

**Breastfeeding Effects**

The WHO recommends mothers exclusively breastfeed for the first 6 months of life after which complementary foods may be introduced (WHO, 2011). Research on the effects of breastfeeding have resulted in conflicting outcomes. Some studies have shown positive effects associated with breastfeeding. These positive effects include increased intelligence, protection against certain diseases and allergies, and protection against overweight and obesity (Wu & Chen, 2009). The protective effects of breastfeeding on obesity focus on breastfeeding duration and intensity. There may be an inverse relationship between duration of breastfeeding and fat mass but no significant relationship between duration of breastfeeding and BMI (Robinson et al, 2009). When combined with maternal obesity, there may be an association between duration of breastfeeding and BMI (Kitsantas & Gaffney, 2009). Other studies have concluded that after adjusting for confounding factors (socioeconomic status, age), little positive effect is shown (Butte, 2009). The Avon Longitudinal Study looked at risk factors for childhood obesity and breastfeeding was not found to be a predictor (Butte, 2009).

Intensity of breastfeeding is also important to consider as high breastfeeding intensity may be protective against excess weight. Possible mechanisms for a protective effect against obesity are the hormones found in breast milk, like leptin and adiponectin, which are important in appetite and energy regulation. Infant who are breastfed may also be more likely to self-regulate their caloric intake (Li, Fein & Grummer-Strawn, 2008).
Another positive effect of breastfeeding may be an increase in an infants’ acceptance of fruits and vegetables because of the flavors of the vegetables going into the breast milk. In order for breastfeeding to impact an infant’s preference for vegetables, the mother must eat a wide variety of vegetables. Few studies have looked at the effects of breastfeeding on acceptance of certain flavors. Exposure to carrot juice during pregnancy and lactation was found to increase infants’ acceptance for carrot-flavored cereal while children who had been breastfed were more likely to eat vegetables at 4 years of age (Burnier, Dubois & Girard, 2010; Mennella, Jagnow & Beauchamp, 2001).

**Vegetable Acceptance**

Exposure to vegetables in utero, breastfeeding and dietary exposure starting in infancy are ways that an infant can learn to accept vegetables (Forestell & Mennella, 2007). Vegetable acceptance in children is important because of the properties of vegetables. Vegetables are low in calories, low in fat and high in fiber, which means they produce a feeling of fullness (important for weight loss). Vegetables are nutrient dense; they are full of antioxidants, vitamins and minerals but are low calorie.

Familiarity leads to preference, which leads to acceptance. An infant must be exposed to the flavors of vegetables in order for them to become familiar with vegetables. Becoming familiar with vegetables will lead to acceptance of vegetables. Acceptance of vegetables starts at a young age. Maternal influence can be through breastfeeding, availability of vegetables in the home and the child’s observations of vegetable intake in the mother (Mennella et al, 2001; Hart, Raynor, Jelalian & Drotar, 2009).
The Feeding Infants and Toddlers Study 2008 examined feeding patterns in infants and toddlers. Results showed that approximately one-third of infants, aged 6 to 11 months, did not eat any vegetables on the recall day. Despite this negative finding, there were improvements in vegetable intake in infants aged 6 to 11 months compared with the FITS 2002 study results. One of these improvements was that two-thirds of the infants in this age group did eat vegetables on the recall day and the most popular vegetables were the yellow, orange and green vegetables.

Among toddlers (older than one year of age) one-third did not consume any vegetables on the recall day and potatoes jumped to the most popular vegetable among this age group. Among the preschoolers (aged 2 to 4 years), 25% did not consume any vegetables on the recall day and like the toddlers, potatoes were the most popular vegetable (Dwyer, Butte, Deming, Siega-Riz & Reidy, 2010). This change from eating yellow, orange and green vegetables to eating potatoes, can set the stage for vegetable preference later in life. This is an important time where preference established during early infancy needs to be continued into later infancy and toddlerhood in order for preference to lead to acceptance.

An infant may need to be exposed to a new food approximately 12 times before they will accept it. Repeated exposure to a new food, specifically a vegetable, will increase the familiarity of the vegetable and lead to acceptance. In addition to repeated exposure, introducing a vegetable with a familiar food like a fruit may help increase the chance of acceptance (Forestell & Mennella, 2007).

Healthy Moms, Healthy Kids Study

The subjects in this thesis are a subset of individuals from the larger study, Healthy Mom’s, Healthy Kids (HMHK). The Healthy Moms, Healthy Kids Study is an on-going NIH
funded research study in Cincinnati, Ohio. Dr. Grace Falciglia is the Principal Investigator. The purpose of the HMHK study is to target the mother/child dyad in order to increase vegetable intake and help prevent weight retention after pregnancy. The study recruits overweight and obese moms and their infants. The study has two groups: a control and intervention group. The control group receives some nutrition information like the Food Guide Pyramid and some information on feeding solid foods to the infants. The intervention group receives a binder with information regarding food groups and servings, vegetable intake, recipes, and introducing solid and toddler foods. The intervention group also participates in four face-to-face nutrition education sessions. The study includes both formula and breastfeeding moms. The aim of the study is to increase vegetable intake in the moms with the goal that the moms will lose weight and the infants will become familiar with the vegetable flavors through exposure to breast milk, develop a preference for those flavors and accept vegetables as a part of their daily diet.

The purpose of this thesis was to develop questionnaires that look in-depth at frequency and preference of the target vegetables of the mother/child dyad and infant feeding patterns.

**Methods**

**Demographics**

Demographic information was obtained and recorded during the HMHK recruitment process. Inclusion criteria for the HMHK study included age (between 21 and 35), weight (must have a BMI greater than 25), must be 6 weeks postpartum, no major health problems, no tobacco or drug use, single infant. The demographic information includes age, ethnicity, marital status, employment status, number of children, pre-pregnancy weight, weight gained during pregnancy and feeding method (breastfeeding/formula feeding).
Anthropometric Measurements

In addition to the qualitative data from the questionnaire, quantitative data was obtained from the Healthy Moms, Healthy Kids study. Anthropometric measurements were taken at baseline (6 weeks), 6 months, and 12 months. Anthropometrics are self-reported and correspond to the age of the infant. Height and weight were self-reported by the mothers. BMI was calculated using the formula: weight (kg) divided by height (m)\(^2\).

Questionnaires

These questionnaires were formulated to further investigate the relationship between the eating habits and feeding methods of moms and their infants. The data obtained from the larger study provided quantitative data to look at vegetable intake and weight loss patterns in the mom and growth patterns in the infant. These questionnaires were designed to obtain data that could provide an in-depth look at the subjects involved in the study. All four questionnaires were administered during the nine-month nutrition education session that is part of the intervention protocol for the HMHK study. Participants who are part of the intervention group take part in four nutrition education sessions; the sessions are scheduled at two, four, six and nine months. These time periods coincide with the age of the infant. This time period was chosen because at nine months the infants have been eating solids and the mothers have had a chance to introduce each of the target vegetables. It would not have been feasible to do the questionnaires at six months of age because most infants have not started eating solids yet or have only been introduced to infant cereal.

Before the questionnaires were designed, several areas of focus were determined. The areas of focus are frequency and preference of vegetable intake as well as motivators and barriers
to vegetable intake, self-efficacy and infant feeding practices. The development of the questionnaires began by researching the design of previously used Food Frequency Questionnaires (FFQ). The time intervals and design of the Vegetable Frequency Questionnaire was modeled after the Fred Hutchinson Cancer Research Center (FHCRC) Food Questionnaire (FHCRC, 2011). The Vegetable Frequency Questionnaire examines how often in the past month the mother/infant pairs have consumed the six target vegetables. This questionnaire gives quantitative data for each mother/infant pair. Comparing and contrasting the data allows for insight into similarities and differences within each pair as well as the three pairs together.

The Food Preference Questionnaire uses the headings from ‘dislike extremely’ to ‘like extremely’ for the mother and uses ‘smiley faces’ to indicate preference for the infant. This questionnaire provides insight into the preferences for each mother/infant pair. The data can also be analyzed along with the Vegetable Frequency Questionnaire in order to get insight into the habits of the mother and infant such as which vegetables are preferred but eaten infrequently or which vegetables are eaten frequently but are also disliked.

The Infant Feeding Practices Questionnaire examines which vegetables were accepted by the infant the first time it was offered. For the vegetables that were disliked the first time, there are questions regarding how many times the vegetable was offered before the infant accepted the vegetable and how many times the vegetable was offered before the mother stopped offering the vegetable. This questionnaire gives information about how the mother feeds her infant. If the infant rejects a vegetable the first time it is offered and the mother stops offering the vegetable, then the infant cannot develop a preference or learn to accept the vegetable.
**Vegetable Frequency Questionnaire - Mom**

Please indicate how often in the past month you have consumed these six vegetables.

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Never</th>
<th>1 per month</th>
<th>2-3 per month</th>
<th>1 per week</th>
<th>2 per week</th>
<th>3-4 per week</th>
<th>5-6 per week</th>
<th>1 per day</th>
<th>2+ per day</th>
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<tbody>
<tr>
<td>Carrots</td>
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<td>Winter Squash</td>
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</table>

**Vegetable Frequency Questionnaire- Infant**

Please indicate how often in the past month your infant has consumed these six vegetables.

<table>
<thead>
<tr>
<th>Vegetables</th>
<th>Never</th>
<th>1 per month</th>
<th>2-3 per month</th>
<th>1 per week</th>
<th>2 per week</th>
<th>3-4 per week</th>
<th>5-6 per week</th>
<th>1 per day</th>
<th>2+ per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrots</td>
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</table>
**Vegetable Preference Questionnaire- Mom**

Please circle the number which reflects how much you like each of the six vegetables listed.

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Dislike Extremely</th>
<th>Neutral</th>
<th>Like Extremely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrots</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sweet Potatoes</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Winter Squash</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Peas</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Broccoli</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Spinach</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Vegetable Preference Questionnaire- Infant**

Please indicate your infant’s preference of the following vegetables by placing an X under the appropriate expression.

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>😞</th>
<th>😞</th>
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<tbody>
<tr>
<td>Carrots</td>
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<tr>
<td>Sweet Potatoes</td>
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<td>Winter Squash</td>
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<td>Peas</td>
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<td>Broccoli</td>
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<td>Spinach</td>
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</table>
Infant Feeding Practices Questionnaire

- Circle which vegetables your infant LIKED the first time you offered these vegetables to him/her.

Carrots  Sweet Potatoes  Winter Squash  Peas  Broccoli  Spinach

- Circle which vegetables your infant DISLIKED the first time you offered these vegetables to him/her.

Carrots  Sweet Potatoes  Winter Squash  Peas  Broccoli  Spinach

- For the vegetables your infant initially DISLIKED, how many times did you offer the vegetable before they finally liked the vegetable? Write that number next to any vegetable your infant DISLIKED. Also indicate how many times you offered a vegetable they DISLIKED before you finally stopped giving them that vegetable.

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Number of times before they liked the vegetable.</th>
<th>Number of times before you stopped offering the vegetable.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrots</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweet Potatoes</td>
<td></td>
<td></td>
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<tr>
<td>Winter Squash</td>
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<td>Peas</td>
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<td>Broccoli</td>
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<td>Spinach</td>
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</table>
The last questionnaire is the *Food Determinants Questionnaire*, which asks questions regarding motivators and barriers to buying/cooking vegetables, vegetable preparation, and infant food choices. These 24 questions were formulated based on personal interaction with the study subjects as well as information provided to the study subjects in the intervention materials. The design of the questionnaire was created based on ease of use, having clear directions and maintaining a cohesive nature.

**Food Determinants Questionnaire**

1. Who does most of the grocery shopping in your household?  
   a. Myself  
   b. My significant other  
   c. Other

2. Who prepares most of the meals in your household?  
   a. Myself  
   b. My significant other  
   c. Other

The following questions relate to choosing vegetables:

3. Which best describes your routine for deciding which vegetables to buy before you go to the grocery store?  
   a. I go through the refrigerator and make a list.  
   b. I keep track of which vegetables we need throughout the week.  
   c. I briefly look through the refrigerator, but I don’t write anything down.  
   d. I don’t keep track or look through the refrigerator beforehand.  
   e. I don’t buy vegetables when I go to the grocery store.

4. I feel comfortable selecting and buying vegetables at the grocery store.  
   a. Strongly disagree  
   b. Disagree  
   c. Neutral  
   d. Agree  
   e. Strongly agree

5. Money influences my decision to buy or not buy vegetables.  
   a. Strongly disagree  
   b. Disagree  
   c. Neutral  
   d. Agree  
   e. Strongly agree
6. Preference influences my decision to buy or not buy vegetables (for example, myself or someone in my family does not like vegetables or only likes certain vegetables.)
   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree

7. Availability influences my decision to buy or not buy vegetables.
   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree

8. Knowing that vegetables are good for my health influences my decision to buy or not buy vegetables.
   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree

Questions 9 through 16 relate to vegetable preparation for you and your infant.

9. I normally prepare vegetables by microwaving.
   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree

10. I normally prepare vegetables by frying.
    a. Strongly disagree
    b. Disagree
    c. Neutral
    d. Agree
    e. Strongly agree

11. I normally prepare vegetables by sautéing.
    a. Strongly disagree
    b. Disagree
    c. Neutral
    d. Agree
    e. Strongly agree
12. I normally prepare vegetables by baking.
   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree

13. I normally eat vegetables fresh (no cooking).
   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree

   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree

15. I normally feed my infant homemade baby food.
   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree

16. I normally feed my infant food that is modified from the family’s meal (ie. Mashing up a potato from dinner.)
   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree

Questions 17 through 24 relate to motivators and barriers to eating vegetables.

17. Making a grocery list before going to the store makes it easier for me to buy vegetables.
   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree
18. Preparing meal ideas in advance (action plan) makes it easier for me to eat vegetables.
   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree

19. Having vegetables available in my house makes it easier for me to eat vegetables.
   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree

20. Knowing how to cook vegetables (having recipes) makes it easier for me to buy and eat vegetables.
   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree

21. Money is an issue that makes it harder for me to buy vegetables.
   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree

22. My family’s preferences (ie. My children don’t like vegetables) makes it harder for me to buy vegetables.
   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree

23. Not knowing how to cook vegetables makes it harder for me to buy and eat vegetables.
   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree

24. Lack of time makes it harder for me to cook and eat vegetables.
   a. Strongly disagree
   b. Disagree
   c. Neutral
   d. Agree
   e. Strongly agree
Results

All data that was gathered from the questionnaires is presented in this section according to each mother/infant pair.

Mother/Infant Pair A

Pair A- Mother is a 35 year old, Caucasian woman. She is married and is currently employed. She has four children. Her pre-pregnancy weight was 91.05 kg and she gained approximately 12.68 kg during her last pregnancy. She was formula feeding. The following table contains all anthropometric data for the mother from Pair A from pre-pregnancy through 12 months.

<table>
<thead>
<tr>
<th></th>
<th>Pre-pregnancy</th>
<th>At Delivery</th>
<th>6 weeks</th>
<th>6 months</th>
<th>12 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (m)</td>
<td>1.57</td>
<td>1.57</td>
<td>1.57</td>
<td>1.57</td>
<td>1.57</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>91.05</td>
<td>103.73</td>
<td>92.41</td>
<td>94.22</td>
<td>92.86</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>37</td>
<td>42</td>
<td>37</td>
<td>38</td>
<td>37</td>
</tr>
</tbody>
</table>

At baseline, she was eating 0.50 servings (1/4 cup) of dark green vegetables (green peas, broccoli, spinach) per day and 0.03 servings (1 teaspoon) of dark yellow vegetables (carrots, winter squash, sweet potatoes) per day. Her total servings of vegetables (includes target vegetables and all other vegetables including potatoes) were 4.70 servings per day. The servings of vegetables listed in the results section correspond to servings of vegetables in cups. A serving of green peas, broccoli, carrots, winter squash or sweet potatoes is a half of a cup (1/2 cup). A
A serving of raw spinach is one cup. The servings of dark green and dark yellow vegetables are listed as servings and in parenthesis are the servings in cups/tablespoons/teaspoons.

At 6 months, she was eating 0.16 servings (1.5 tablespoons) of dark green vegetables per day and 0.01 servings (~ 0 cups) of dark yellow vegetables per day. Her total servings of vegetables were 2.62 servings per day.

At 12 months, she was eating 0.00 (0 cups) servings of dark green vegetables per day and 0.65 servings (1/3 cup) of yellow vegetables per day. Her total servings of vegetables were 1.62 servings per day.

The following table contains the data from the Vegetable Frequency Questionnaire for Pair A. The numbers are based on the frequency of consumption in a month. Therefore each number is the number of times in a month each vegetable was consumed. For frequencies that use a range (ie. 3-4 times per week), the smallest number was used.

**Vegetable Frequency Questionnaire**

<table>
<thead>
<tr>
<th>Vegetables</th>
<th>Frequency- Mother</th>
<th>Frequency- Infant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrots</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Sweet Potatoes</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Winter Squash</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Peas</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Broccoli</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Spinach</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>
The next table contains the data from the *Vegetable Preference Questionnaire* for Pair A. A numerical scale was used for the mother, which ranges from 1 to 5 (1 being ‘dislike extremely’ and 5 being ‘like extremely’). A corresponding “smiley face” chart was used for the infant (sad face being dislike extremely and happy face being like extremely with a neutral face in between). The infant’s preference for broccoli and spinach is recorded as non-applicable (n/a) because the infant does not eat broccoli or spinach; therefore a preference is unknown. The mother also clarified that while the infant likes carrots, they are consumed infrequently since they cause stomach irritation in this infant.

**Vegetables Preference Questionnaire**

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Preference- Mother</th>
<th>Preference- Infant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrots</td>
<td>4</td>
<td>☺️</td>
</tr>
<tr>
<td>Sweet Potatoes</td>
<td>4</td>
<td>☺️</td>
</tr>
<tr>
<td>Winter Squash</td>
<td>3</td>
<td>☺️</td>
</tr>
<tr>
<td>Peas</td>
<td>5</td>
<td>☺️</td>
</tr>
<tr>
<td>Broccoli</td>
<td>5</td>
<td>n/a</td>
</tr>
<tr>
<td>Spinach</td>
<td>3</td>
<td>n/a</td>
</tr>
</tbody>
</table>

The following table contains data from the *Infant Feeding Patterns Questionnaire* for Infant A. The infant accepted the vegetables the first time so the last column is left blank. Also ‘n/a’ is used in the acceptance column because the infant has never eaten broccoli or spinach.
**Infant Feeding Patterns Questionnaire**

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Liked/Disliked</th>
<th>Number of times before acceptance</th>
<th>Number of times before stopped offering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrots</td>
<td>Liked, but irritates stomach</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sweet Potatoes</td>
<td>Liked</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Winter Squash</td>
<td>Liked</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Peas</td>
<td>Liked</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Broccoli</td>
<td>Never fed</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Spinach</td>
<td>Never fed</td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>

The results of the *Food Determinants Questionnaire* show that the mother from Pair A does the grocery shopping and meal preparation for herself and her family. She makes a list before going to the grocery store. She does not feel comfortable selecting and buying vegetables but knowing that vegetables are good for her health influences her to buy them. She states that money, lack of time and personal preferences does not influence her decision to buy vegetables or make it harder to eat vegetables. Making a list, preparing meal ideas in advance and having vegetables available are things that do make it easier for her to buy and eat vegetables. She usually eats fresh vegetables but occasionally bakes them.

**Mother/Infant Pair B**

Pair B-Mother is a 26 year old, Caucasian woman. She is married and currently employed. She has one child. Her pre-pregnancy weight was 87.88 kg and she gained approximately 11.77 kg during her pregnancy. She was breastfeeding. The following table
contains all anthropometric data for the mother from Pair B from pre-pregnancy through 6 months.

**Anthropometric Data**

<table>
<thead>
<tr>
<th></th>
<th>Pre-pregnancy</th>
<th>At Delivery</th>
<th>6 weeks</th>
<th>6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (m)</td>
<td>1.6</td>
<td>1.6</td>
<td>1.6</td>
<td>1.6</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>87.88</td>
<td>99.65</td>
<td>87.80</td>
<td>89.69</td>
</tr>
<tr>
<td>BMI (wt/ht$^2$)</td>
<td>34</td>
<td>39</td>
<td>34</td>
<td>35</td>
</tr>
</tbody>
</table>

At baseline, she was eating 0.84 servings (~1/3 cup) of dark green vegetables and 0.44 servings (~1/4 cup) of dark yellow vegetables. Her total servings of vegetables were 3.09 servings per day.

At 6 months, she was eating 0.49 (1/4 cup) servings of dark green vegetables and 0.09 servings (~2 teaspoons) of dark yellow vegetables. Her total servings of vegetables were 2.93 servings per day.

The following table contains the data from the *Vegetable Frequency Questionnaire* for Pair B.

The next table contains the data from the *Vegetable Preference Questionnaire* for Pair B. The infant does not eat broccoli or spinach therefore preference is recorded as not applicable (n/a) because preference is unknown.
Vegetable Frequency Questionnaire

<table>
<thead>
<tr>
<th>Vegetables</th>
<th>Frequency- Mother</th>
<th>Frequency- Infant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrots</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Sweet Potatoes</td>
<td>2</td>
<td>12</td>
</tr>
<tr>
<td>Winter Squash</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Peas</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Broccoli</td>
<td>12</td>
<td>0</td>
</tr>
<tr>
<td>Spinach</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Vegetable Preference Questionnaire

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Preference- Mother</th>
<th>Preference- Infant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrots</td>
<td>5</td>
<td>😊</td>
</tr>
<tr>
<td>Sweet Potatoes</td>
<td>5</td>
<td>😊</td>
</tr>
<tr>
<td>Winter Squash</td>
<td>4</td>
<td>😊</td>
</tr>
<tr>
<td>Peas</td>
<td>2</td>
<td>😊</td>
</tr>
<tr>
<td>Broccoli</td>
<td>5</td>
<td>n/a</td>
</tr>
<tr>
<td>Spinach</td>
<td>3</td>
<td>n/a</td>
</tr>
</tbody>
</table>

The following table contains data from the Infant Feeding Patterns Questionnaire for Infant B. The infant accepted the vegetables the first time so the last column is left blank.
### Infant Feeding Patterns Questionnaire

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Liked/Disliked</th>
<th>Number of times before acceptance</th>
<th>Number of times before stopped offering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrots</td>
<td>Liked</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sweet Potatoes</td>
<td>Liked</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Winter Squash</td>
<td>Liked</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Peas</td>
<td>Liked</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Broccoli</td>
<td>Never fed</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Spinach</td>
<td>Never fed</td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>

The results of the *Food Determinants Questionnaire* show that the mother from Pair B does the grocery shopping and meal preparation for her family. Before going grocery shopping, she briefly looks through the refrigerator but doesn’t make a list, even though she states that making a grocery list makes it easier to buy vegetables. She feels comfortable buying and selecting vegetables. Making a list, preparing meal ideas in advance, having vegetables around the house and knowing how to cook vegetables makes it easier for her to buy and eat vegetables. Lack of time, lack of knowledge about how to cook certain vegetables and her family’s preferences make it more difficult for her to buy and eat vegetables. She decides which vegetables to buy based on preference, availability and health benefits. She prefers to eat vegetables fresh or by microwaving.
Mother/Infant Pair C

Pair C- Mother is a 31 year old, Caucasian woman. She is married and employed. She has 2 children. Her pre-pregnancy weight was 75.65 kg and she gained 14.9 kg during her last pregnancy. She was breastfeeding. The following table contains all anthropometric data for the mother from Pair C from pre-pregnancy through 6 months.

**Anthropometric Data**

<table>
<thead>
<tr>
<th></th>
<th>Pre-pregnancy</th>
<th>At Delivery</th>
<th>6 weeks</th>
<th>6 months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height (m)</td>
<td>1.62</td>
<td>1.62</td>
<td>1.62</td>
<td>1.62</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>75.65</td>
<td>90.55</td>
<td>82.89</td>
<td>82.89</td>
</tr>
<tr>
<td>BMI (wt/ht^2)</td>
<td>28</td>
<td>34</td>
<td>31</td>
<td>31</td>
</tr>
</tbody>
</table>

At baseline, she was eating 0.49 servings (1/4 cup) of dark green vegetables and 0.30 servings (1/6 cup) of dark yellow vegetables per day. Her total servings of vegetables were 2.23 servings per day.

At 6 months, she was eating 0.33 servings (1/6 cup) of dark green vegetables and 0.45 servings (~1/4 cup) of dark yellow vegetables. Her total servings of vegetables were 2.07 servings per day.

The following table contains the data from the Vegetable Frequency Questionnaire for Pair B.
### Vegetable Frequency Questionnaire

<table>
<thead>
<tr>
<th>Vegetables</th>
<th>Frequency- Mother</th>
<th>Frequency- Infant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrots</td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td>Sweet Potatoes</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>Winter Squash</td>
<td>20</td>
<td>12</td>
</tr>
<tr>
<td>Peas</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td>Broccoli</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>Spinach</td>
<td>4</td>
<td>0</td>
</tr>
</tbody>
</table>

The next table contains the data from the Vegetable Preference Questionnaire for Pair C. The infant does not eat broccoli or spinach therefore preference is recorded as not applicable (n/a) because preference is unknown.

### Vegetable Preference Questionnaire

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Preference- Mother</th>
<th>Preference- Infant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrots</td>
<td>4</td>
<td>☺</td>
</tr>
<tr>
<td>Sweet Potatoes</td>
<td>5</td>
<td>☺</td>
</tr>
<tr>
<td>Winter Squash</td>
<td>5</td>
<td>☺</td>
</tr>
<tr>
<td>Peas</td>
<td>4</td>
<td>☺</td>
</tr>
<tr>
<td>Broccoli</td>
<td>4</td>
<td>n/a</td>
</tr>
<tr>
<td>Spinach</td>
<td>2</td>
<td>n/a</td>
</tr>
</tbody>
</table>
The following table contains data from the *Infant Feeding Patterns Questionnaire* for Infant C.

The infant accepted the vegetables the first time so the last column is left blank.

<table>
<thead>
<tr>
<th>Vegetable</th>
<th>Liked/Disliked</th>
<th>Number of times before acceptance</th>
<th>Number of times before stopped offering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrots</td>
<td>Liked</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sweet Potatoes</td>
<td>Liked</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Winter Squash</td>
<td>Liked</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Peas</td>
<td>Liked</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Broccoli</td>
<td>Never fed</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>Spinach</td>
<td>Never fed</td>
<td>n/a</td>
<td></td>
</tr>
</tbody>
</table>

The results of the *Food Determinants Questionnaire* shows that the Pair C mother does the grocery shopping and food preparation for her and her family. Before going to the grocery store she goes through the refrigerator and makes a list. She states that she feels comfortable selecting and buying vegetables. She is influenced by money, preferences, availability and knowing the health benefits of vegetables. Making a list, preparing meal ideas in advance, having vegetables available and knowing how to cook them makes it easier to buy and eat vegetables. Money and a lack of time make it harder to buy and eat vegetables. She eats vegetables fresh and cooks them by sautéing and microwaving.
Discussion

The purpose of this thesis was to develop a set of questionnaires that focused on obtaining qualitative data regarding vegetable intake frequency, vegetable preference and determinants of food intake. The questionnaires were administered to a subset of women and their infants who are part of a larger, on-going study. The results of the questionnaires provided in-depth information about these pairs.

Mother/Infant Pair A. The vegetables the mother most frequently consumed (at least once a week) are carrots, peas and broccoli. The infant most frequently consumed sweet potatoes, winter squash, and peas. The mother’s most preferred (rated 4 or 5) vegetables were carrots, sweet potatoes, peas and broccoli. The infant’s favorite vegetables (rated as ☺) are sweet potatoes, winter squash, and peas. The mother and infant both consumed their favorite vegetables at least once a week with one exception. The mother rated sweet potatoes as one of her most preferred vegetables but eats them infrequently (once a month). In the Food Determinants Questionnaire, the mother stated that she does not feel comfortable selecting and buying vegetables and that having recipes makes it easier for her to buy and eat vegetables. Her infrequent consumption of one her most preferred vegetables could be due to a lack of knowledge about preparation.

Mother/Infant Pair B. The vegetables the mother most frequently consumed are carrots, peas, and broccoli. The infant most frequently consumed carrots, sweet potatoes, winter squash and peas. The mother’s most preferred vegetables were carrots, sweet potatoes, winter squash, and broccoli. The infant likes carrots, sweet potatoes, winter squash, and peas. The mom dislikes peas but eats them frequently (twice a week). The mother also likes winter squash but never eats
it (zero times a month). Possible reasons for these contradictions come from the answers to the
*Food Determinants Questionnaire*. The mother stated that two ways that she selects vegetables
are based on availability and knowledge of health benefits. Since she does not like peas but eats
them twice a week, her motivation could be health benefits or it could be that peas are available
to her. Since she likes winter squash but never consumes it, she may be uncomfortable preparing
this vegetable or her family may not prefer this vegetable. These conclusions are drawn from the
*Food Determinants Questionnaire*, where she indicates that family preference and lack of
knowledge about preparing vegetables are constituents that make it difficult for her to buy and
eat certain vegetables.

**Mother/Infant Pair C.** The mother frequently consumed all six target vegetables. The infant
frequently consumed carrots, sweet potatoes, winter squash and peas. The mother prefers
carrots, sweet potatoes, winter squash, peas and broccoli. The infant prefers carrots, sweet
potatoes, winter squash and peas. The mother doesn’t like spinach but eats it at least once a
week. This mother states that she is influenced by knowledge of health benefits, money and
availability. Despite her aversion to spinach, she may be knowledgeable regarding the health
benefits of spinach or it may be a cost-effective and/or available vegetable.

**Mother/Infant Pair A, B and C.** Looking at the data from each pair separately gives information
specific to each mother and infant; however, looking at the three pairs together provides insight
into the group as a whole. Among the three mothers, the most preferred vegetables were broccoli
and sweet potatoes. The most preferred vegetables were however, not the most frequently
consumed. The most frequently consumed vegetables among the three mothers were carrots and
peas. Although the reasons behind these differences are unknown, 2/3 of the mothers reported
time as being an issue related to vegetable consumption. Carrots and peas may be easier to eat raw or require less cooking time. The mothers may feel incapable of preparing broccoli or sweet potatoes or feel that they take too long to prepare and cook. This finding may also indicate that vegetable intake in the mothers is based on familiarity. Carrots and peas are very common vegetables in the American cuisine and as such the taste and preparation of these two vegetables are well-known to most. This finding that preference did not lead to consumption, is not in accordance with the current literature, which concludes that acceptance of vegetables leads to preference and this preference leads to consumption (Forestell et al, 2007).

Among the three infants, the most preferred vegetables were carrots, sweet potatoes, winter squash and peas. The most frequently consumed vegetable was sweet potatoes. None of the three infants consumed broccoli or spinach. A possible explanation for this is that all three infants were fed commercial baby food and with the exception of one mixed vegetable baby food, broccoli and spinach are not available. This is finding suggests that vegetable consumption in infants is based on the commercial availability of baby food. All three of these mothers bought commercial baby food and chose not to prepare their own baby food; therefore, they can only feed their infants what is available to them.

The mothers reported that all three infants liked the vegetables the first time that they were introduced to each vegetable. This finding is not in line with previous research because the literature available indicates that it can take approximately 12 exposures before an infant accepts a new food (Mennella et al, 2001). Given that two out of the three infants were breastfed, this acceptance could be because of increased exposure to flavors through the breast milk. Because of the small sample size, a definitive conclusion cannot be drawn.
Conclusion

Overall, these questionnaires were able to give in-depth insight into the reasons why the mothers and infants eat vegetables. It provided information regarding frequency of intake, preferences and food determinants. These questionnaires have the possibility to be added into similar nutritional research studies in order to supplement quantitative data. Although this thesis provided a cross-sectional view, the questionnaires could be administered several times during a study to provide a longitudinal view. This could provide the opportunity to see more of the influence that the mother’s diet has on the vegetable preferences of the infant by viewing the vegetable intake of the mother during pregnancy and lactation.

The limitations of this thesis are the sample size. This was a preliminary trial done on a subset of participants from a larger study. Drawing conclusions and trends is improbable because of the lack of power. Another limitation of this thesis is that the questionnaires were administered only once. Administering the questionnaires during the pregnancy would allow for comparison of the two time periods and more pertinent information could be derived regarding the influence of the mother’s diet on the infants’ preferences.

A strength of this thesis is the ability to use these questionnaires to obtain qualitative information from a larger sample size. Another strength is that by asking participants to recall vegetable frequencies from the previous month as opposed to using a longer time interval, recall bias is minimized.
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