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The Feasibility And Validity Of Novel Dietary Assessment Methods In A Pre-School Setting

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THE FEASIBILITY AND VALIDITY OF NOVEL DIETARY ASSESSMENT METHODS IN A PRE-SCHOOL SETTING

A Thesis Presented

by

Harley Eriksen

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of

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ABSTRACT

To properly evaluate initiatives targeting children’s fruit and vegetable (FV) consumption, we need feasible and valid dietary assessment methods that are time, cost, and resource effective. The objectives of this study were to test the feasibility and validity of two methods, digital imaging (DI) and aggregate plate waste (APW), for assessing children’s FV consumption. UVM dietary assessment team graduate students prepared and distributed FV snacks in two pre-school classrooms over 30 consecutive school days. Feasibility of APW was tested by recording the frequency and weight of waste sorting errors by pre-school children and performing paired t-tests comparing uncorrected and corrected FV waste. Feasibility was tested for DI by determining the total number of individual FV snacks from which FV consumption could be estimated using the digital images. Validity was tested for DI using paired t-tests to compare FV consumption as assessed by DI against actual consumption as assessed by weighed plate waste (WPW). A total of 159 cluster APW weights were recorded during the 20 days of APW collection, with an overall mean difference of 0.57 grams (p=0.440) between uncorrected and corrected FV waste. Researchers were able to capture 100-percent usable digital images, effectively displaying 214 individual FV snack servings over the 10-day DI study period. Percent agreement between the two digital image coders was 99.1-percent. DI estimations for individual FV item and cumulative consumption were strongly correlated with WPW (all above r=0.97). Overall FV consumption as estimated by DI differed from WPW by less than one gram, and DI estimations for individual FV items differed from WPW by no more than two grams. Paired t-tests revealed no significant difference between DI estimations of clementine (p=0.954) and peapod (p=0.806) consumption and WPW measurements. However, paired t-tests indicated statistically significant differences between DI and WPW measurements for overall (p=0.001), grape (p=0.031), carrot (p=0.008), and pepper (p=0.027) consumption. Both methods were feasible for assessing mean FV consumption. DI estimations for individual FV items and cumulative consumption were strongly correlated with WPW, suggesting that despite statistical significance between DI and WPW measurements in some cases, the DI method is still precise for mean FV consumption evaluation. APW may be especially advantageous for rapid and efficient evaluation of behavior change in response to interventions targeting children’s FV consumption. Due to ease of administration and instantaneous results, the APW method reduces the need for trained research staff to be present, drastically increasing accessibility to group-level dietary assessment.
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CHAPTER 1: REVIEW OF THE LITERATURE

1.1. Introduction

The prevalence of obesity in children between the ages of 2-19 years old has been a growing concern for our nation for decades. For this age group as a whole, the prevalence has held steady at about 17 percent since 2003.\(^1\) Children between the ages of 2-5 years old have seen the most improvement in recent years, with a decrease from 13.9 percent in 2004 to 8.4 percent in 2012.\(^2\) This decline is due to rigorous efforts targeting the availability of healthy foods and integration of physical activity within the community.\(^3\) Nonetheless, children who are obese are at an increased risk for development of previously adult onset diseases such as type II diabetes, high blood pressure, and high cholesterol.\(^4\) Data from adults in a National Health and Nutrition Examination Survey (NHANES) follow-up (baseline survey 1982; follow-ups 1984, 1987, and 1992) indicated that childhood overweight is significantly associated with severe obesity in adulthood, further perpetuating chronic disease risk.\(^5\)

Fruit and vegetable (FV) intake plays an important role in achieving and maintaining a healthy weight\(^6\), and is a crucial element in the prevention of major illnesses such as cardiovascular diseases and certain cancers\(^7\), yet the majority of youth are not meeting the recommendations for FV consumption.\(^8\)

1.2. Health Implications of Low FV Consumption

Fruit and vegetable consumption in children has become a primary focus in the fight against childhood obesity, as these foods are low in calories and rich in valuable
nutrients. Consumption of fruits and vegetables is associated with reduced risk of many chronic diseases\textsuperscript{4}, including reduced risk of cardiovascular complications, namely heart attack and stroke, as well as reduced risk of certain types of cancers.\textsuperscript{7} Additionally, FV consumption is critical to maintenance of a healthy weight, as they are low in calories and high in fiber.\textsuperscript{7} There is evidence to suggest decreased levels of central obesity and other symptoms of metabolic syndrome when diets rich in fruits and vegetables are consumed.\textsuperscript{9} Children’s diets are influenced as early as infancy, with the first five years marked by the development of important dietary behaviors that can set the stage for eating patterns throughout childhood and adulthood.\textsuperscript{10} Encouraging children to consume fruits and vegetables from a young age is essential to establishing these healthy dietary habits for them to adhere to throughout life.\textsuperscript{10}

The diets of American children are marked by an increased intake of calories and a lack of appropriate nutrients for growth and development.\textsuperscript{11} Processed foods such as cake, cookies, and pastries top the list for sources of energy intake among American children between the ages of 2 and 18 years old.\textsuperscript{11} One study, which examined changes in the diets of children between the ages of 2 and 6 years old over a 20-year period from 1989 to 2008, found that total daily energy intake increased by 109 calories during the period.\textsuperscript{12} Researchers attributed this change to children increasingly consuming foods high in added sugars and solid fats from food items such as savory and sweet snacks, fruit juice, pizza/calzones, and Mexican dishes.\textsuperscript{12} There is evidence that increased intake of sugar-sweetened beverages (SSB) by children 2 to 5 years old also contributes to the observed increase in energy intake.\textsuperscript{13,14} A review of NHANES from 1988 to 2004 found a 12 percent increase in the daily caloric contribution from SSBS and 100 percent fruit juice
in children age 2 to 19.\textsuperscript{15} Fruit drinks comprised the majority of SSB calories in preschool aged children, providing up to 11 percent of their total calories, while soft drinks provided an additional 6 percent in the one third of children who reportedly consumed them.\textsuperscript{15,16}

Children are not consuming the recommended amounts of fruits and vegetables. It is recommended that children between the ages of 2 and 8 years old consume 1 to 1 ½ cups of fruit and 1 ½ cups of vegetables per day.\textsuperscript{17} Recent reports indicate that whole fruit consumption has replaced fruit juice as the main contributor to children’s diets, with consumption increasing by 67 percent between 2003 and 2010.\textsuperscript{17} However, the amount of vegetables children are consuming did not change from 2003 to 2010, and nine out of ten children still do not consume the recommended amount of vegetables. Additionally, an alarming one-third of the vegetables children consume are white potatoes, 63 percent of which are fried.\textsuperscript{17} Identifying strategies to increase young children’s consumption of a variety of FVs has become a public health priority.

1.3. Strategies to Address Pre-School Dietary Behavior

Pre-schools represent an important environment for addressing children’s FV consumption\textsuperscript{18,19}, since an increased proportion of children are consuming meals outside of the home.\textsuperscript{20} Approximately 61 percent of children ages 0-6 years are enrolled in some form of childcare\textsuperscript{20} and consume up to one-third of their calories in this setting.\textsuperscript{21} Fruit and vegetable focused education and activities have had mixed success with the pre-school age group.\textsuperscript{22,23} There have been different approaches to address pre-school aged
children’s dietary behaviors within the pre-school setting, such as nutrition education, farm-to-preschool, and teacher involvement.

A nutrition education program that enrolled 24 child-care centers serving low-income families found that nutrition education improved children’s FV consumption at home.\textsuperscript{24} Parents reported their child’s dietary behaviors in the home environment by telephone or mail survey at baseline and again at follow-up. The child-care centers were matched by region, type, and size and sorted into intervention and control groups. In the intervention groups, registered dietitians provided nutrition education to children and their parents separately during a 6 to 10 week period. Throughout this period, weekly parent newsletters with activities and recipes were distributed. Training sessions were also held for child-care center staff, to educate them on physical activity and healthy eating. While the program did not have a significant impact on children’s at-home daily consumption of fruits, the mean number of cups of vegetables consumed increased by 0.12 cups for the intervention group. Additionally, a statistically significant increase in the rate of child-initiated vegetable snacking was observed. Consistent with the effects on vegetable consumption, children in the intervention groups initiated vegetable snacking 0.3 days more than at baseline.\textsuperscript{24}

As for pre-school gardens, one study aiming to increase the number of FV provided to and consumed by children in childcare by incorporating a garden showed promise for increasing FV consumption.\textsuperscript{25} The study enrolled four childcare centers that were randomized into intervention and control centers. Dietary assessments of three randomly selected children from each classroom were conducted over a two-day period prior to randomization, and again five months later when the intervention ended.
Registered dieticians used direct observation to estimate children’s FV selection, consumption, and waste. The intervention included a fruit and vegetable garden, structured curriculum for childcare providers, and gardening support. Childcare centers grew lettuce, strawberries, spinach, and broccoli during the four-month intervention. Post-intervention dietary assessment revealed that vegetable consumption increased by an average of ¼ of a serving in children in the intervention centers, whereas a slight decrease was observed in the control centers. Researchers did not detect an increase in fruit consumption, which may be attributed to the intervention including three vegetables and one fruit.\textsuperscript{25}

While the beneficial effects of parental modeling and exposure to FVs on children’s FV consumption have been well documented,\textsuperscript{26,27} the effectiveness of teacher modeling has rarely been examined experimentally, and findings have been inconsistent.\textsuperscript{23} Some research suggests that teacher modeling does not significantly influence pre-school aged children’s consumption of FV.\textsuperscript{22} A study assessing the effectiveness of a childcare center-based role-modeling program evaluated the success of parent and teacher influence on child nutrition outcomes.\textsuperscript{22} The study randomized 28 childcare centers serving low-income families into intervention and control arms. The intervention included menu modifications, a child’s healthy lifestyle curriculum, and an adult healthy lifestyle role-modeling curriculum. Nutrition data were collected pre and post-intervention, at the beginning and end of the school year. Children’s FV consumption was measured by parental response to questions from the Healthy Kids Checklist, which was validated for use with the study population.\textsuperscript{22} The parental intervention was found to have significantly increased children’s consumption of FVs.
over the course of one school year. Teachers did not significantly influence pre-school aged children’s nutrition patterns throughout the school year.\textsuperscript{22}

A study considering the conditions under which teacher modeling is effective found silent teacher modeling of food consumption without including positive language to be ineffective in encouraging both familiar and new food acceptance. Under silent modeling conditions, introduction of new foods appeared to elicit an initial novelty response, followed by a rapid decrease in consumption after the first meal. Enthusiastic teacher modeling produced more promising results, with new food acceptance being maintained across five meals. However, further experiments exploring the effectiveness of enthusiastic teacher modeling in competition with a peer model revealed that enthusiastic teacher modeling was no longer effective at influencing new food acceptance when a competing peer model was present.\textsuperscript{23}

\section*{1.4. Dietary Assessment of Children}

Fruit and vegetable consumption has become a central focus of efforts to cultivate healthy dietary behaviors in children. The accurate measurement of children’s food consumption is critical to evaluating the impact of interventions that target their diet. To properly evaluate these initiatives, we need feasible and valid dietary assessment methods. These methods must be time, cost, and resource effective to maximize their availability and usefulness. Previous dietary assessment methods have succeeded in evaluating pre-school aged children’s dietary intake, though not without limitations.

Subjective dietary assessment using children’s self-reported intake is dependent upon the child’s memory and cognitive abilities, and portion sizes may be difficult to
Therefore, more objective measures of dietary assessment are preferred, though very few studies have tested these methods with the pre-school age group. Dietary assessment using meal observations provides information on food selection and plate waste and is independent of self-reporting errors. Accurate measurement of food intake is one of the most challenging aspects of nutrition research.

1.5. Subjective Measures of Dietary Assessment

Self-reporting methods of dietary assessment such as food diaries, 24-hour recalls, and food frequency questionnaires have well-documented limitations. Food diaries reduce the risk of food items going unreported, but the inability to estimate portion size, even by parents or other caregivers, is an issue. Food frequency questionnaires and dietary recalls often over- or underestimate intake due to inaccuracies in portion size estimates or memory lapses.

Few studies have attempted to validate self-reporting methods of dietary recall in pre-school aged children. However, the existence of misreporting has been “conclusively demonstrated” in studies aiming to validate the three main measures of self-reported energy intake in children. Those studies found that repeated measures of dietary intake do not necessarily generate valid measurements, as one case of under- or over-reporting likely leads to repeated instances of this bias.

Pre-school aged children, in particular, lack the cognitive ability to accurately self-report their food intake or estimate portion sizes. Children in this age group require adult assistance to provide accurate dietary information as they have limited reading skills and depend on adults to provide their food. Therefore, by-proxy reporting of
children’s dietary intake by parents and other caregivers is accepted for children under eight years old. However, issues with biased reporting may arise from reports by parents or other caregivers, and reliable reporting of children’s food intake is still ambiguous.\textsuperscript{28}

### 1.6. Objective Measures of Dietary Assessment

Many of the limitations of using subjective dietary assessment methods to measure children’s dietary intake may be overcome by using more objective measures. Objective dietary assessment methods rely on physical and visual evaluation of food components before, during, and after a meal. Estimation of food selected and consumed can be achieved by direct measurements of food components, visual estimation based on a six-point scale, or digital images taken before and after consumption. These methods require trained researchers to be present, and can be time and labor intensive.\textsuperscript{29}

The weighed plate waste (WPW) method consists of weighing individual food components to the nearest gram before and after a meal. This method has long been considered the “gold-standard” for meal observations as it provides reliable estimates of food intake by physically weighing food selections and plate waste. Although this method is the most accurate dietary assessment approach, it is infrequently used because it is intrusive as well as time and labor intensive.\textsuperscript{29} Current research primarily uses this approach for the validation of new dietary assessment methods.

Alternatively, food consumption can be visually estimated using direct observation (DO), digital imaging (DI), or a combination of the two. Direct observation is another more objective dietary assessment method, based on a six-point scale comparing selected and consumed amounts to a reference image. This method allows observation of
child behavior such as trading and sharing but is limited by the number of trained researchers available and how many children each researcher can observe. While DO has been shown to be a valid and reliable dietary assessment approach in child-care settings, it requires trained observers and thus external resources that are not widely available.

Recently, our UVM research team established DI as a feasible, reliable, and valid measure of elementary school children’s FV intake. The DI method involves taking digital images of food selections and plate waste and analyzing them at a later date. Digital imaging is increasingly used because data collection procedures are less likely to disrupt the food environment, require less highly trained researchers to be present at mealtime, and allow additional time to estimate portion sizes. The imaging portion requires limited training, therefore allowing researchers as well as teachers, parents, or other caregivers to administer the method. Additionally, DI may be employed in combination with DO (DI+O) if the researcher is interested in child behaviors such as trading and sharing. However, our UVM research team found that the validity of DI and DI+O for mean FV consumption estimations was similar enough to WPW to suggest the exclusion of observations would not greatly influence the accuracy of the mean FV consumption estimations.

The DI method is not without limitations, however. Estimation of consumption involves reference images of food items, which must display portion size and gram weight measurements. This requires additional servings of foods and increases participant burden if caregivers must weigh, measure, and image several food items. Furthermore, analysis of digital images demands more highly trained research analysts or advanced
software capabilities. While both valid and reliable in elementary school children, DI is not yet widely available for dietary assessment in pre-school children.
STUDY AIMS

The aim of this study was to establish the feasibility and validity of novel dietary assessment methods to measure FV consumption in pre-school aged children. Interventions designed to increase pre-school children’s FV consumption drives the need for practical and accessible evaluation tools. WPW is regarded as the gold standard for measuring children’s dietary intake, but this method is time and labor intensive. Dietary assessment using DI may be more practical, but it has not been validated for measuring FV consumption in a pre-school setting. Feasibility of the DI method has not previously been tested in the pre-school environment or in the context of an intervention aimed at increasing FV consumption in pre-school aged children.

In addition, we aimed to establish the feasibility of a new method, aggregate plate waste (APW), as a more time, cost and resource effective dietary assessment method. Collection of APW does not require trained researchers to be present, making it a more accessible and less demanding method. This method has potential for dietary assessment in the pre-school setting due its ease of administration and lack of obtrusiveness.
HYPOTHESES

Feasibility

**Hypothesis 1**: It is feasible to collect fruit and vegetable consumption data from pre-school children using aggregate plate waste.

**Hypothesis 2**: It is feasible to collect fruit and vegetable consumption data using digital imaging in the context of a pre-school intervention to increase fruit and vegetable consumption.

Validity

**Hypothesis 3**: Pre-school children’s mean fruit and vegetable consumption as assessed by digital imaging will not be significantly different from mean consumption using weighed plate waste.
CHAPTER 2: METHODOLOGY

2.1. Protocol Overview

A trained research team collected data in two Burlington, VT YMCA classrooms. Research assistants completed a twelve-hour training in Spring 2015. Training focused on protocols for assessing FV consumption using Aggregate Plate Waste (APW), Weighed Plate Waste (WPW), and Digital Imaging (DI). Beginning in March 2015, the research assistants collected data using these methods during the pre-school classrooms’ afterschool snack time. Data were collected using three methods over 30 consecutive school days from March 18 to April 29, 2015. During this time, the UVM research team provided all afterschool snacks. The study protocol is outlined in Figure 1.

The two classrooms were recruited to serve as an intervention and control room for a FV consumption intervention that this study was embedded in. The intervention consisted of training school-aged (grades 3 and 4) children enrolled in the YMCA to serve as FV mentors to nudge the FV consumption of pre-school aged children. FV mentors were encouraged to: 1) model FV consumption by eating the featured FV snack, 2) use targeted verbal cues to influence consumption, and 3) use statements of praise for children who ate some or all of their FV snack.

Socio-economic differences between the two classrooms made evident by a parent survey necessitated a change in the study structure. Survey questions regarding WIC participation revealed that thirty percent of children in one classroom were enrolled in WIC, while no children in the other classroom were enrolled in WIC. As a result, the
researchers opted to administer the intervention in both classrooms while each acted as their own control.

During each school visit, one or more methods were used to assess FV consumption in order to test the feasibility of APW and DI in the pre-school setting and in the context of an intervention, respectively, and to test the validity of DI against WPW. Figure 2 provides a timeline of the dietary assessment methods used in each phase of the study, including variations in research assistant responsibilities and waste collection procedures. Data were collected on an average of ten children per classroom during each visit. Data were collected on plate waste, while no identifying information was collected about the children. Recruitment packages included consent forms with a description of the study, a parent survey incorporating a child allergy screen, and a snack menu. Informed consent was required as it was an intervention involving children.

2.2. Research Assistant Training

The team of research assistants consisted of two graduate students and 18 undergraduate nutrition majors or minors (freshmen, sophomores, juniors, and seniors) at the University of Vermont. Undergraduates were recruited from nutrition courses and from recruitment flyers in the main nutrition building. The undergraduate students completed a 12-hour training program developed and facilitated by two graduate nutrition students in Spring 2015. The objective was to train the students as research assistants in data collection procedures for collecting FV consumption data during pre-school snack time using APW, DI, and WPW, as well as behavioral intervention procedures.
Undergraduate students were required to complete human subject research training prior to data collection training.

Research assistants completed seven, 90-120 minute training sessions in a conference room at the University of Vermont. The first training session provided an introduction to the study and an overview of the study protocol and general procedures for using APW, DI, and WPW. The following six weeks focused on specific periods throughout the study and the corresponding field methods: baseline data collection, FV mentor training and intervention data collection, and post-intervention data collection. Detailed research assistant training procedures are provided in Appendix A. Research assistants attended a review of the field methods one week before data collection began.

During initial training sessions, research assistants were provided background information addressing the importance of the research and a brief overview of dietary assessment methods in the context of study objectives. Background information included childhood obesity prevalence, current dietary patterns and FV consumption in children, and the importance of the pre-school environment in shaping dietary behaviors. The project objectives included, 1) recruit, collect baseline FV consumption, administer “nudge” intervention, and collect post intervention FV consumption data, and 2) Test feasibility of APW and DI, and test validity of DI against WPW.

Baseline data collection training detailed the pre-school classroom set-up, where children were seated in clusters and each research assistant was responsible for observing one to two clusters of children. This was followed by an explanation of FV mentor training and data collection procedures during the intervention. During these phases of the study, waste was collected and weighed aggregately by cluster. Clusters of pre-school
children were responsible for sorting their snack waste into two bins provided by the UVM research team: one for FV waste and one for all other waste. Selection, APW, and observational data were recorded on baseline data collection forms (Appendix B) and intervention data collection forms (Appendix C). Research assistants were required to record any errors made in sorting the snack components.

Post-intervention training employed two additional data collection methods: DI and WPW. Children continued to be seated in clusters; APW bins were removed and waste was collected individually by cluster. Research assistant responsibilities included: recording individual child FV selection within their assigned cluster, collecting individual child food waste, imaging FV waste as a cluster, weighing individual FV waste, and combining FV waste to record an aggregate weight. Selection, WPW, APW, and observational data were recorded on post-intervention data collection forms (Appendix D).

Research assistants provided the snack to the children in their cluster and unobtrusively observed behavior and waste sorting abilities throughout the first four weeks of the study. Research assistants were instructed to limit their interaction with the children and observe away from the cluster but be within earshot. When the children finished their snack and disposed of their waste in the bins, they were allowed to leave the table to go to the play area. At that time, research assistants removed the bins from the table and began waste measurement procedures in a separate room away from the children. In the final two weeks of the study, children were instructed to leave all of their waste at their table. When the children were finished and had gone to play, research assistants collected individual FV waste to image and weigh in a separate room.
2.3. YMCA Partnership and Pre-School Classroom Settings

Two pre-school classrooms and one grade 3-4 classroom participating in YMCA programs were recruited to participate in the study. The YMCA was selected because of its close proximity to the UVM campus and the convenience of having FV mentors and pre-school children enrolled in YMCA programs in the same building. The YMCA has a widespread national presence making it an ideal partner for interventions that address youth behaviors. Child education and leadership are central priorities of the YMCA and their core values are relevant to our intervention.

A brief announcement of the study was emailed to potential FV mentor parents from the director of the afterschool program in late January 2015, prior to recruitment package distribution in February 2015 (Appendix E). Pre-school recruitment packages (Appendix F) were distributed to the director of the pre-school programs at the YMCA in early February 2015. When parents arrived to pick up their children, the teacher handed them a recruitment package and offered a brief explanation of the study. Each recruitment package contained a cover letter, consent package, envelope, and parent information sheet.

Two pre-school classrooms from the Y Early Childhood Program were recruited. Approximately 15 children were enrolled per classroom. Children were assigned to eat their snack in clusters of approximately three. Clusters were assigned by teachers and based on children who played well together. Each cluster was assigned a different shape and color for children to identify their cluster.
2.4. Procedure for Baseline Data Collection

Baseline FV consumption data were collected in two pre-school classrooms across ten consecutive days. Classroom teachers adhered laminated cluster identification signs prepared by UVM graduate researchers to tables prior to the study beginning. Each cluster of children was assigned a specific color and shape for researcher identification within the classroom, such as red star, blue smiley face, etc. Children were to associate these signs with their seats during snack time. One UVM research assistant was assigned to each cluster of approximately three pre-school children, though scheduling conflicts occasionally resulted in one researcher being responsible for two clusters.

Outside of the classroom, researchers identified clusters by a classroom identification letter and a cluster number one through five. For example, the “red star” cluster was I-1, and the “purple star” cluster was C-2; the letters identified the different classrooms. A full list of these identification codes can be found in Appendix G. Research assistants were provided a baseline data collection form with the date, their name, the featured FV, and their cluster assignment already filled in by a graduate researcher. Research assistants were responsible for recording FV selection identification numbers and waste measurements in a table provided on the form.

During the ten days of baseline data collection, FV waste was measured using APW. The APW method consisted of sorting food waste into various collection bins based on the nature of the food item. In the pre-school classrooms, each cluster of children received two mini trash bins to dispose of their snack waste: one for FV waste and one non-FV waste. Children were instructed by their teachers to sort their snack waste components into designated bins on their assigned table. The FV waste bins were
affixed with a laminated picture of the featured FV. The non-FV waste bin was not labeled.

When snack time began, graduate students distributed grain and dip snacks to preschool children. Research assistants were responsible for distributing the pre-portioned FV snack to their assigned clusters. Research assistants recorded identification numbers from the bottom of the FV snack cup before distributing FV snacks to their cluster. If a child requested a second FV snack, research assistants recorded the second identification number in the same box as the child’s first serving.

Approximately 5-10 minutes after children received their snacks, research assistants placed two mini trash bins on the table. During the first three days of data collection, teachers were allowed to remind children of the waste sorting procedures. During these days, teachers were allowed to verbally correct children if they witnessed sorting errors. Research assistants were to watch for sorting errors and note them on the data collection form, but they were not permitted to intervene in the classroom. When all of the children in the research assistants’ clusters were finished with their snack, the research assistant took the waste to a separate room for weighing. Sorting errors were corrected at the weighing station, away from the children. The weight of the FV bin waste was taken before and after corrections were made. Waste was measured to the nearest gram and recorded on the data collection form. Throughout the study, all of the data recorded on data collection forms were entered into an Excel spreadsheet.
2.5. Procedure for Intervention Data Collection

The intervention took place during weeks 3-4 of the study, across ten consecutive school days. Each classroom received one week of the FV nudging intervention with the FV mentors and one week of verbal FV consumption encouragement from the classroom teachers. Research assistants were provided an intervention data collection form with the date, their name, the featured FV, and their cluster assignment already filled in by a graduate researcher. Pre-school children received their snack under the same protocol as baseline data collection. During the FV mentor portion of the intervention, at least one FV mentor was present in each cluster of pre-school children. Research assistants were responsible for recording the FV mentor’s snack identification number in the designated area on the intervention data collection form. Additionally, research assistants were responsible for ensuring that FV mentor snack waste was returned to them and not sorted into the waste bins.

Approximately 15 minutes before snack time, graduate researchers collected 3rd and 4th grade FV mentors from afterschool program classrooms. Mentors reviewed verbal cues and the importance of modeling FV consumption with the UVM dietary assessment team. FV mentors were encouraged to: 1) model FV consumption by eating the featured FV snack, 2) use targeted verbal cues to influence consumption, and 3) use statements of praise for children who are some or all of their FV snack. Mentors were instructed to return their FV waste to the research assistant responsible for the cluster they were seated with.

After recording FV identification numbers for pre-school children and FV mentors in their cluster and distributing FV snacks, research assistants were instructed to
unobtrusively monitor FV consumption by FV mentors and record FV mentor’s use of verbal cues and pre-school children’s responses to the verbal cues. When snack time concluded, aggregate pre-school child cluster waste and individual FV mentor waste was measured and recorded to the nearest gram in a separate room.

During the week that the classroom did not have FV mentors, teachers were assigned verbal cues and statements of praise to use to encourage FV consumption. Research assistants were responsible for recording the teachers’ use of verbal cues and the pre-school children’s response to those cues. Snack distribution and waste collection followed the same protocol as baseline data collection.

### 2.6. Procedure for Post-Intervention Data Collection

Snack distribution followed the same protocol as baseline data collection. Research assistants were provided a post-intervention data collection form with the date, their name, the featured FV, and their cluster assignment already filled in by a graduate researcher. Aggregate waste collection and the use of the mini trash bins ended with the intervention. Research assistants collected individual child FV waste from their cluster. All other waste was disposed of in the classroom trashcan. Research assistants conducted DI, WPW, and APW procedures in a separate room away from the children.

At the weighing station in the separate room, research assistants first captured digital images of the FV waste. Digital images were taken in clusters rather than individually. At the digital image station, research assistants recorded individual FV identification numbers from the bottom of the snack cups on identification cards to be placed directly in front of the corresponding cup for the digital image. The date and
cluster identification code was also noted on the first identification card in the image. Digital images were taken at an approximately 45-degree angle above the cups to ensure that the depth of the contents could be perceived for digital image coding purposes. An example of a properly executed digital image of cluster FV waste can be seen below:

![Digital Image 1](image-url)

*Digital Image 1: A pre-school cluster's FV waste properly labeled with date, FV item, cluster identification code, and individual FV snack identification codes.*

After digital images of cluster FV waste were taken, research assistants weighed and recorded the contents of each cup from their cluster, paying close attention to the FV identification code. Research assistants zeroed the Cuisinart scale to the weight of a small paper plate before placing the contents of individual cups onto the plate. When the weight of the FV contents of each individual cup in a cluster had been recorded, cluster waste was combined and measured aggregately for consistency throughout the study. All waste was measured to the nearest gram and recorded on the post-intervention data collection forms.
2.7. Snack Preparation

Snacks provided aligned with the USDA Child and Adult Care Food Program (CACFP) snack nutrition standards for pre-school aged children. Prior to the start of the study, members of the UVM dietary assessment team observed snacks provided by parents of the pre-school children at the YMCA. Observed snacks did not typically include FV and were high in added sugars and/or sodium, such as Cheetos. The snacks provided throughout our study were intended to be a positive addition to the children’s dietary intake. Parents completed an allergy screen and were provided with a menu (Appendix F) of all potential snacks to be served as part of the recruitment package.

All snacks were prepared in a clean and sanitary environment at the University of Vermont by the UVM dietary assessment team graduate students, including a student who was trained in safe food preparation at the Culinary Institute of America. Snacks were prepared fresh every morning throughout the six weeks of the study. FV snack items were properly washed, weighed to the nearest gram, individually packaged in plastic cups with lids, and stored in the refrigerator before each visit. Gram weights of individual FV snacks were recorded in an Excel spreadsheet. During the baseline and post-intervention phases of the study, 40 individual FV snacks were prepared. This was enough for each potential child (n=30) plus seconds for up to ten pre-school children. During the intervention phase, 45 individual FV snacks were prepared to account for mentors. The amount of fruit or vegetable to purchase each week to make 40 snacks/day and 45 snacks/day was calculated using the website Food Buying Guide: Calculator of Child Nutrition Programs.34
All children received ¼ cup of a whole grain snack, ½ cup of a FV snack, and 1-2 ounces of a dip. FV snacks were portioned by weight to reflect the average gram measurement of a ½ cup serving of the specific FV’s. These gram measurements can be found in Appendix H. Large grain snacks such as wheat thins and whole grain pita chips were measured by counting individual pieces, and smaller ones such as cheerios were measured by volume using a ¼ cup-measuring cup. Grain snacks were packaged in snack size Ziploc bags. Dips were poured or scooped into two ounce disposable cups with lids and stored in the refrigerator until transport to the YMCA. UVM dietary assessment graduate students transported snacks to the YMCA approximately 20 minutes prior to snack time.

During weeks 5-6 of the study, baseline digital images of FV snacks were taken during snack preparation. All digital images were taken with Canon PowerShot ELPH 300 HS digital cameras, held at approximately 45-degrees and 12-16 inches above the snack cup. After FV snacks were portioned and corresponding identification codes and weights were recorded, one FV snack was selected for the baseline digital image. An identification card detailing the date, FV item, and average ½ cup serving gram weight was placed in front of the FV snack that was subject of the baseline digital image; an example of a baseline digital image captured during this study can be found immediately following this paragraph. Research associates compared FV plate waste collected from pre-school classrooms to this reference image during the DI coding process. In order to estimate percentage consumed, research associates could compare FV waste captured in digital images at the YMCA to the baseline image of a standard serving size.
Digital Image 2: A baseline digital image of a standard ½ cup serving of clementines, displaying date, FV item, and average gram weight of a single serving.

2.8. Outcome Measures

Feasibility

Feasibility was tested for APW during weeks 1-4 by recording the incidence of waste sorting errors by pre-school children and measuring the weight of the errors. Research assistants closely monitored the children in their assigned cluster as they sorted their waste, recording any incidence of sorting error. Assistants recorded whether the error was FV waste being incorrectly sorted into the non-FV waste bin or non-FV waste being incorrectly sorted into the FV bin. During weighing, research assistants measured and recorded the weight of the FV waste before and after sorting errors were corrected. If FV waste was incorrectly sorted into the non-FV waste bin, original FV waste weight was first recorded. FV waste from the non-FV waste bin was then moved to the FV waste bin and the weight was recorded again. If non-FV waste was incorrectly sorted into the FV waste bin, the weight of the FV waste bin was first recorded. Incorrectly sorted non-FV waste was removed and the weight of the FV bin was recorded once more.
Feasibility was tested for DI during weeks 5-6 by determining the total number of individual FV snacks from which FV consumption could be estimated using the digital images. The FV snack was included in the final sample of snacks collected if the DI allowed researchers to identify individual snack cups and estimate FV plate waste. FV snacks were not included in the final sample if the DI did not clearly display the contents of the snack container or if individual FV snack identification cards did not provide sufficient detail for accurate identification.

Validity

The validity of DI was tested during weeks 5-6 by comparing estimations of FV consumption using DI against actual consumption as measured by WPW. Consumption for each FV item was determined by subtracting the grams plate waste from the grams selected for individually identified FV snack servings. The gram weight of individual FV snacks selected was available in the Excel spreadsheet from food preparation. FV consumption as determined by WPW was calculated as follows:

\[
\text{FV consumption (g)} = \text{FV selection (g)} - \text{FV plate waste (g)}
\]

During these visits, researchers collected and digitally imaged all snack cups as previously stated. Two research associates completed the digital image coding process for each visit by comparing the baseline FV image and cluster FV plate waste images side-by-side on a computer. Research associates estimated the percentage of FV consumed to the nearest increment using the Comstock six-point scale (none=0%, taste=10%, some=25%, half=50%, most=75%, all=100%). The two research associates estimations of grams consumed were averaged for each FV item and entered into an Excel
spreadsheet. FV consumption as assessed by DI was calculated by multiplying the estimated percentage consumed by the previously recorded gram weight of the FV snack selected as follows:

\[ \text{FV consumption (g)} = \text{FV selection (g)} \times \text{Percent consumed} \]

Grams of FV consumed as estimated by DI were compared to actual FV consumption measured by WPW for all snack cups that were successfully collected using DI. Validity was tested by comparing estimates of grams consumed against actual grams consumed for total FV consumption and per food item. FV consumption per food item was calculated by summing grams consumed of individual food items across the ten day DI validation period.

2.9. Data Analyses

Data analyses were performed to test feasibility and validity using the Statistical Package for the Social Sciences (SPSS). For all statistical tests, significance was set at \( p < 0.05 \) and the tests were two sided.

Feasibility

Feasibility of APW was tested during weeks 1-4 by recording the frequency and weight of sorting errors within clusters during each visit. Paired \( t \)-tests compared uncorrected FV waste against corrected FV waste for all FV waste across all days of data collection, within individual classrooms, and for individual FV items.

Feasibility of using DI to collect FV consumption data in the context of a pre-school intervention to increase FV consumption was tested during weeks 5-6 of the study.
Frequencies of number of cluster digital images collected and omitted were compared. The percentage of digital images collected was evaluated against the goal of collecting at least 95 percent usable images.

**Reliability**

Percent agreement was assessed to examine the reliability of the DI method for estimating FV consumption. For each FV item, the two observers were in agreement if their estimates of the percentage consumed were within 25 percent of each other. Percent agreement was calculated as follows:

\[
\text{Percent Agreement} = \left( \frac{\text{Observer agreements}}{\text{Observer agreements} + \text{observer disagreements}} \right) \times 100
\]

Acceptable percent agreement was defined as \( \geq 85\)-percent.

**Validity**

Paired samples correlations compared DI to WPW for assessing individual FV item and overall FV consumption. Correlations were considered acceptable if \( \geq 0.95\).

Paired \( t\)-tests compared WPW to DI for total FV consumption and consumption per FV item. The paired \( t\)-tests determined the degree of under- or over-estimation for estimated mean consumption when DI was compared against actual mean consumption as measured by WPW.
Figure 1: Study Protocol

Recruitment and Training
• Recruit Research Assistants November-December 2015
• Recruit YMCA Participants January-February 2015
• Train Research Assistants January-March 2015

Objective 1:
• Collect Baseline FV Consumption March 18-31
• Administer Nudge Intervention and collect FV consumption April 1-14
• Collect Post-Intervention FV Consumption April 15-29

Objective 2
• Test Feasibility of APW Weeks 1-4
• Observe Child Sorting Abilities
• Weigh Sorting Errors
• Test Validity of DI via WPW Weeks 5-6
• Digital Image Clusters
• Weigh Individual Child Food Waste
Figure 2: Timeline of Dietary Assessment Methods and Associated Data Collection Procedures

March 18 - April 29, 2015: Test Feasibility of APW and Feasibility and Validity of DI.

**Weeks 1-6**

**Research assistant responsibilities:**
Serve snack to each child in assigned cluster, record individual FV identification numbers on data collection form.

**Weeks 1-4:** Feasibility of APW

**Weeks 1-4**
Pre-school children sort snack waste into two aggregate waste bins: FV waste in one bin, all other waste in second bin.

**Classroom Observations**
Observe children sorting snack waste. If errors are present, note on data collection form.

**Waste Collection Procedures**
1. Collect cluster's APW bins, take to separate room for weighing.
2. Weigh contents of FV waste bin, record on data collection form.
3. If sorting errors are present, weigh and record before and after corrections are made.

**Weeks 5-6:** Feasibility and Validity of DI against WPW

**Weeks 5-6**
Pre-school children leave FV waste on table to be collected individually.

**Waste Collection Procedures**
1. Collect individual FV waste from children in assigned cluster, take to separate room for imaging and weighing.
2. Sort and label cluster's waste for digital image: display date, food item, cluster identification code, and individual FV snack identification codes.
3. Capture digital image
4. Weigh individual FV waste and record on data collection form.
5. Combine cluster waste and record aggregate weight.
CHAPTER 3: RESULTS

3.1. Feasibility

The average number of clusters of children observed per visit was eight. Due to child absences, only six clusters were present on one of the 20 APW data collection days, and seven were present on three of these data collection days. During each visit, researchers successfully obtained FV consumption data from 100% of the APW mini bins distributed. A total of 159 cluster APW weights were recorded. Table 1 lists the mean uncorrected and corrected FV APW measurements, as well as the mean difference, confidence interval, and significance of the uncorrected versus corrected FV waste measurements from weeks 1-4 of the study.

Paired t-tests found no statistically significant difference between uncorrected and corrected means for overall waste (p=0.440) or for any specific fruit or vegetable (carrot (p=1.000), clementine (p=0.955), peapod (p=0.325), grape (p=0.325), pepper (p=0.131)). Classroom 1 saw no significant difference in uncorrected and corrected FV waste measurements (p=0.506). The only significant difference in uncorrected and corrected FV waste measurements was observed in classroom 2 (p=0.030; this was a difference of just 1.9 grams per serving).

During the final ten days of the study a total of 76 pre-school clusters were observed. Trained research assistants successfully captured 100-percent of FV snack waste in digital images. These images featured 214 individual FV servings, all of which were usable, meaning FV consumption estimations could be made for each serving of FVs. The goal of collecting at least 95-percent usable digital images was exceeded.
3.2. Reliability

Percent agreement for DI observer reliability assessments is shown in Table 2. Two research associates evaluated all FV servings observed by DI. Percent agreement was 99.1-percent. FV consumption assessed by DI was compared to actual FV consumption measured by WPW for the final ten visits. Each of the five individual FV items were featured for two of these ten visits. Data on overall FV consumption were compared between DI and WPW for 214 individual FV servings during ten visits. Data on individual FV item consumption were compared between DI and WPW for two visits each, ranging from 33 to 69 individual servings.

3.3 Validity

Results of validity tests for overall and individual FV items as assessed by DI and WPW are presented in Table 3. Paired t-tests found that DI was not significantly different from WPW for assessing clementines (p=0.954) and peapods (p=0.806) with 95% CIs [-0.73, 0.78] and [-0.66, 0.52], respectively. DI was found to be significantly different from WPW in assessing overall (p=0.001, 95% CI [-1.04, -0.29]) FV consumption, as well as peppers (p=0.027, 95% CI [-2.60, -0.16]), carrots (p=0.008, 95% CI [-3.75, -0.61]), and grapes (p=0.031, 95% CI [-0.47, -0.02]).

Paired samples correlations were collected for assessment of individual FV items and overall FV consumption (Table 4). Correlations were lowest for carrot (r=0.97) and pepper (r=0.98) consumption, and above r=0.99 for overall FV consumption, as well as for peapods, grapes, and clementines.
Table 1: Mean fruit and vegetable aggregate plate waste during 20 visits: comparison of uncorrected and corrected waste, feasibility of pre-school children sorting fruit and vegetable waste aggregately

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. Observed</th>
<th>Mean Uncorrected (g)</th>
<th>Mean Corrected (g)</th>
<th>Mean Difference (g)(^1)</th>
<th>95% CI</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>n=159</td>
<td>67.46</td>
<td>66.89</td>
<td>0.57</td>
<td>-0.88, 2.01</td>
<td>0.440</td>
</tr>
<tr>
<td>Classroom</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Room 1</td>
<td>n=80</td>
<td>84.35</td>
<td>85.13</td>
<td>-0.78</td>
<td>-3.08, 1.53</td>
<td>0.506</td>
</tr>
<tr>
<td>Room 2</td>
<td>n=79</td>
<td>50.35</td>
<td>48.43</td>
<td>1.92</td>
<td>0.20, 3.65</td>
<td>0.030</td>
</tr>
<tr>
<td>FV Item</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carrot</td>
<td>n=32</td>
<td>91.91</td>
<td>91.91</td>
<td>0</td>
<td>-2</td>
<td>1.0</td>
</tr>
<tr>
<td>Clementine</td>
<td>n=32</td>
<td>99.00</td>
<td>98.84</td>
<td>0.16</td>
<td>-5.47, 5.79</td>
<td>0.955</td>
</tr>
<tr>
<td>Peapod</td>
<td>n=32</td>
<td>51.66</td>
<td>51.34</td>
<td>0.31</td>
<td>-0.33, 0.95</td>
<td>0.325</td>
</tr>
<tr>
<td>Grape</td>
<td>n=32</td>
<td>20.34</td>
<td>21.31</td>
<td>-0.97</td>
<td>-2.95, 1.01</td>
<td>0.325</td>
</tr>
<tr>
<td>Pepper</td>
<td>n=31</td>
<td>74.61</td>
<td>71.19</td>
<td>3.42</td>
<td>-1.08, 7.92</td>
<td>0.131</td>
</tr>
</tbody>
</table>

\(^1\)Differences were defined as uncorrected weights minus actual weights; a positive value indicates an underestimation of FV consumption in uncorrected waste; a negative value indicates an overestimation of FV consumption in uncorrected waste.

\(^2\)Confidence interval could not be computed; no difference observed in mean uncorrected versus mean corrected waste measurements.
<table>
<thead>
<tr>
<th>Valid</th>
<th>Frequency</th>
<th>Valid Percent</th>
<th>Cumulative Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>0&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2</td>
<td>0.9</td>
<td>0.9</td>
</tr>
<tr>
<td>1&lt;sup&gt;b&lt;/sup&gt;</td>
<td>212</td>
<td>99.1</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<sup>a</sup> indicates that a discrepancy of more than 25% of a FV serving between observers.

<sup>b</sup> indicates a discrepancy of less than 25% of a FV serving between observers.
Table 3: Validity of digital imaging against weighed plate waste

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. Observed</th>
<th>Mean Est. Consumed (g)</th>
<th>Actual Mean Consumed (g)</th>
<th>Mean Difference (g)</th>
<th>95% CI</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carrot</td>
<td>n=33</td>
<td>17.37</td>
<td>19.55</td>
<td>-2.18</td>
<td>-3.75, -0.61</td>
<td>0.008</td>
</tr>
<tr>
<td>Clementine</td>
<td>n=40</td>
<td>48.20</td>
<td>48.18</td>
<td>0.02</td>
<td>-0.73, 0.78</td>
<td>0.954</td>
</tr>
<tr>
<td>Peapod</td>
<td>n=34</td>
<td>10.87</td>
<td>10.94</td>
<td>-0.07</td>
<td>-0.66, 0.52</td>
<td>0.806</td>
</tr>
<tr>
<td>Grape</td>
<td>n=69</td>
<td>27.38</td>
<td>27.62</td>
<td>-0.25</td>
<td>-0.47, -0.02</td>
<td>0.031</td>
</tr>
<tr>
<td>Pepper</td>
<td>n=37</td>
<td>19.06</td>
<td>20.43</td>
<td>-1.38</td>
<td>-2.60, -0.16</td>
<td>0.027</td>
</tr>
<tr>
<td>Cumulative</td>
<td>n=213</td>
<td>25.67</td>
<td>26.34</td>
<td>-0.66</td>
<td>-1.04, -0.29</td>
<td>0.001</td>
</tr>
</tbody>
</table>

1 Weight determined by digital imaging.
2 Actual weight determined by weighed plate waste.
3 Differences were defined as estimated weights minus actual weights; a positive value indicates overestimation, and a negative value indicates underestimation of grams consumed.
4 Significance was set at P<0.05.
Table 4: Correlations of DI estimation and WPW for individual FV items and overall FV consumption

| Variable | No. Observed | Mean Est. Consumed (g)
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(g)$^1$</td>
</tr>
<tr>
<td>Carrot</td>
<td>n=33</td>
<td>17.37</td>
</tr>
<tr>
<td>Clementine</td>
<td>n=40</td>
<td>48.20</td>
</tr>
<tr>
<td>Peapod</td>
<td>n=34</td>
<td>10.87</td>
</tr>
<tr>
<td>Grape</td>
<td>n=69</td>
<td>27.38</td>
</tr>
<tr>
<td>Pepper</td>
<td>n=37</td>
<td>19.06</td>
</tr>
<tr>
<td>Cumulative</td>
<td>n=213</td>
<td>25.67</td>
</tr>
</tbody>
</table>

$^1$Weight estimated by digital imaging.

$^2$Actual weight measured by weighed plate waste.

$^3$All correlations were significant at P<0.01.
CHAPTER 4: DISCUSSION

This study evaluated the feasibility of APW for estimating pre-school children’s FV consumption, and the feasibility and validity of DI for estimating pre-school children’s FV consumption in the context of an intervention aimed at increasing FV consumption. The major findings were: 1) APW and DI were feasible methods to collect FV consumption data; 2) DI is a valid method for estimating overall mean FV consumption in the highly researcher controlled pre-school setting that this study was conducted in; and 3) APW appeared especially promising for measuring group mean FV consumption in a highly efficient manner.

Results from this study supported the hypothesis that it is feasible to collect FV consumption from pre-school children using APW. FV consumption could be estimated for each individual cluster (n=159) in both pre-school classrooms throughout the 20-day APW collection period. Uncorrected FV waste was not significantly different from corrected FV waste overall or for individual FV item waste measurements (Table 1, p=0.440), 95% CI [-0.88, 2.01]. The overall uncorrected mean FV waste as assessed by APW differed from the corrected mean waste by 0.57 grams, indicating a very slight underestimation (less than 2-percent of any ½ cup serving of FVs) of total FV consumption if waste sorting errors are not corrected. This equates to approximately ¼ of one grape (a 31 gram ½ cup serving is approximately 16 grapes) or 1/20th of one baby carrot (a 61 gram ½ cup serving is approximately 6 carrots).

Throughout the study, the pre-school children demonstrated their ability to sort individual food items into designated waste collection bins with little variability. A total of 406 individual snacks were served throughout the 20 days of APW collection and only
14 waste sorting errors were observed. No difference was found between uncorrected and corrected waste measurements for carrots. On days that carrots were served, researchers observed that most pre-school children either ate their entire FV snack or did not touch their FV snack except to dispose of it. Additionally, children who did not eat their carrots typically consumed all of their grain and dip snacks. This all-or-nothing consumption pattern may have contributed to the 100-percent waste sorting precision on these days. Peapod and clementine consumption was underestimated by less than 1-percent of a ½ cup serving before corrections were made, while grape consumption tended to be overestimated by about 3-percent of a ½ cup serving, or ½ of one grape. Uncorrected and corrected waste measurements would have been identical for grapes if not for one child incorrectly sorting their entire untouched serving of grapes; no other waste sorting errors were observed on days that grapes were featured.

The greatest difference between uncorrected and corrected waste measurements was observed in peppers, with uncorrected waste tending to underestimate consumption by approximately 3.4 grams, or 7.7-percent of a 46 gram serving. For reasons unknown, the frequency of waste sorting errors was much higher on days that peppers were served, with children tending to incorrectly sort their non-FV waste into the FV waste bin. In fact, as many sorting errors occurred on the 4 days that peppers were served as on the 16 other days of APW collection combined (researchers recorded a total of 7 waste sorting errors in the 4 days that peppers were served, and a total of 7 waste sorting errors in the remaining 16 APW collection days).

Recently, APW was utilized to measure change in FV consumption in response to an intervention to increase elementary school students’ FV consumption during lunch.36
A promising feature of this research was the use of food service records to determine the amount of individual FV served. Students were instructed to leave food waste on tables to be sorted by research staff.\textsuperscript{36} In this study, we found that children are able to accurately apply aggregate waste sorting methods at a very young age, thus improving efficiency. The APW method is a more accessible and less demanding dietary assessment method due to its ease of administration and lack of obtrusiveness, as it offers immediate results with little time, cost, and resource burden.

This research was conducted in a controlled environment where researchers prepared FV snacks for up to 15 children per classroom per day. FV snacks were served in ready-to-eat pieces with inedible portions removed. Research has shown that children are likely to consume more of a FV snack that is easier for them to eat, such as when it is pre-sliced.\textsuperscript{37} The design of this study allowed researchers to regulate and record the exact weight of each snack served. This degree of precision and control is not necessary to use the APW method to measure group mean consumption. Group mean intake can be accurately assessed using a record of the bulk weight of individual FVs available before the meal, meaning APW can be useful in self-serve situations. A study testing the validity of using salad bar pan weight to estimate FVs taken from an elementary school self-service salad bar found no significant difference between individual FV weights and estimates based on pan weight.\textsuperscript{38} As APW does not require a record of individual FV servings to estimate group mean consumption, these findings have valuable application for future research in a less controlled environment.

Researchers were able to capture 100-percent usable digital images displaying a total of 214 individual FV snack servings over the 10-day DI study period. DI in this
environment differed from previous research as children did not dispose of waste themselves and were not present while digital images were captured, thus limiting the potential for error. As a result of the controlled environment of this research, common obstacles such as visual obstructions and disappearing servings were avoided. This research does not demonstrate the natural pre-school food environment, as each child received an identical snack that was prepared by researchers, and researchers collected child food waste prior to digital imaging. Collection of post-meal digital images in the natural pre-school environment may be equally effective however, as it is becoming more common for waste disposal to consist of sorting different meal components such as liquids, recycling, trash, and compost, thus slowing the waste disposal process and allowing increased time for digital imaging. This increase in waste sorting also decreases the intrusiveness of requiring children to sort different meal components such as fruit and vegetable waste per APW methods.

DI is widely utilized to evaluate initiatives targeting school children’s FV consumption, but dietary assessment in pre-school populations still relies heavily on subjective dietary recall methods or WPW. This study found that DI was a reliable method for estimating pre-school children’s FV consumption. Percent agreement between two observers exceeded the acceptable level of 85-percent at 99.1-percent. Of the 214 individual observations, the two observers differed by more than 25-percent of a serving on just two occasions (Table 2). DI estimations for individual FV items and cumulative consumption were strongly correlated with WPW (Table 4, all above r=0.97). DI estimations of clementine, peapod, grape, and overall FV consumption correlated with WPW at greater than r=0.99. This finding suggests that despite the statistical significance
of DI estimations compared to WPW measurements for several FV items and overall FV consumption (Table 3), the DI method is still precise for group FV consumption evaluation. An afterschool program study had similar results: DI estimations were highly correlated with WPW at 0.90 to 0.93 for FV consumption. The mean difference in consumption between DI estimations and WPW was 6-percent of a FV serving. In this study, the mean difference in consumption between the two methods was less than 2.5-percent of a FV serving.

This study found evidence to support the hypothesis that estimations of mean FV consumption by DI may not be significantly different from WPW in a pre-school environment. DI estimations of clementine and peapod consumption were not significantly different from WPW measurements. Although overall FV consumption as estimated by DI differed from WPW by less than one gram (Table 3, -0.66 grams), the cumulative difference between DI estimations and WPW measurements was statistically significant at p=0.001, though practical consideration of the corresponding 95% CI [-1.04, -0.29] indicates that the method is valid for measuring overall mean FV consumption. Further statistical analysis indicated that a difference of 0.37 grams would have been significant at p=0.05; this is less than 1-percent of any FV serving in the context of this study. In all cases, estimations of mean consumption were within two grams of actual consumption as assessed by WPW, indicating that the degree of inaccuracy was very small. In context, two grams is roughly equivalent to ½ of one pea pod. Overall consumption as estimated by DI differed from WPW by just 0.66 grams, or approximately 1/3 of one grape. The small serving and sample sizes, as well as an overall
average FV consumption of just 26 grams likely contributed to the statistical significance of the very slight mean differences.

With the exception of clementine consumption, which was underestimated by an average of 0.02 grams (less than 0.03-percent of a clementine, or 2-percent of one clementine wedge), DI estimations tended to slightly overestimate FV consumption compared to WPW. The greatest degree of overestimation occurred with baby carrots. DI estimations for baby carrot consumption differed from WPW by an average of -2.18 grams (approximately 3.5-percent of a ½ cup serving), which equates to an overestimation of approximately 1/5th of one baby carrot. This difference could be attributed to the variability in the size of baby carrots, or to the Comstock scale that was implemented for DI estimations, as this scale generally overlooks differences of less than 25-percent (with the exception of estimates greater than 0 but less than 10-percent consumption). Pepper consumption was overestimated by approximately 3-percent (-1.38 grams) of a serving, while overestimation of grape and peapod consumption was just 0.03 (-0.25 grams) and 0.02-percent (-0.07 grams) of a serving, respectively. For reference, 0.25 grams is approximately 1/8th of one grape. In a meal simulation scenario that assessed 106 FV servings, DI overestimated mean FV consumption by approximately 5 grams.50

There were notable strengths to the design of this study. The study recruited preschool classrooms from the local YMCA Early Childhood Program. The YMCA has a widespread national presence, making it an ideal partner for interventions that address youth behaviors, as well as for the development, evaluation, and expansion of dietary assessment methods. The study developed and tested protocols for two dietary
assessment methods within the context of a nationwide program; one method that is commonly used to assess children’s food consumption (DI), and one novel dietary assessment method (APW).

This study evaluated the feasibility of a new dietary assessment method, APW, for collecting FV consumption data from pre-school children. These APW collection methods were specifically designed for pre-school classrooms, and this study found that children immediately understood and applied the appointed waste sorting methods. The APW method used in this study can be applied to future research in any YMCA pre-school classroom, allowing for widespread evaluation of dietary behaviors. This may be especially helpful in the evaluation of dietary behavior change, such as interventions aimed at increasing FV consumption.

There are several limitations to this study. While the protocols for both APW and DI waste collection may be generalizable to other YMCA locations and pre-school classrooms, the snack preparation and distribution methods applied in this study require extensive planning and skillful execution. This study was limited to observations of snacks that were prepared specifically for this research; it did not assess FV consumption in a natural setting, where children may bring food from home or receive a snack offered in the venue. Although APW sorting procedures were easy to implement in the pre-school classroom, the resulting food waste measurements require a baseline for comparison to obtain useful dietary assessment information. Baseline APW measurements of FV waste taken prior to the implementation of an initiative to increase FV consumption can be used to detect a change in mean consumption post-intervention. Likewise, a record of the bulk weights of individual food items before and after a meal
can be used in conjunction with the weight of individual APW collection bins to estimate mean consumption of specific food items of interest. Programs offering a standard daily snack may be able to apply either dietary assessment method with relative ease.

As previously stated, this study solely evaluated snacks that were pre-portioned and documented by trained research staff. It was anticipated that this research would establish the validity DI against WPW, given the control researchers had over the situation. Despite the statistical significance of some validation test results, practical consideration of the slight differences in mean consumption, consistently narrow 95% CIs, and very strong correlations between DI and WPW measurements suggests that validation was successful. Major advantages of DI in the pre-school environment include a manageable child to instructor (or researcher) ratio, and that snack and mealtime are more likely to take place in a controlled classroom environment. The need for trained research staff to evaluate digital images continues to be a limitation of this method. Future research in a similar environment could use DI measurements of group mean FV consumption to test the validity of the APW method for measuring group mean FV consumption.

The procedure for DI in this study differed from standard post-meal DI practices in several ways. Food waste was removed from the classroom by researchers, who then had ample time to organize, label, and digitally image their assigned cluster. Each research assistant was responsible for no more than two clusters, comprised of no more than four pre-school children each. Only one fruit or vegetable was offered each day; in a natural environment, it is likely that a variety of FVs will be present, and images would
be taken as children approached the waste disposal area. These characteristics limited the potential complications of capturing usable digital images.

Future research could expand use of the APW method to evaluate the effectiveness of interventions aimed at increasing consumption of specific food items. The APW method is ideal for rapid and efficient detection of changes in food waste on a group level. This research indicates that the APW method can further reduce the time, cost, and resource burden of dietary assessment. Establishing easy to implement dietary assessment methods that reduce or eliminate the need for trained research staff can drastically increase the efficiency and availability of dietary assessment.

In conclusion, this study found that APW and DI are both feasible methods to collect FV consumption data from pre-school children; DI specifically was found to be a feasible method for data collection in the context of an intervention aimed at increasing FV consumption. The validity of DI was established for measuring group mean FV consumption in this highly controlled setting. DI appears exceptionally precise for measuring FV consumption, though APW may be more advantageous for evaluating behavior change in response to interventions designed to increase mean FV consumption due to ease of administration and instantaneous results.


44. Characteristics of the home food environment that mediate immediate and sustained increases in child fruit and vegetable consumption: mediation analysis from the

doi:10.1017/S136898001300102X.


Appendix A: Research Assistant Training

Research Assistant Training

- Team consisted of two graduate students and 18 undergraduate students
  - Primarily nutrition majors
  - Freshman, sophomore, junior, senior
- Undergraduates recruited
  - Flyers in main nutrition department building, announcements in undergraduate nutrition courses
- Undergraduate students completed 12 hours of training developed and facilitated by the two graduate students (Spring 2015)
  - Objective to train in APW, WPW, & DI data collection procedures
  - Intervention procedures
  - Prior to training undergraduates required to complete human subject research training
- Detailed training schedule: Seven, 90-120 minute training sessions
  - Week 1: Introduction/overview of project, study timeline, class training schedule
  - Week 2: Training on baseline data collection, FV mentor training
  - Weeks 3-4: Training on intervention data collection
  - Weeks 5-6: Field methods for novel dietary assessment methods
    - Feasibility of APW, validity of DI via WPW
  - Week 7: Review of field methods
    - Took place two weeks after the final training (after spring break)
- Detailed training procedures during initial training sessions:
  - Research assistants provided brief background information
    - Prevalence of childhood obesity
    - Current dietary patterns in children
    - Addressing FV consumption in children
    - Importance of pre-school environment in shaping dietary behaviors
    - Social Cognitive Theory
  - Brief overview of dietary assessment methodology
    - Explanation of what DI/WPW are, how to apply these methods
    - Research teams previous work with DI/WPW
    - New concept: APW
  - Objectives of the project
    - Objective one: Weeks 1-4
      - Recruit
      - Collect baseline FV consumption
• Administer “nudge” intervention
• Collect post-intervention FV consumption data

• Objective two: Weeks 1-4, 5-6
  • Weeks 1-4: Feasibility of APW
  • Weeks 5-6: Validity of DI via WPW

• Baseline data collection
  • APW: methodology detailed later
  • Two classrooms
  • Pre-school classroom set-up
    • Children sit in clusters
  • Researcher responsibilities
    • Responsible for 1-2 clusters
  • Baseline data collection form
  • Waste separation – minimal interference
  • Weigh waste in separate room
  • Record waste in gram weight measurements

• Mentor training
  • Recruited from afterschool program at YMCA
  • Training FV mentors: modeling FV consumption, verbal cues, positive reinforcement strategies

• Detailed intervention data collection training
  • 1-2 FV mentors per cluster – eat snack with pre-school children
  • RA’s record mentor FV selection in addition to pre-school children’ FV selection
  • Mentors sort FV waste into separate bin
  • RA’s measure/record FV consumption of both pre-school cluster and mentor
  • RA’s record verbal cues used by mentors (and teachers)
  • All of these on intervention data collection form (Appendix C)

• Detailed post-intervention/feasibility and validity of novel dietary assessment methods training

  • Aggregate plate waste methodology training
    • Children sort waste into two bins: dip/grain, FV
    • FV bins have laminated FV picture of daily featured FV
    • Corrections made during weighing, away from children
    • Weights recorded before and after corrections
    • Feasibility of APW: RA’s kept tally of sorting errors weeks 1-4
    • APW collection ended after week 4
      • Researchers continued to weigh clusters aggregately after individual weights taken

  • Validity of DI using WPW methodology training
    • RA’s collect their cluster’s individual child food waste, take to weighing station in separate room
    • DI training
• DI consists of comparing pre and post images to estimate consumption
• Imaging angle 45 degrees, practice on site
• Single image of cluster, individual ID #s noted on paper in front of cups

• WPW training
  • WPW consists of weighing individual food components before and after meal
  • Weigh individual FV waste after DI
  • Weigh cluster waste aggregately

• Post-intervention data collection form (Appendix D)
• Final session day before data collection began: review of expectations and data collection methods
Appendix B: YMCA Fruit and Vegetable Study: Baseline Data Collection Form

Classroom:

Observer:

Date:

Cluster Shape/Color:

Featured Fruit or Vegetable:

Number of Children Attending Cluster Today: ______

<table>
<thead>
<tr>
<th>FV ID Number</th>
<th>Total Waste-P (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note: record # at bottom of cup FV before handing to child</td>
<td></td>
</tr>
</tbody>
</table>

**Important:** before handing child snack, please record # in first column. If child asks for seconds, also record the # and also write “-2” next to it.
Appendix C: YMCA Fruit and Vegetable Study: Intervention Data Collection Form

Classroom:
Observer:
Date:
Cluster Shape/Color:
Featured Fruit or Vegetable:
Number of Children Attending Cluster Today: ____

<table>
<thead>
<tr>
<th>FV ID #-P</th>
<th>Total Waste-P (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note: record # at bottom of cup FV before handing to child</td>
<td></td>
</tr>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FV ID # -M</th>
<th>Waste-M (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Important: before handing child snack, please record # in first column. If child asks for seconds, also record the # and also write “-2” next to it. Note: P=Pre-schooler; M=Mentor

Verbal Cues

Assigned Cues: Write Y/N (Yes/No) if teacher used cue.

1.
2. **Other Cues:** Write all other TEACHER and MENTOR verbal cues used during snack. Write “M” next to mentor cues and “T” next to teacher cues.

Verbal Cue 1:
____________________________________________________________________________________
____________________________________________________________________________________

Observed Response to Verbal Cue 1:
____________________________________________________________________________________
____________________________________________________________________________________

Verbal Cue 2:
____________________________________________________________________________________
____________________________________________________________________________________

Observed Response to Verbal Cue 2:
____________________________________________________________________________________
____________________________________________________________________________________

Verbal Cue 3:
____________________________________________________________________________________
____________________________________________________________________________________

Observed Response to Verbal Cue 3:
____________________________________________________________________________________
____________________________________________________________________________________

Verbal Cue 4:
____________________________________________________________________________________
____________________________________________________________________________________

Observed Response to Verbal Cue 4:
____________________________________________________________________________________
____________________________________________________________________________________

*Please record FV Mentor verbal cues and child responses as accurately as possible.*
Appendix D: YMCA Fruit and Vegetable Study: Post-Intervention Data Collection

Form

Room 3

Observer:

Date:

Featured Fruit or Vegetable:
<table>
<thead>
<tr>
<th>FV ID Number</th>
<th>M/F</th>
<th>Total Waste-P (g)</th>
<th>APW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purple Star-C1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue Circle-C2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow Square-C3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green Smiley-C4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: record # at bottom of cup FV before handing to child
YMCA Fruit and Vegetable Study: Post-Intervention Data Collection Form

Room 4

Observer:

Date:

Featured Fruit or Vegetable:
<table>
<thead>
<tr>
<th>FV ID Number</th>
<th>M/F</th>
<th>Total Waste-P (g)</th>
<th>APW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note: record # at bottom of cup FV before handing to child</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red Star-I1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow Circle-I2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green Square-I3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Blue Smiley-I4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix E: FV Mentor Recruitment Package

Dear Parent/Guardian,

Thank you for your willingness to read and complete the recruitment package for our research study addressing the effect of older children (grades 3-4) that participate in the Burlington VT Live Yer’s Afterschool Program on pre-school aged children’s fruit and vegetable consumption. We will provide you with a $10 gift card to City Market in Burlington, VT for taking the time to complete and return this recruitment package, regardless of your decision to allow your child to participate in the research study. The goal of this research study is to encourage and measure fruit and vegetable consumption behaviors in pre-school children who participate in the Y Early Childhood Program. We will explore whether your child can serve as a “Fruit and Vegetable Mentor” through modeling fruit and vegetable consumption behaviors and using positive verbal cues (“ex. These carrots taste really yummy, Johnny!”). As part of our study, we will serve a fruit and vegetable and whole grain snack to your child during the afternoon snack time from March 16, 2015 to March 27, 2015.

In this packet you will find: 1) a brief parent survey, 2) an allergy screen, 3) consent form including a detailed description of the study, timeline, and snack menu. When you are finished completing this package, please return it to the Director of the Afterschool Program, Hallie Wolklin.

Thank you so much for your time.

Sincerely,

Sarah A. Amin

Harley Erikson

Dr. Rachel K. Johnson (Principal Investigator)

Parent Survey

Dear Parent/Guardian,

You are being asked to complete this survey as a parent/guardian of a child attending the Live Y’ers Afterschool Program in Burlington, VT. We are interested in conducting a brief survey before you decide whether or not your child will participate in this study. In particular, we would like to know a little more information about you and your child and certain food and meal-related practices.

Your answers to the survey will be used to help us better understand previous fruit and vegetable consumption behavior of our potential pre-school participants. All data will be kept confidential and no data will be reported on an individual child. The survey should take about 5-10 minutes to complete.

1. How often do you have family meals?
   - □ Always (7 days/week)
   - □ Often (5-6 days/week)
Sometimes (3-4 days/week)
- Rarely (1-2 days/week)
- Never

2. How often is broccoli served at home?
- Never
- Less than once per month
- 1-3 times per month
- Once per week
- 2-4 times per week
- More than 4 times per week

3. When broccoli is served to your child, does he/she usually eat it?
- refuse to eat it.
- take only a bite or two.
- eat some of it (less than half of it).
- eat most of it (more than half of it).
- eat all of it.

4. How often are green peppers served at home?
- Never
- Less than once per month
- 1-3 times per month
- Once per week
- 2-4 times per week
- More than 4 times per week

5. When green peppers are served to your child, does he/she usually eat them?
- refuse to eat it.
- take only a bite or two.
- eat some of it (less than half of it).
- eat most of it (more than half of it).
- eat all of it.

6. How often are carrots served at home?
- Never
- Less than once per month
- 1-3 times per month
- Once per week
- 2-4 times per week
- More than 4 times per week

7. When carrots are served to your child, does he/she usually eat them?
- refuse to eat it.
- take only a bite or two.
- eat some of it (less than half of it).
- eat most of it (more than half of it).
- eat all of it.

8. How often is cauliflower served at home?
- Never
- Less than once per month
- 1-3 times per month
- Once per week
- 2-4 times per week
More than 4 times per week

9. When cauliflower is served to your child, does he/she usually eat it?
☐ refuse to eat it.
☐ take only a bite or two.
☐ eat some of it (less than half of it).
☐ eat most of it (more than half of it).
☐ eat all of it.

10. How often is asparagus served at home?
☐ Never
☐ Less than once per month
☐ 1-3 times per month
☐ Once per week
☐ 2-4 times per week
☐ More than 4 times per week

11. When asparagus is served to your child, does he/she usually eat it?
☐ refuse to eat it.
☐ take only a bite or two.
☐ eat some of it (less than half of it).
☐ eat most of it (more than half of it).
☐ eat all of it.

12. How often are grapes served at home?
☐ Never
☐ Less than once per month
☐ 1-3 times per month
☐ Once per week
☐ 2-4 times per week
☐ More than 4 times per week

13. When grapes are served to your child, does he/she usually eat them?
☐ refuse to eat it.
☐ take only a bite or two.
☐ eat some of it (less than half of it).
☐ eat most of it (more than half of it).
☐ eat all of it.

14. How often are apples served at home?
☐ Never
☐ Less than once per month
☐ 1-3 times per month
☐ Once per week
☐ 2-4 times per week
☐ More than 4 times per week

15. When apples are served to your child, does he/she usually eat them?
☐ refuse to eat it.
☐ take only a bite or two.
☐ eat some of it (less than half of it).
☐ eat most of it (more than half of it).
☐ eat all of it.

16. How often are clementines served at home?
☐ Never  
☐ Less than once per month  
☐ 1-3 times per month  
☐ Once per week  
☐ 2-4 times per week  
☐ More than 4 times per week

17. When clementines are served to your child, does he/she usually eat them?  
☐ refuse to eat it.  
☐ take only a bite or two.  
☐ eat some of it (less than half of it).  
☐ eat most of it (more than half of it).  
☐ eat all of it.

18. Do you and/or another younger child in your household qualify for WIC?  
☐ Yes  
☐ No

19. If you answered 'yes' above, do you and/or your younger child receive supplemental nutritious food packages through WIC?  
☐ Yes  
☐ No

**Allergy Screen**

*Please indicate whether your child has an allergy to any of the food items listed by checking the box below:*

**Fruits**  
☐ Grapes  
☐ Apples  
☐ Clementine

**Vegetables**  
☐ Broccoli  
☐ Green Peppers  
☐ Carrots  
☐ Cauliflower  
☐ Asparagus

**Other**  
☐ Milk  
☐ Eggs  
☐ Peanuts  
☐ Tree nuts (such as almonds, cashews, walnuts)  
☐ Soy  
☐ Wheat

Does your child have any dietary restrictions not listed here? If so, please explain:

____________________________________________________________________

__________
Informed Consent

Title of Research Project: Nudging Fruit and Vegetable (FV) Consumption & the Feasibility and Validity of Novel Dietary Assessment Methods During Snack Time in the Pre-School Setting

Principal Investigator: Rachel K Johnson, PhD, MPH, RD, FAHA, University of Vermont

Funding Agency: USDA/Vermont Agricultural Experiment Station

Your son or daughter is being invited to take part in this research study because he/she attends the Live Y’ers Afterschool Program in Burlington, VT. This study is being conducted by the University of Vermont, Department of Nutrition and Food Sciences and is funded by the USDA/Vermont Agricultural Experiment Station. We encourage you to ask questions and take the opportunity to discuss the study with anybody you think can help you make this decision.

Why is This Research Study Being Conducted?
The prevalence of childhood obesity in the United States has undeniably become one of the most critical public health issues facing our nation. Children's diets are influenced as early as infancy with the first five years marked by the development of important dietary behaviors. Fruit and vegetable consumption has become a central focus of efforts to cultivate healthy dietary behaviors in children because they are low in calories and rich in essential nutrients. Fruits and vegetables have many health benefits including intake of critical shortfall nutrients, reduced risk of chronic diseases, and weight maintenance. Since children do not meet current recommendations for fruit and vegetable consumption, identifying strategies to encourage fruit and vegetable preferences and consumption has become a public health priority.

Pre-schools represent an important environment for addressing children’s fruit and vegetable consumption since an increased proportion of children are consuming meals outside of the home. Approximately 61 percent of children (0-6 years) are in childcare and consume up to one-third of their calories (2-5 years) in this setting. In the proposed study, the UVM Dietary Assessment Team will partner with the Burlington, VT YMCA to design and implement a fruit and vegetable consumption intervention. School-aged children (grades 3 and 4) enrolled in the Burlington, VT YMCA Live Y’ers after school program will be trained to serve as “FV Mentors” to nudge the fruit and vegetable consumption of pre-school aged children in the same program.

The YMCA has a widespread national presence making it an ideal partner for interventions that address youth behaviors, including diet. The organization prioritizes the health and wellness of children through national initiatives including Healthy Kids Day® that over 1,500 Y’s across the country participate in. Our proposed project demonstrates promise as an easy to implement and sustainable initiative to bring children together and encourage positive dietary changes.

How Many People Will Take Part In The Study?
Working in collaboration with the Burlington, VT YMCA we will recruit approximately five children (grades 3-4) from the Live Y’ers Afterschool Program between January and February 2015. We will also recruit ~30 pre-school children (age 4) from the Y Early Childhood Program.
What is Involved in The Study?

FV Mentor Training Sessions

During the weeks of March 2nd and March 9th, the UVM Dietary Assessment Team will engage your child (the Fruit and Vegetable or “FV” Mentor) in brief training sessions. A few members of the UVM Dietary Assessment Team will work with these children across three to five days to explain what their role will be in helping out with the project. This training will include allowing your child to try the fruit and vegetable snacks that will be served before eating snack with the pre-school children. We will also explain the importance of modeling fruit and vegetable consumption, and practice different verbal cues and reinforcement strategies with your child.

FV Mentor Involvement in Afternoon Snack Time

During March 16, 2015 to March 27, 2015 afterschool program children will have their afternoon snack with the pre-school children (3:15PM-3:45PM). The UVM Dietary Assessment team will serve one of eight potential snacks comprised of a fruit or vegetable with a dip along with a grain snack (Wheat Thins, plain Cheerios, etc.). All snacks will be prepared in a clean and sanitary environment (UVM Foods Lab) by the UVM Dietary Assessment Team’s graduate students, including a student who was trained at the Culinary Institute of America during the morning before snack time. Fruit and vegetable snack items will be properly washed, weighed (to nearest gram), individually packaged, and stored in the Foods Lab refrigerators before each visit.

Approximately 15 minutes before snack time, the 3rd and 4th grade FV Mentors will be reminded to: model fruit and vegetable consumption by eating the featured fruit and vegetable snack, use targeted verbal cues to influence consumption (“This carrot is really yummy!”), and use statements of praise for children who eat some or all of the fruit and vegetable snack. Your child will eat snack with no more than three pre-school aged children and may also play with them (color or read a story) during the snack time. After being served the snack, all children will be permitted to take seconds of any fruit and vegetable snacks, but not the whole grain snack. The menu and alternative menu items for the study are listed below.

For each day that the FV Mentors help us out, that they will receive a “gold star” on a project chart to be used towards a prize of their choice (book, crayons, etc.). Stars will be given regardless of whether the FV Mentor eats his/her fruit or vegetable or uses verbal cues.

Participation in Data Collection

Between March 16, 2015 to March 27, 2015 the UVM Dietary Assessment Team will unobtrusively measure fruit and vegetable consumption.

Project Menu

Monday: Great Green Broccoli Trees with Rocking Ranch and Wheat Thins

Tuesday: Rad Red Grapes with Yummy Yogurt Dip and Cheerios

Wednesday: Peppy Pepper Spears with Salsa and Tortilla Chips

Thursday: Amazing Apple Slices with Yummy Yogurt Dip and Graham Crackers

Friday: Crazy Crunchy Carrots with Rocking Ranch and Wheat Thins
Alternative Menu Items: Cool Cauliflower with Rocking Ranch and Wheat Thins OR Awesome Asparagus Spears and Whole Grain Goldfish OR Clementine with Yummy Yogurt Dip and Cheerios

What Are the Risks and Benefits of Participating In the Study?
The UVM Dietary Assessment Team foresees no direct risks to your child by participating in this study. The snacks to be provided to your child will be a positive addition to their daily diet. All children will receive a ¼ cup of a whole grain snack and a ½ cup of a fruit or vegetable during each snack. Children will be permitted to take seconds of the fruit and vegetable snack. Since the main goal of the study is to develop fruit and vegetable preferences in young children, there are many foreseen benefits to this research in terms of improving children’s dietary behavior. Also, your child will develop leadership skills by serving as a positive role model for younger children.

Are There Any Costs?
There is no cost for participation in this project.

What Is the Compensation?
There is no compensation to your child participating in the study other than the provision of a nutritious snack. We will provide you with a $10 gift card to City Market in Burlington, VT for taking the time to complete and return this recruitment package, regardless of your decision to allow your child to participate in the research study.

Can You Withdraw or Be Withdrawn From This Study?
You may discontinue your participation in this study at any time.

What About Confidentiality?
No individually identifiable data of your child will be collected across the duration of the study. To ensure confidentiality of any dietary intake data, a random number will be assigned to your child on the day of data collection. Any data collected will be stored in a confidential database and that will not be able to be traced back to you or your child in any way.

You may contact Dr. Rachel Johnson, the Principal Investigator in charge of this study, at (802) 656-0540 for more information about this study. If you have any questions about your rights as a participant in a research project you should contact Nancy Stalnaker, the Director of the Research Protections Office at the University of Vermont at (802) 656-5040.

Signature of Consent
You have been given and have read the summary of this research study. Should you have any further questions about the research, you may contact Dr. Rachel Johnson at the address and telephone number given below. Your participation is voluntary and you may refuse to participate or withdraw at any time without penalty or prejudice.

I agree for my child to participate in this study and understand that I will receive a signed copy of this form.

_____________________________ ____________________________
Signature of Subject Date

I do not agree for my child to participate in this study and I understand that I will receive a signed copy of this form.
Signature of Subject ____________________________ Date

This form is valid only if the Committees on Human Research’s current stamp of approval is shown below.

Name of Subject Printed

___________________________________________________ ______________________
Signature of Principal Investigator or Designee

Name of Principal Investigator or Designee

Name of Principal Investigator: Rachel K. Johnson, PhD
Address: 225B Marsh Life Sciences, University of Vermont, Burlington, VT 05405
Telephone Number: (802) 656-0540

Please return this form to the Director of the Afterschool Program, Hallie Wolklin
Appendix F: Pre-school FV Participant Recruitment Package

Dear Parent/Guardian,

Thank you for your willingness to read and complete the recruitment package for our research study addressing the fruit and vegetable consumption of pre-school aged children who attend the Burlington, VT Y Early Childhood Program. We will provide you with a $10 gift card to City Market in Burlington, VT for taking the time to complete and return this recruitment package, regardless of your decision to allow your child to participate in the research study.

The goal of this research study is to encourage and measure fruit and vegetable consumption behaviors in pre-school children. We will explore whether older children (grades 3-4) that participate in the Live Y’ers Afterschool Program can serve as “Fruit and Vegetable Mentors” or “FV Mentors” through modeling fruit and vegetable consumption behaviors and using positive verbal cues (“ex. These carrots taste really yummy, Johnny!”). As part of our study, we will serve a fruit and vegetable and whole grain snack to your child during the afternoon snack time from March 2, 2015 to April 17, 2015. If you agree to have your child participate, we will ask that you do not prepare/pack an afternoon snack for your child.

In this packet you will find: 1) a brief parent survey, 2) an allergy screen, 3) consent form including a detailed description of the study, timeline, and snack menu. When you are finished completing this package, please return it to the Director of the Pre-school Program, Meg Edmunds.

Thank you so much for your time.

Sincerely,

Sarah A. Amin

Harley Eriksen

Dr. Rachel K. Johnson (Principal Investigator)

Parent Survey

Dear Parent/Guardian,

You are being asked to complete this survey as a parent/guardian of a pre-school child attending the Y Early Childhood Program in Burlington, VT. We are interested in conducting a brief survey before you decide whether or not your child will participate in this study. In particular, we would like to know a little more information about you and your child and certain food and meal-related practices.

Your answers to the survey will be used to help us better understand previous fruit and vegetable consumption behavior of our potential pre-school participants. No data will be reported on an individual basis. The survey should take about 5-10 minutes to complete.

1. How often do you have family meals?
   - [ ] Always (7 days/week)
   - [ ] Often (5-6 days/week)
2. How often is broccoli served at home?
   - Never
   - Rarely (1-2 days/week)
   - Sometimes (3-4 days/week)

3. When broccoli is served to your child, does he/she usually eat it?
   - Refuse to eat it.
   - Take only a bite or two.
   - Eat some of it (less than half of it).
   - Eat most of it (more than half of it).
   - Eat all of it.

4. How often are green peppers served at home?
   - Never
   - Rarely (1-2 days/week)
   - Sometimes (3-4 days/week)

5. When green peppers are served to your child, does he/she usually eat them?
   - Refuse to eat it.
   - Take only a bite or two.
   - Eat some of it (less than half of it).
   - Eat most of it (more than half of it).
   - Eat all of it.

6. How often are carrots served at home?
   - Never
   - Rarely (1-2 days/week)
   - Sometimes (3-4 days/week)

7. When carrots are served to your child, does he/she usually eat them?
   - Refuse to eat it.
   - Take only a bite or two.
   - Eat some of it (less than half of it).
   - Eat most of it (more than half of it).
   - Eat all of it.

8. How often is cauliflower served at home?
   - Never
   - Rarely (1-2 days/week)
   - Sometimes (3-4 days/week)
More than 4 times per week

9. When cauliflower is served to your child, does he/she usually eat it?
   □ refuse to eat it.
   □ take only a bite or two.
   □ eat some of it (less than half of it).
   □ eat most of it (more than half of it).
   □ eat all of it.

10. How often is asparagus served at home?
    □ Never
    □ Less than once per month
    □ 1-3 times per month
    □ Once per week
    □ 2-4 times per week
    □ More than 4 times per week

11. When asparagus is served to your child, does he/she usually eat it?
    □ refuse to eat it.
    □ take only a bite or two.
    □ eat some of it (less than half of it).
    □ eat most of it (more than half of it).
    □ eat all of it.

12. How often are grapes served at home?
    □ Never
    □ Less than once per month
    □ 1-3 times per month
    □ Once per week
    □ 2-4 times per week
    □ More than 4 times per week

13. When grapes are served to your child, does he/she usually eat them?
    □ refuse to eat it.
    □ take only a bite or two.
    □ eat some of it (less than half of it).
    □ eat most of it (more than half of it).
    □ eat all of it.

14. How often are apples served at home?
    □ Never
    □ Less than once per month
    □ 1-3 times per month
    □ Once per week
    □ 2-4 times per week
    □ More than 4 times per week

15. When apples are served to your child, does he/she usually eat them?
    □ refuse to eat it.
    □ take only a bite or two.
    □ eat some of it (less than half of it).
    □ eat most of it (more than half of it).
    □ eat all of it.

16. How often are clementines served at home?
☐ Never
☐ Less than once per month
☐ 1-3 times per month
☐ Once per week
☐ 2-4 times per week
☐ More than 4 times per week

17. When clementines are served to your child, does he/she usually eat them?
☐ refuse to eat it.
☐ take only a bite or two.
☐ eat some of it (less than half of it).
☐ eat most of it (more than half of it).
☐ eat all of it.

18. Do you and/or your pre-school aged child qualify for WIC?
☐ Yes
☐ No

19. If you answered 'yes' above, do you and your child receive supplemental nutritious food packages through WIC?
☐ Yes
☐ No

Allergy Screen

*Please indicate whether your child has an allergy to any of the food items listed by checking the box below:*

**Fruits**
☐ Grapes
☐ Apples
☐ Clementine

**Vegetables**
☐ Broccoli
☐ Green Peppers
☐ Carrots
☐ Cauliflower
☐ Asparagus

**Other**
☐ Milk
☐ Eggs
☐ Peanuts
☐ Tree nuts (such as almonds, cashews, walnuts)
☐ Soy
☐ Wheat

Does your child have any dietary restrictions not listed here? If so, please explain:

____________________________________________________________________

____________________________________________________________________
Informed Consent

**Title of Research Project:** Nudging Fruit and Vegetable (FV) Consumption & the Feasibility and Validity of Novel Dietary Assessment Methods During Snack Time in the Pre-School Setting

**Principal Investigator:** Rachel K Johnson, PhD, MPH, RD, FAHA, University of Vermont

**Funding Agency:** USDA/Vermont Agricultural Experiment Station

Your son or daughter is being invited to take part in this research study because he/she attends the Y Early Childhood Program in Burlington, VT. This study is being conducted by the University of Vermont, Department of Nutrition and Food Sciences and is funded by the USDA/Vermont Agricultural Experiment Station. We encourage you to ask questions and take the opportunity to discuss the study with anybody you think can help you make this decision.

**Why is This Research Study Being Conducted?**
The prevalence of childhood obesity in the United States has undeniably become one of the most critical public health issues facing our nation. Children’s diets are influenced as early as infancy with the first five years marked by the development of important dietary behaviors. Fruit and vegetable consumption has become a central focus of efforts to cultivate healthy dietary behaviors in children because they are low in calories and rich in essential nutrients. Fruits and vegetables have many health benefits including intake of critical shortfall nutrients, reduced risk of chronic diseases, and weight maintenance. Since children do not meet current recommendations for fruit and vegetable consumption, identifying strategies to encourage fruit and vegetable preferences and consumption has become a public health priority.

Pre-schools represent an important environment for addressing children’s fruit and vegetable consumption since an increased proportion of children are consuming meals outside of the home. Approximately 61 percent of children (0-6 years) are in childcare and consume up to one-third of their calories (2-5 years) in this setting. In the proposed study, the UVM Dietary Assessment Team will partner with the Burlington, VT YMCA to design and implement a fruit and vegetable consumption intervention. School-aged children (grades 3 and 4) enrolled in the Burlington, VT YMCA Live Y’ers after school program will be trained to serve as Fruit and Vegetable or “FV” Mentors to nudge the fruit and vegetable consumption of pre-school aged children in the same program.

The YMCA has a widespread national presence making it an ideal partner for interventions that address youth behaviors, including diet. The organization prioritizes the health and wellness of children through national initiatives including Healthy Kids Day® that over 1,500 Y’s across the country participate in. Our proposed project demonstrates promise as an easy to implement and sustainable initiative to bring children together and encourage positive dietary changes.

**How Many People Will Take Part In The Study?**
Working in collaboration with the Burlington, VT YMCA we will recruit ~30 pre-school children (age 4) from the Y Early Childhood Program between January and February 2015. We will also recruit approximately five children (grades 3-4) from the Live Y’ers Afterschool Program.
What is Involved in The Study?

**Afternoon Snack Time**
During March 2, 2015 to April 17, 2015 parents will be instructed not to prepare or pack an afternoon snack (3:15PM-3:45PM) for their child. The UVM Dietary Assessment team will serve one of eight potential snacks comprised of a fruit or vegetable with a dip along with a grain snack (Wheat Thins, plain Cheerios, etc.). All snacks will be prepared in a clean and sanitary environment (UVM Foods Lab) by the UVM Dietary Assessment Team’s graduate students, including a student who was trained at the Culinary Institute of America during the morning before snack time. Fruit and vegetable snack items will be properly washed, weighed (to nearest gram), individually packaged, and stored in the Foods Lab refrigerators before each visit. Upon arriving at the two pre-school classrooms, children will be served the snack. Children will be permitted to take seconds of any fruit and vegetable snacks, but not the whole grain snack. The menu and alternative menu items for the study are listed below.

From March 2, 2015 to March 13, 2015 and March 23, 2015 to April 17, 2015 all children will be provided with a snack from the UVM Dietary Assessment Team. From March 16, 2015 to March 27, 2015 all snacks will be served as described above, but your child may or may not have a 3rd-4th grade FV Mentor eating with them during the snack time. The FV Mentor will be modeling positive fruit and vegetable consumption behavior (eating the fruit and vegetable snack) and using verbal cues ("This carrot is really yummy!") to positively encourage the fruit and vegetable consumption of your child. The FV Mentor may also play with your child (color or read a story) during the snack time.

**Participation in Data Collection**
Between March 2, 2015 to April 17, 2015 the UVM Dietary Assessment Team will unobtrusively measure fruit and vegetable consumption and instruct children how to sort their snack waste. The interaction that UVM Dietary Assessment Team members would have with your child consists of: serving your child a snack and instructing your child how to dispose of their snack into a separate bin for fruit and vegetable waste, grain waste, and plastic.

**Project Menu**
**Monday:** Great Green Broccoli Trees with Rocking Ranch and Wheat Thins

**Tuesday:** Rad Red Grapes with Yummy Yogurt Dip and Cheerios

**Wednesday:** Peppy Pepper Spears with Salsa and Tortilla Chips

**Thursday:** Amazing Apple Slices with Yummy Yogurt Dip and Graham Crackers

**Friday:** Crazy Crunchy Carrots with Rocking Ranch and Wheat Thins

**Alternative Menu Items:** Cool Cauliflower with Rocking Ranch and Wheat Thins **OR** Awesome Asparagus Spears and Whole Grain Goldfish **OR** Clementine with Yummy Yogurt Dip and Cheerios

**What Are the Risks and Benefits of Participating In the Study?**
The UVM Dietary Assessment Team foresees no direct risks to your child by participating in this study. Our protocol has been designed to adapt to the natural environment of the Burlington, VT YMCA pre-school snack setting. The snacks to be provided to your child will be a positive addition to their daily diet. The snacks that will be served align with the United States Department of Agriculture (USDA) Child and Adult Care Food Program (CACFP) snack nutrition standards for
pre-school aged children. All children will receive a ¼ cup of a whole grain snack and a ½ cup of a fruit or vegetable during each snack. Children will be permitted to take seconds of the fruit or vegetable snack. Since the over-arching goal of the study is to develop fruit and vegetable preferences in young children, there are many foreseen benefits to this research in terms of improving children’s dietary behavior.

**Are There Any Costs?**
There is no cost for participation in this project.

**What Is the Compensation?**
There is no compensation to your child participating in the study other than the provision of a nutritious snack. We will provide you with a $10 gift card to City Market in Burlington, VT for taking the time to complete and return this recruitment package, regardless of your decision to allow your child to participate in the research study.

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**Signature of Consent**
You have been given and have read the summary of this research study. Should you have any further questions about the research, you may contact Dr. Rachel Johnson at the address and telephone number given below. Your participation is voluntary and you may refuse to participate or withdraw at any time without penalty or prejudice.

I agree for my child to participate in this study and understand that I will receive a signed copy of this form.

____________________________  __________________________
Signature of Subject  Date

I do not agree for my child to participate in this study and I understand that I will receive a signed copy of this form.

____________________________  __________________________
Signature of Subject  Date

This form is valid only if the Committees on Human Research’s current stamp of approval is shown below.

______________________________________________
Name of Subject Printed
Name of Principal Investigator: Rachel K. Johnson, PhD
Address: 225B Marsh Life Sciences, University of Vermont, Burlington, VT 05405
Telephone Number: (802) 656-0540

Please return this form to the Director of the Pre-school, Meg Edmunds
## Appendix G: YMCA Cluster Identification Codes

<table>
<thead>
<tr>
<th>Color/Shape</th>
<th>Cluster ID</th>
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<tbody>
<tr>
<td>Red Star</td>
<td>I-1</td>
</tr>
<tr>
<td>Yellow Circle</td>
<td>I-2</td>
</tr>
<tr>
<td>Green Square</td>
<td>I-3</td>
</tr>
<tr>
<td>Blue Smiley</td>
<td>I-4</td>
</tr>
<tr>
<td>Purple Heart</td>
<td>I-5</td>
</tr>
<tr>
<td>Purple Star</td>
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</tr>
<tr>
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<tr>
<td>Yellow Square</td>
<td>C-3</td>
</tr>
<tr>
<td>Green Smiley</td>
<td>C-4</td>
</tr>
<tr>
<td>Red Heart</td>
<td>C-5</td>
</tr>
</tbody>
</table>
Appendix H: YMCA FV Study Snack Menu

Monday:
- **Red Grapes:**
  - Single Serving Portion: 31 g
- **Yogurt Dip:**
  - 2 oz. per serving: 80 oz.
- **Multi-grain Cheerios**
  - ¼ cup serving

Tuesday:
- **Carrots (baby):**
  - Single Serving Portion: 61 g
- **Hummus:**
  - 2 oz. per serving
- **Pita Chips:**
  - ¼ cup serving

Wednesday:
- **Clementine:**
  - Single Serving Portion: 74 g
- **Yogurt dip:**
  - 2 oz. per serving
- **Animals Crackers:**
  - ¼ cup serving

Thursday:
- **Pea Pods:**
  - Single Serving Portion: 31 g
- **Ranch Dressing:**
  - 2 oz. per serving
- **Wheat Thins:**
  - ¼ cup serving

Friday:
- **Pepper Spears:**
  - Single Serving Portion: 46 g
- **Salsa:**
  - 2 oz. per serving
- **Whole Grain Tortilla Chips**
  - ¼ cup serving