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Effectiveness of a Parent Health Report in Increasing
Fruit and Vegetable Consumption Among
Preschoolers and Kindergarteners

Sanita Lisa Hunsaker

A dissertation submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of

Doctor of Philosophy

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ABSTRACT

Effectiveness of a Parent Health Report in Increasing Fruit and Vegetable Consumption Among Preschoolers and Kindergarteners

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Doctor of Philosophy

Patterns of fruit and vegetable consumption begin in childhood and persist into adulthood. Educating parents regarding appropriate dietary requirements for preschoolers is critical to supporting their appropriate growth and development. The purpose of this study was to determine whether a parent health report (including information about the child's fruit and vegetable consumption and recommendations regarding how to increase fruit and vegetable consumption) resulted in a greater fruit and vegetable intake in preschoolers and kindergarteners. Results from both the open trial and the randomized-controlled trial suggest that the parent health report may be a beneficial tool to increase vegetable consumption in preschoolers and kindergarteners. Increases in vegetable consumption can lead to the establishment of lifelong habits of healthy vegetable intake and decrease risk for chronic diseases in the future.

Keywords: fruit and vegetable intake, intervention, preschool and kindergarten children, parents

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Effectiveness of a Parent Health Report in Increasing Fruit and Vegetable Consumption among Preschoolers and Kindergarteners

The benefits of fruit and vegetable consumption have been well documented, with research indicating that consumption of fruits and vegetables is especially important in young children. Patterns of healthy fruit and vegetable consumption often start in childhood and track into adulthood (Mikkilä, Räsänen, Raitakari, Pietinen, Viikari, 2004). As a result, early childhood is an important period for prevention and intervention efforts targeting this health behavior. The importance of this critical period is underscored by evidence that fruit and vegetable consumption is correlated with weight status and research suggesting that weight loss in adolescence and adulthood is difficult (Dehghan, Akhtar-Danesh, & Merchant, 2005; Gerberding & Marks, 2004). Research suggests that the preschool years are particularly critical in establishing healthy eating habits that can follow children into adulthood (Witt & Dunn, 2012). Furthermore, preschoolers have unique nutritional requirements that increase the importance of eating fruits and vegetables. Thus, informing parents of appropriate dietary requirements for preschoolers is critical to supporting their appropriate growth and development (Taylor, Gallagher, & McCullough, 2004).

Adequate fruit and vegetable intake has been linked to a reduction in chronic diseases such as cancer, cardiovascular disease, and stroke (Van Duyn & Pivonka, 2000). It has also been shown to reduce risk for development of cataracts, chronic obstructive pulmonary disease, diabetes, and possibly hypertension (Slavin & Llyod, 2012; Van Duyn & Pivonka, 2000; Charlton, 2008). Increasing fruit and vegetable consumption to at least five servings per day during early childhood may be a good strategy for reducing the probability of developing chronic diseases by helping children develop a habit of healthy eating that will not only enhance their

current diet, but also stay with them throughout their lives (Dehghan et al., 2005; Van Duyn & Pivonka, 2000; Wyse et al., 2010).

Inadequate fruit and vegetable intake has also been associated with increased risk for obesity. Data from the National Health and Nutrition Examination Survey has shown that the obesity rate among preschoolers has doubled and nearly tripled among children in general since 1980, with approximately 12.5 million children and adolescents being classified as obese in the United States alone (Ogden, Carroll, Kit, & Flegal, 2012). Studies consistently show that most children and adolescents do not consume the recommended amount of fruits and vegetables, a factor that has been shown to contribute to weight gain and obesity (Guenther, Dodd, Reedy, & Krebs-Smith, 2006; Gerberding & Marks, 2004; Krebs-Smith et al., 1996). Increasing fruit and vegetable consumption while children are young may decrease their risk of becoming overweight, because fruits and vegetables are high in nutrients and low in calories (Gerberding & Marks, 2004; Juby & Meyer, 2010; Matthews, Wien, & Sabate, 2011; Wosje et al., 2010).

One possible mechanism by which fruit and vegetables provide protection from chronic disease is through antioxidants, which provide optimal benefit when they are eaten as whole foods rather than dietary supplements (Liu, 2004; Van Duyn & Pivonka, 2000). Another mechanism by which fruits and vegetables may prevent chronic diseases is through the consumption of fiber (Bennett & Sothorn, 2009; Slavin & Llyod, 2012). Fiber intake has been associated with both a reduction in coronary heart disease and an increase in satiety, which is associated with a decreased risk of obesity (Slavin & Llyod, 2012).

Factors that Result in Decreased Fruit and Vegetable Consumption

Children's food preferences often limit the types of food they will consume, regardless of how motivated their parents are to provide their children with healthy meals (Rasmussen et al.,

2006; Taylor et al., 2004). Parents often resort to unhealthy food options to encourage their children to eat because they refuse the healthier options. Thus it is not surprising to note that children who are neophobic, or reluctant to try new foods, often consume fewer fruits and vegetables than their peers (Cooke et al., 2003; Patrick & Nicklas, 2005; Taylor et al., 2004).

Often children's eating habits are influenced less by hunger and more by their environment (Rasmussen et al., 2006). Increased television viewing has been associated with decreased fruit and vegetable consumption (Patrick & Nicklas, 2005; Rasmussen et al., 2006). In addition, studies have shown that foods that are advertised frequently are consumed more often, which is problematic because there are relatively few advertisements that focus on fruits and vegetables (Patrick & Nicklas, 2005). Other environmental factors that have been associated with a decreased fruit and vegetable consumption are eating fast food, lack of availability in the home (which not only provides less accessibility, but also leads to decreased fruit and vegetable exposure), and living in a household with two working parents because they often have less time to prepare fruits and vegetables and as a result they rely more on convenience foods that are high in calories and low in nutrients (Blanchette & Brug, 2005, Patrick & Nicklas, 2005; Rasmussen et al., 2006).

Parent and family factors may also contribute to suboptimal fruit and vegetable intake. For example, a mother's physical and emotional well-being has been associated with decreased child fruit and vegetable consumption. Mothers who face emotional or physical challenges may not be attentive to feeding cues or may give their children highly palatable, less nutritious food instead of fruits and vegetables because palatable foods are less likely to lead to food refusal (Taylor et al., 2004). In addition, families with lower incomes may not select fruits and vegetables because they are perishable and more costly. Instead, they often resort to foods with

higher fat and sugar content that have a longer shelf life and tend to be more convenient and inexpensive to purchase (Rasmussen et al., 2006; Taylor et al., 2004).

Factors that Result in Increased Fruit and Vegetable Consumption

Despite these obstacles to fruit and vegetable consumption, research indicates that there are many ways to increase intake in young children. Early exposure to fruits and vegetables alters taste preferences and predicts consumption later in life (Birch, 1999; Cooke et al., 2003; Nanney, Schermbeck, & Haire-Joshu, 2007). One potential reason for this is consistent with the learned safety hypothesis. Children learn at a young age that the taste of new foods will not result in a negative gastrointestinal consequence, thus producing an enhanced taste preference (Birch, McPhee, Shoba, Pirok, & Steinberg, 1987, Blanchette & Brug, 2005). Humans' predisposition to prefer sweet and salty tastes over bitter and sour tastes does not favor the intake of vegetables (Birch, 1999; Blanchette & Brug, 2005). This innate predisposition can be overcome by repeated exposure to new foods. Studies have found that exposing a child to new foods five to ten times can increase preference for it (Birch, 1999; Wardle, Hererra, Cooke, & Gibson, 2003). Thus, introducing children to a variety of new fruits and vegetables while they are young can increase their fruit and vegetable intake by altering their food preferences.

Because parents control much of their child's food intake, increasing their child's fruit and vegetable consumption is often dependent on them. Parents' food preferences affect the type of food available in homes (Patrick & Nicklas, 2005). Also, a mother's motivation to provide her child with a healthy food predicts the quality of her child's diet (Taylor et al., 2004). In addition, similar dietary behaviors often cluster within families. Because children often imitate their parents' behaviors, modeling may be a significant contributor to the clustering of diet in families (Blanchette & Brug, 2005). Children who have parents who model fruit and vegetable

consumption are more likely to increase their own fruit and vegetable intake (Nanney et al., 2007; Natale et al., 2014; Patrick & Nicklas, 2005).

Other factors that result in increased child fruit and vegetable consumption are serving fruits and vegetables more often, making them readily available in the home, and having them accessible and ready to be eaten (Patrick & Nicklas, 2005; Rasmussen et al., 2006). Frozen and canned fruits and vegetables are often cheaper than their fresh counterparts and can increase accessibility and availability, especially in lower income homes (Castro, Samuels, & Harman, 2013; Mushi-Brunt, Haire-Joshu, & Elliott, 2007). Sharing a traditional family mealtime has been shown to predict fruit and vegetable intake (Cooke et al., 2003; Patrick & Nicklas, 2005; Rasmussen et al., 2006). Research also suggests that parents who receive more education have children who eat more vegetables, likely because they tend to be more health conscious in food choices (Cooke et al., 2003; Patrick & Nicklas, 2005).

Several publically available resources have been developed to assist parents in increasing children's fruit and vegetable consumption. For example, choosemyplate.gov provides recommendations that have been developed by the United States Department of Agriculture (USDA) to provide information to aide in making healthy dietary decisions. According the USDA's Dietary Guidelines for Americans (2010), research supporting these recommendations is limited, thus they are seen as "helpful hints that are to be tailored to individuals and groups." All of the recommendations provided by the USDA (see Figure1) were provided to parents in the randomized controlled trial because they conformed to empirically supported principles previously discussed in this paper (e.g., repeated exposure, parental modeling, and increasing availability and accessibility of fruits and vegetables). Fruit and vegetable recommendations that were worded similarly were combined to increase simplicity.

- Set a good example for children by eating fruit and vegetables every day with meals or as snacks.
- Allow your children to help you shop for, clean, peel, or cut up fruits and vegetables.
- While shopping, allow children to pick out a new fruit or vegetable to try later at home.
- Offer children a choice of fruits for lunch.
- Decorate plates or serving dishes with fruit slices.
- Top off a bowl of cereal with some berries. Or, make a smiley face with sliced bananas for eyes, raisins for a nose, and an orange slice for a mouth.
- Offer raisins or other dried fruits instead of candy.
- Make fruit kabobs using pineapple chunks, bananas, grapes, and berries.
- Pack a juice box (100% juice) in children's lunches instead of soda or other sugar-sweetened beverages.
- Look for and choose fruit options, such as sliced apples, mixed fruit cup, or 100% fruit juice in fast food restaurants.
- Offer fruit pieces and 100% fruit juice to children. There is often little fruit in "fruit-flavored" beverages or chewy fruit snacks.
- Let children decide on the dinner vegetables or what goes into salads.
- Use cut-up vegetables as part of afternoon snacks.
- Children often prefer foods served separately. So, rather than mixed vegetables try serving two vegetables separately.

Figure 1. Recommendations Used in the Parent Health Report

Interventions that Increase Fruit and Vegetable Consumption

Efforts to increase fruit and vegetable consumption among children have varied from school-wide interventions to home-based interventions. The majority of interventions targeting preschoolers and kindergarteners have been administered in schools.

School fruit and vegetable interventions. Several school interventions have sought to increase fruit and vegetable consumption during snack time by modeling and rewarding fruit and vegetable consumption and by exposing children to a curriculum focused on fruit and vegetable consumption (Horne et al., 2011; Witt & Dunn, 2012). These interventions were associated with increases in both fruit and vegetable consumption, with effect sizes ranging from 1.29-2.21 for fruit consumption and 0.90-1.07 for vegetable consumption. Other interventions aimed to increase fruit and vegetable intake in school lunches by offering fruit and vegetables family-style before the meal and by using a more extensive school-wide intervention (i.e., loud speaker announcements giving facts about the fruit or vegetable of the day, a CD-ROM delivering nutrition information through animation characters, and lunch aides giving students stickers and praise for eating their fruits and vegetables in the cafeteria). Some interventions employed a significant family component (Harnack et al., 2012; Hoffman, Franko, Thompson, Power, & Stallings, 2010). Examples of family interventions employed in previous studies include assigning interactive books to read for homework and providing cookbooks with healthy meal ideas to parents. Improvements in fruit and vegetable consumption ranged from a 0.08 serving per meal increase in fruit intake in one study to 0.21 servings of fruit intake and 0.07 servings of vegetable intake per meal in another study.

Another school intervention gave children an opportunity to grow a garden at school in addition to providing lessons about healthy eating, physical activity breaks, opportunities to taste fruits and vegetables, story books to supplement the lesson, and letters to parents to encourage them to reinforce these activities at home (Farfan-Ramirez, Diemoz, Gong, & Lagura, 2011). Results from this study indicated that children were more willing to try and had increased

preference for some of the fruits and vegetables targeted in the intervention (e.g., figs, snap peas, and raspberries) when compared with the control group.

Taken together, these studies suggest that increasing a child's exposure to fruits and vegetables, whether it be through a focused curriculum or by offering fruits and vegetables before a meal, helps increase their intake.

Fruit and vegetable interventions targeting parents. Parental influence, particularly the mother's influence, seems to be an important factor in children's dietary behavior (Olivera et al., 1992; Taylor et al., 2004). There are a variety of ways that parents, acting as "gatekeepers" of their child's nutrition, affect their child's eating habits. Parents choose what foods they will bring into their home, model dietary choices, and reinforce eating patterns that they consider appropriate for their children (Birch, Savage, & Ventura, 2007; Pearson, Timperio, Salmon, Crawford, & Biddle, 2009). In a cross-sectional telephone survey study Wyse, Campbell, Nathan, and Wolfenden (2011) found that children's fruit and vegetable consumption was positively associated with their parents' fruit and vegetable consumption, the number of times parents provided these foods to their children, set mealtimes, and the availability and accessibility of fruits and vegetables in their home, suggesting that these modifiable aspects of the home environment may be good points of intervention.

One parent-focused intervention sought to increase fruit and vegetable consumption by providing resources such as newsletters and workbooks and by providing participants with information through telephone calls that focused on subjects such as vegetable availability, supportive family eating routines, role modeling, and information about picky eating (Tabak, Tate, Stevens, Siega-Riz, & Ward, 2012). When compared to a control group, this intervention

significantly increased vegetable availability in the home as well as the number of times children were offered fruits and vegetables for snacks.

A more intensive intervention included home visits, sing-a-long workbooks and audiocassettes, and nutrition training for the parents. This intervention resulted in an increase in fruit and vegetable intake for the parents, with subsequent increases in fruit and vegetable intake among normal weight children by an average of 0.20 servings per day. Parents also reported an increase in knowledge and availability of fruits and vegetables in the home (Haire-Joshu et al., 2008).

Another study used a multi-component intervention which involved teacher training, classroom activities such as arts and crafts, weekly educational stations at school, and parent handouts to encourage parents to pack fruits, vegetables, and grains in their children's lunches (Sweitzer et al., 2010). This intervention resulted in an increase in vegetable and whole grain servings received by the child, but no significant difference was observed in fruit consumption, possibly because both the intervention and comparison groups already exceeded the targeted one serving of fruit at the outset of the study. Taken together, these studies suggest that increasing parents' knowledge of how to improve their child's consumption of fruits and vegetables, and encouraging parental modeling of fruit and vegetable intake could result in increased fruit and vegetable intake in their children.

Limitations to Interventions Targeting Parents

While several documented interventions have successfully promoted increased fruit and vegetable consumption in children, several limitations to existing research should be noted. First, each of these studies was time intensive for parents, and thus might have limited effectiveness for parents who may not have as much time to devote to attending classes or

participating in telephone calls. Second, each of these studies required significant time and financial investment from interventionists. Researchers had to provide the information sessions or telephone calls and develop newsletters, which may be less feasible to sustain over a longer period of time. Third, many of these studies used resources such as workbooks and audiocassettes which when produced in mass may become costly, also making the intervention more difficult to sustain.

Theory of Planned Behavior

A model that explains whether or not parents will engage their children in healthier eating behaviors like increasing fruit and vegetable consumption is the Theory of Planned Behavior (Andrews, Silk, & Eneli, 2010; Kothe, Mullan, & Butow, 2012). This theory posits that behavior is determined by behavioral intention and perceived behavioral control (PBC) and that behavioral intention is determined by the subject's attitude towards the behavior (the degree to which a person has a favorable or unfavorable view of the goal), the subjective norm (perceived social pressure to perform a behavior mediated by motivation to comply with others views) and PBC (the belief that performance of a behavior is within their control) (Ajzen, 1991; Kothe et al., 2012). In a review of social cognitive theories used in fruit and vegetable interventions, Guillaumie, Godin, & Vézina-Im (2010) suggest that there is sound justification for using this theoretical model, as it is a strongly supported model of intention and behavior.

The present study seeks to affect behavior change by altering the participants' behavioral intention by targeting their subjective norms, their attitudes, and their perceived behavioral control. Subjective norms will be targeted by reminding parents of the national recommendation of five fruits and vegetables per day and showing them how their child's consumption compares to national recommendations. Seeing the discrepancy between their child's consumption and the

national attitude may result in a change of attitude as parents may become more concerned about their child's fruit and vegetable consumption. Providing parents with simple recommendations will increase their perceived control. Together, these factors are hypothesized to promote parental behavior change (i.e., making fruits and vegetables more available, encouraging children to consume them).

Health Report Card

One potentially effective way to engage parents in influencing their children's health behavior is through a health report card. Chomitz, Collins, Kim, Kramer, and McGowan (2003) used this approach to increase parental awareness of their child's weight status. Parents in an intervention group received information regarding their child's height, weight, weight category (i.e., underweight, normal weight etc.), and fitness test results as well as some interpretive information. In addition, they received a one-page general information sheet, which promoted lifestyle behavior change such as watching two or less hours of television or videos, engaging in one hour of physical activity, and eating five servings of fruits and vegetables per day. Results showed that parents with overweight children in the intervention group had a greater awareness of their child's weight status and were more likely to initiate weight control activities such as seeking medical services, or engaging in dietary change or physical activities. This intervention did not appear to improve health behavior outcomes that were not directly targeted, such as increasing fruit and vegetable consumption. This study suggests that giving parents a health related report card that targets specific health behaviors (i.e., fruit and vegetable consumption) might be an effective way of both increasing awareness of the health behavior and promoting related behavior change.

One reason why this intervention might not have increased children's fruit and vegetable consumption was because the feedback was not tailored to this particular health behavior. A computer-based intervention study examining the effectiveness of providing personalized feedback about fruit and vegetable intake to adults resulted in increased fruit and vegetable consumption (Brug, Glanz, Van Assema, Kok, & van Breukelen, 1998). This intervention provided computer-generated personalized feedback messages based on information provided at baseline with messages including information about fruit and vegetable intake and suggestions for increasing these behaviors. A control group received a general nutrition information letter, which provided basic information about positive health consequences of consuming more fruits and vegetables and less dietary fat and suggestions on how they could improve these dietary behaviors. Results suggested that tailored feedback significantly improved vegetable consumption compared to control subjects, who only received general dietary information. Fruit consumption improved significantly when iterative feedback was given. This study suggests that a tailored feedback targeting fruit and vegetable consumption may be an effective way of increasing intake.

Building on previous studies of feedback-based interventions for health behavior change, the present study is designed to test the effectiveness of a simple, low-cost intervention to increase fruit and vegetable intake that may be disseminated to a large group of preschoolers and kindergarteners. This intervention is designed to increase parents' knowledge of their child's daily fruit and vegetable consumption by providing them with a health report. Parents will also receive information informing them how their child's intake compares with the national recommendation of five fruits and vegetables per day and suggestions regarding how to increase their child's intake.

Hypothesis

This purpose of this study is to evaluate whether providing parents with a health report of their child's fruit and vegetable consumption is an effective method for increasing fruit and vegetable intake among preschoolers and kindergarteners. Parents will be provided with information about their child's current daily fruit and vegetable intake and the recommendation that their child eat five fruits and vegetables per day. In addition, parents will be provided with recommendations for increasing their child's fruit and vegetable intake from choosemyplate.gov, which was created by USDA. We hypothesize that this parent health report will increase fruit and vegetable consumption in kindergarteners and preschoolers. We evaluated this hypothesis using two studies. Study 1 was conducted as an open trial of the intervention with no control condition. Study 2 consisted of a randomized controlled trial to provide a more rigorous test of the intervention's effectiveness.

Method

Open Trial (Study 1)

Participants. Sixty-three children (38 male, 25 female; M age = 4.53, SD=0.59) enrolled in Brigham Young University's Child and Family Studies Lab (CFSL) during the 2012-2013 academic year and their parents participated in this study. The parent who was most responsible for preparing the child's meals was invited to complete the study surveys. All parent/child dyads participating in the preschool and kindergarten programs were invited to participate. CFSL personnel sent an e-mail inviting parents to consent to participation. Consent was obtained through an online Qualtrics survey. Parents received a \$10 gift card for completing two online surveys.

Procedures. Parents of the preschool and kindergarten students at CFSL completed the National Cancer Institute (NCI) Fruit and Vegetable Screener Questionnaire. This data was then analyzed for each child and the child's average daily fruit and vegetable consumption was calculated. This estimate was provided to parents in a parent health report along with the national guideline that children consume five fruits and vegetables per day. Parents were also provided a standardized set of recommendations for increasing fruit and vegetable intake provided by the USDA on choosemyplate.gov. A sample report is provided in Figure 2. The report was sent to parents via e-mail at the end of the week when the baseline data was collected. A month after the baseline data was collected, parents again completed the NCI Fruit and Vegetable Screener Questionnaire to ascertain post-intervention fruit and vegetable intake. Brigham Young University's Institutional Review Board approved all study procedures.

Dear Parent,

Recently you provided information regarding your child's diet. We have provided information about this assessment and several recommendations for improving your child's health behaviors below.

Your responses to our online questionnaire provided information about your child's current eating habits. You reported that your child eats an average of 2 fruits and vegetables daily. National dietary guidelines recommend that your child consume 5 servings of fruits and vegetables per day. Some strategies that can help you increase your child's fruit and vegetable intake are to:

- Keep cut up fresh fruits and vegetables ready for quick snacks.
- Offer your child 100% juice options when giving your child juice.
- Use canned fruits in addition to fresh fruits.

Figure 2. Sample Parent Health Report from Study 1

Measure. The NCI Fruit and Vegetable Screener Questionnaire, a 10-item measure adapted for use with children, was used to ascertain children's fruit and vegetable consumption over the previous month in both Study 1 and Study 2. This measure asks parents to report all

fruits and vegetables consumed by their child, including those that are raw and cooked, eaten at snacks and at meals, eaten at home and away from home, and eaten alone and mixed with other foods. The following domains were covered by this screener: Consumption of 100% juice, fruit, lettuce salad, French fries or fried potatoes, white potatoes, cooked dried beans, other vegetables, tomato sauce, and vegetable soup. The item assessing fried potato consumption was not included in the analysis. Parents were asked to rate the frequency of consumption of each fruit or vegetable per day over the past month. Item choices ranged from never to five or more times per day. They were also asked to report the quantity of each food their children ate, ranging from half a cup to more than three cups depending on the specified fruit or vegetable. Since some of the response choices indicated times per month, all of the response choices were converted to times per day. To create the Fruit Consumption Scale we averaged items one and two; to create the Vegetable consumption scale we averaged items three through nine (excluding item four which assessed fried potato consumption).

Although the NCI screener and similar measures have some limitations, including potential reporter bias and limits to reports of foods eaten outside of the home, parent reports have been shown to have adequate agreement to other measures of fruit and vegetable intake (Collins, Watson & Burrows, 2009). Thompson et al. (2002) found that the NCI screener correlated moderately well with four 24-hour fruit and vegetable intake recalls. The correlation with these recalls ranged from .5 to .7 in adults. The estimate generated from this screener differed on average by .3 to 1.2 servings of fruits and vegetables from the 24-hour recalls. One strength of the NCI screener is that it takes into account portion size (as estimated by the 2005 MyPyramid definitions of fruit and vegetable cup equivalents), to more accurately capture the

participant's true intake. However, validation studies of the NCI screener have not been completed with children.

Analytic plan. Latent growth curve modeling with Bayesian estimation was used to determine growth trajectories for fruit and vegetable consumption. The data was analyzed to determine if there was an interaction between fruit and vegetable consumption and physical activity. In addition, age, gender, and BMI percentile were accounted for as covariates.

Randomized Controlled Trial (Study 2)

Participants. Sixty-five children (32 male, 33 female; M age = 4.79, SD=0.44) enrolled in CFSL during the 2013-2014 academic year and their parents participated in this study. Similar to the previous study, all parent/child dyads participating in the preschool and kindergarten programs were invited to participate in this study, with the exclusion of those that participated in the 2012-2013 academic year (e.g., preschoolers who participated in Study 1 who attended kindergarten at the CFSL during the next academic year). The parent who was primarily responsible for preparing meals was asked to complete the survey. Consent and incentives to participate were identical to the previous study.

Procedures. Participants were randomly assigned to either an intervention or a control group. Parents of the intervention group received a personalized health report with their child's estimated daily fruit and vegetable intake (ascertained by the NCI Fruit and Vegetable Screener) as compared to the national average and a standardized set of recommendations for increasing consumption. The recommendations for this health report differed slightly from Study 1 in that they were more detailed. An example of this version of the Health Report can be found in Figure 3.

Dear Parent,

Recently you provided information regarding your child's diet. We have provided information about this assessment and several recommendations for improving your child's health behaviors below.

Your responses to our online questionnaire provided information about your child's current eating habits. You reported that your child eats an average of **two servings of fruits and vegetables** daily. National dietary guidelines recommend that your child consume **five servings of fruits and vegetables** per day.

Studies suggest **that increasing your child's exposure** to fruits and vegetables, increasing their **availability and accessibility**, and **letting your children see you eating fruits and vegetables**, all result in increased consumption in your children. The following are ideas of how to incorporate these suggestions at home:

- **Set a good example** for children by eating fruit and vegetables every day with meals or as snacks.
- Allow your children to **help you shop for, clean, peel, or cut up** fruits and vegetables.
- While shopping, **allow children to pick out a new fruit or vegetable** to try later at home.
- **Offer children a choice** of fruits for lunch.
- **Decorate plates** or serving dishes with fruit slices.
- **Top off a bowl of cereal** with some berries. Or, **make a smiley face** with sliced bananas for eyes, raisins for a nose, and an orange slice for a mouth.
- **Offer raisins or other dried fruits** instead of candy.
- **Make fruit kabobs** using pineapple chunks, bananas, grapes, and berries.
- **Pack a juice box** (100% juice) in children's lunches instead of soda or other sugar-sweetened beverages
- **Look for and choose fruit options**, such as sliced apples, mixed fruit cup, or 100% fruit juice in fast food restaurants.
- **Offer fruit pieces and 100% fruit juice** to children. There is often little fruit in "fruit-flavored" beverages or chewy fruit snacks.
- **Let children decide** on the dinner vegetables or what goes into salads.
- **Use cut-up vegetables** as part of afternoon snacks.
- Children often prefer foods served separately. So, rather than mixed vegetables **try serving two vegetables separately**.

Figure 3. Sample Parent Health Report from Study 2

A waitlist control group completed the initial baseline assessment but received no intervention until after the completion of the week 4 assessment. Parents of children in both treatment conditions completed the NCI Fruit and Vegetable Screener Questionnaire at baseline, after week 1, after week 2, and again after week 4 to ascertain post-intervention/post-baseline fruit and vegetable intake. A timeline is shown in Figure 4.

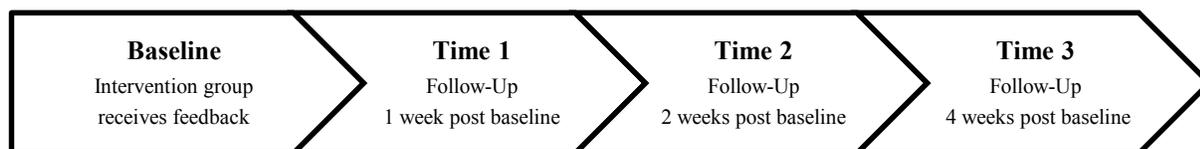


Figure 4. Study 2 Timeline

As a manipulation check, parents in the intervention group were asked if they found that this intervention motivated them to provide their children with more fruits and vegetables. They were also asked what aspects of the intervention they found to be helpful and what aspects they felt were not helpful to ascertain what changes should be made for future iterations of the intervention.

Analytic plan. Latent growth curve modeling with Bayesian estimation was also used in this study to determine growth trajectories for fruit and vegetable consumption. As in the previous study, the data were analyzed to determine whether there was an interaction between fruit and vegetable consumption and physical activity. In addition, age, gender, and BMI percentile were accounted for as covariates.

Results

Data Screening

Prior to data analysis, primary study variables were inspected for data accuracy, missing values, and conformity to the assumptions of multivariate statistical analysis using SPSS Version 22 and STATA Version 13. Descriptive statistics including means, standard deviations, medians, and interquartile ranges were used to examine distributions of study variables.

Box plots and histograms were evaluated to identify univariate outliers. Univariate outliers were fenced to their median +/- two interquartile ranges (IQR) to reduce outliers'

influences on their respective distributions. Next, a missing values analysis was conducted using Little's Missing Completely at Random (MCAR) Test and separate variance t-tests for all variables with 5% or more cases missing. In Study 1 the Little's MCAR test was significant ($\chi^2 = 42.77$, $df = 27$, $p = .03$). Missing values were not significantly related to the dependent variable so missing at random (MAR) was assumed. In Study 2, Little's MCAR test was not significant ($\chi^2 = 117.72$, $df = 95$, $p = .06$). Missing values were not significantly related to the dependent variable so MAR was again assumed. Bivariate scatterplots were examined for departures from homoscedasticity. No significant departures were noted. Histograms and probability plots examining skewness and kurtosis were evaluated to determine normality in variable distributions. In the Study 1 dataset, the time one vegetable and time two fruit and vegetable variables were not normally distributed. In the Study 2 dataset, time one fruit and vegetable, time two vegetable, and time three vegetable variables were not normally distributed. Since Bayesian Estimation does not assume or require normal distributions of data, no transformations were conducted (van de Schoot et al., 2013). Levene's test was conducted to determine homogeneity of variance and no significant variance was found between groups for either year. Finally, distributions were evaluated for multivariate outliers and multicollinearity and neither were identified for either study.

Study 1 Results

Demographics and anthropometric statistics are displayed in Table 1.

To evaluate whether a parent health report intervention increased fruit and vegetable consumption, a growth model was constructed with time 1 and time 2 data points assuming a linear trajectory. The variances of the intercept and slope factors were fixed at 0 for model identification.

Table 1

Demographic and Anthropometric Variable Means, Standard Deviations, and Frequencies

Variable	Mean (SD)	Range	Frequency (%)
Age	4.99 (.50)	4.16 – 6.36	
BMI %	57.24 (27.60)	2.00 – 99.00	
Income	5305.71 (3277.64)	0 – 15000.00	
Weight Status			
Underweight			3.2
Healthy Weight			77.4
Overweight			11.3
Obese			8.1
Gender			
Female			41.9
Male			58.1
Ethnicity			
Caucasian			93.5
Hispanic			3.2
Asian			1.6
Biracial			1.6
Parent Education			
High School			3.3
Some College			10.0
Associate's Degree			3.3
Bachelor's Degree			48.3
Post Graduate Work			3.3
Graduate Degree			31.7

(continued)

Variable	Mean (SD)	Range	Frequency (%)
Spouse Education			
Associate's Degree			1.7
Bachelor's Degree			25.9
Post Graduate Work			13.8
Graduate Degree			58.7

Notes: BMI % = Body Mass Index Percentile for Age; Underweight = BMI % < 5; Healthy Weight = BMI% ≥ 5; Overweight = BMI % ≥ 85; Obese % ≥ 95 (CDC, 2014). Values for anthropomorphic data were reported at baseline (Time 1). Six participants did not provide monthly salary data. Twelve participants did not provide parent education data. Fourteen participants did not provide spouse education data.

Bayesian Estimation was used because of the small sample size (Muthén & Asparouhov, 2012; van de Schoot et al., 2013). Without informative priors, the maximum likelihood estimates were used as priors by default (van de Schoot et al., 2013). The model was estimated in a two-step approach. The first model was estimated without conditioning growth trajectories on covariates. The second model included covariates to determine whether they affected the growth trajectories.

The participants started the intervention with an average of .82 servings of fruit ($M = .82$, $p < .01$) and an average of .74 servings of vegetable ($M = .74$, $p < .01$). Fruit consumption did not change significantly over time as indicated by the non-significant slope ($M = .20$, $p = .07$). Vegetable consumption increased over time as indicated by the significant slope (See Figure 5; $M = .30$, $p < .01$).

The covariates of age, gender, physical activity, and BMI percentile were found to have no significant effects on fruit and vegetable consumption.

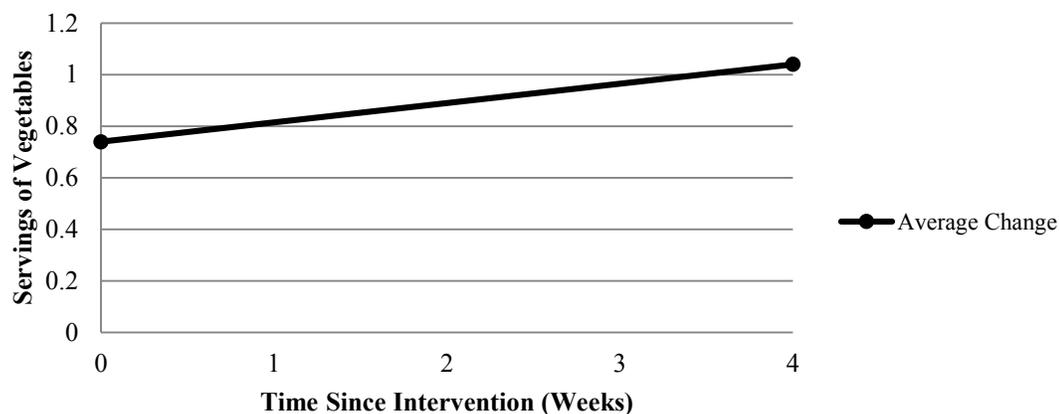


Figure 5. Increase in Vegetable Consumption

Study 2 Results

Demographics and anthropometric statistics for the intervention and control groups are displayed in Table 2.

Table 2

Demographic and Anthropometric Variable Means, Standard Deviations, and Frequencies

Variable	Intervention (M, SD) N = 32	Control (M, SD) N = 33
Age	4.77 (.44)	4.80 (.44)
BMI	47.72 (31.21)	51.64 (25.44)
Monthly Income	6099.50 (3322.64)	5336.33 (2479.93)
Variable	Intervention (Frequency %)	Control (Frequency %)
Weight Status		
Underweight	9.4	3
Healthy Weight	81.3	78.8
Overweight	6.3	18.2
Obese	3.1	0

(continued)

Variable	Intervention (Frequency %)	Control (Frequency %)
Gender		
Female	62.5	36.4
Male	37.5	63.6
Ethnicity		
Caucasian	84.4	93.9
Hispanic	3.1	0
Asian	6.3	0
Biracial	6.3	6.1
Parent Education		
High School	0	3
Some College	9.7	6.1
Associate's Degree	0	6.1
Bachelor's Degree	45.2	54.5
Graduate Degree	45.1	30.3
Spouse Education		
High School	0	3.1
Some College	15.6	12.5
Bachelor's Degree	12.5	15.6
Post Graduate Work	15.6	6.3
Graduate Degree	56.3	62.5

Notes: BMI % = Body Mass Index Percentile for Age; Underweight = BMI % < 5; Healthy Weight = BMI% ≥ 5; Overweight = BMI % ≥ 85; Obese % ≥ 95 (CDC, 2014). Values for anthropomorphic data were reported at baseline (Time 1). Three participants did not provide monthly salary data. One experimental participant did not provide parent education data. One control participant did not provide spouse education data.

Analysis plan. The first step in estimating a Latent Growth Curve Model (LGCM) for controlled experiments is identifying a two group model (control and experimental) that best

represents change over time. Prior research suggests that fruit and vegetable consumption often increases after intervention but subsequently decreases over time, indicating that either a linear or a non-linear model of change could appropriately characterize change over time (Knai, Pomerleau, Lock, & McKee, 2006; Upton, Upton, & Taylor, 2012). We assumed homogeneity due to small sample size. To ensure that we identify the model of change that best represented the data, we evaluated both linear and non-linear models.

Data were collected at the following assessment points: baseline and one, two, and four weeks after the intervention. Time was coded to reflect the average time since the first measurement. We used 0, 1, 2, and 4 to indicate a one-week gap before the final measurement. Factor loadings for the intercepts for the four observed measures of fruit and vegetable consumption were fixed at 1; factor loadings for the slope factor were set to 0, 1, 2, and 4 for the linear trajectory. Factor loadings were set to 0, .69, 1.1, 1.61 for the logarithmic trajectories and to 0, .1, .4, 1.6 for the quadratic trajectories. Means and variances for the intercept and slope factors were allowed to be freely estimated and vary across classes. All models were estimated with Mplus version 7.3.

As noted, we estimated linear and non-linear models to identify the best two-group model to serve as the base model for the analyses. We estimated two series of growth models, one for fruit consumption and one for vegetable consumption. The growth model includes two latent factors, the intercept and the slope. A growth model consists of five important parameters that aid in interpretation: the mean of the intercept factor, the mean of the slope factor, the variance of the intercept factor, the variance of the slope factor, and the covariance between the intercept and slope factors (Bollen & Curran, 2006). The mean of the intercept factor represented baseline levels of fruit or vegetable consumption and mean of the slope factor represented average levels

of change in fruit and vegetable consumption. The variance of the intercept indicates the differences in baseline levels of fruit and vegetable consumption and the variance of the slope indicates the differences in the change rate. Finally, the covariance between the intercept and the slope indicates the association between these two estimates.

Model estimation. Similar to the first study, Bayesian Estimation was used because of the small sample size and maximum likelihood estimates were used as priors by default (Muthén & Asparouhov, 2012; van de Schoot et al., 2013). A two-step approach was again adopted for this estimation. First, we estimated growth trajectories without conditioning them on the covariates. In the second step, we included covariates to determine whether covariates affected the growth trajectories.

Model selection and interpretation for fruit consumption. We explored linear and non-linear growth trajectories for fruit consumption. Because it was hypothesized that the intervention and control groups would differ in their growth trajectories, we evaluated combinations of linear and non-linear growth trajectories in both groups. We then compared information criteria to determine which trajectory pattern fit the data best. Information criteria are reported in Table 3. These models were compared in terms of information criteria.

The quadratic model for the experimental group and the linear model for the control group had the smallest BIC, indicating the best trajectory. The experimental group started with an average of 1 serving of fruit ($M = 1.00, p < .01$). Experimental group participants had significant variance in baseline values for fruit consumption as indicated by the variance of the intercept factor ($M = .29, p < .01$). These respondents did not change significantly over time as indicated by the non-significant slope ($M = -.03, p = .21$), even though they varied in their slope slightly ($M = .01, p < .01$).

Table 3
Information Criteria for Fruit Consumption

Model of Change	p-value	DIC	pD	BIC
Linear	.25	317.22	8.90	345.31
Quadratic	.33	317.19	8.85	345.34
Experimental Linear/ Control Quadratic	.33	317.36	8.48	345.85
Experimental Quadratic/ Control Linear	.28	315.58	8.74	343.28

Notes. p-value = posterior predictive p-value; DIC = deviance information criteria; pD = estimated number of parameters; BIC = Bayesian information criteria. Only models with significant findings are displayed.

The control group started with an average of .94 servings of fruit ($M = .94, p < .01$). Control group participants also had significant variance in baseline values for fruit consumption as indicated by the variance of the intercept factor ($M = .29, p < .01$). These respondents did change over time as indicated by a significant negative slope ($M = -.06, p = .01$), and they also varied slightly in their slope ($M = .01, p < .01$).

Next, we included the covariates of age, gender, physical activity, and BMI percentile to determine whether they were associated with growth trajectories. Physical activity was associated with initial fruit consumption in the intervention group (unstandardized $M = .002, p = .03$; standardized $M = .37, p = .03$) but not in the control group; however this was not related to the overall change. Although the overall change was non-significant, there was a gender difference with the change in male consumption being lower than the female consumption ($M = -.22, p = .01$).

Another unconditional growth curve model was run to determine whether growth trajectory differed between genders by experimental group. An interaction was found between gender and intervention group (experimental or control), with fruit consumption decreasing in the control group for males ($M = -.1, p = .01$) but staying the same in the both group for females.

Model selection and interpretation for vegetable consumption. We explored linear, logarithmic, and quadratic growth trajectories for vegetable consumption as well as combinations of these trajectories to allow for different trajectories between groups. Criteria information is reported in Table 4.

Table 4

Information Criteria for Vegetable Consumption

Model of Change	p-value	DIC	pD	BIC
Linear	.13	332.17	10.44	356.55
Logarithmic	.31	323.44	10.35	348.17
Quadratic	.05	339.61	8.33	368.32

Note. p-value = posterior predictive p-value; DIC = deviance information criteria; pD = estimated number of parameters; BIC = Bayesian information criteria. Only models with significant findings are displayed.

After comparing the groups to ascertain the best growth trajectory, we determined that the logarithmic model had the smallest BIC, indicating the best trajectory. The experimental group started with an average of .76 servings of vegetables ($M = .76, p < .01$). Experimental group participants had significant variance in baselines values for vegetable consumption as indicated by the variance of the intercept factor ($M = .19, p < .01$). These respondents did change significantly over time as indicated by the positive slope (See Figure 6; $M = .19, p < .01$), and they varied in their slope slightly ($M = .08, p < .01$).

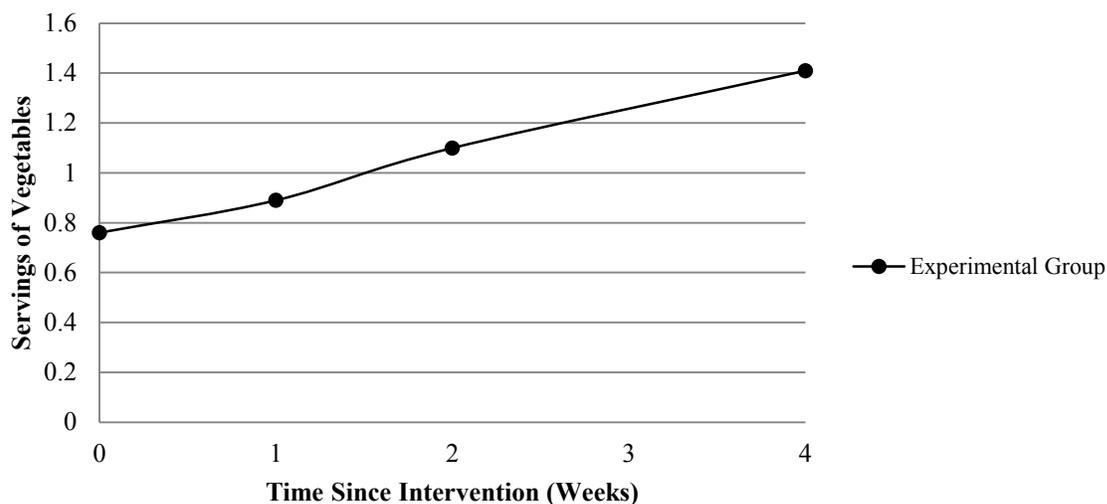


Figure 6. Increase in Vegetable Consumption in Experimental Group

The control group started with an average of .72 servings of vegetables ($M = .72, p < .01$). Control group participants had significant variance in baseline values for vegetable consumption as indicated by the variance of the intercept factor ($M = .19, p < .01$). These respondents did not change significantly over time as indicated by the non-significant slope ($M = .09, p = .1$), and they varied also in their slope slightly ($M = .08, p < .01$).

Next, we included the covariates of age, gender, physical activity, and BMI percentile to determine whether they affected the growth trajectories. None of these variables appeared to have an effect on the overall model.

Manipulation Check

Out of the 34 intervention participants, 20 parents of the participants reported that they tried to provide their children with more fruits and vegetables after receiving the feedback, eight parents indicated that they did not try to increase their child's fruit and vegetable intake, and six parents did not complete the follow-up survey.

Not all of the eight parents gave feedback about why they did not try to increase their children's fruit and vegetable consumption. Of the three parents that did provide feedback, the common theme was that the parents felt that their children already had a well-balanced, healthy diet.

Parents were also asked what aspects of the intervention were helpful and less helpful. Parents indicated that helpful aspects of the report included providing information that compared their child's intake to the ideal intake, becoming more aware of what their child was eating, and including recommendations (e.g., including vegetables as snacks and not just at lunch or dinner). Parents indicated that the report could be improved by providing more detail (e.g., information about serving size and including other aspects of diet such as protein consumption).

Discussion

Fruit and vegetable consumption in young children is important because it engenders lifelong healthy eating habits and may prevent chronic diseases later in life (Van Duyn & Pivonka, 2000; Witt & Dunn, 2012). Parents play an important role in helping their children establish healthy consumption of fruits and vegetable. The two studies comprising this dissertation sought to evaluate the effectiveness of a parent health report in increasing fruit and vegetable consumption in preschoolers and kindergarteners. Consistent with our hypothesis, we found that providing parents with a health report resulted in increased vegetable consumption. However, no significant increase in fruit consumption was noted.

To evaluate the effectiveness of a parent health report intervention we conducted two studies, a pre-post design open trial and a randomized controlled trial. The open trial was designed to provide proof of concept and the subsequent randomized trial assessed the effectiveness of the health report compared to a control condition.

Open Trial (Study 1) Results

All participants who participated in the pre-post design open trial received the parent health report indicating their child's daily servings of fruit and vegetables. Participants started the intervention with an average of .82 servings of fruits and .74 servings of vegetables per day. Results from the open trial indicated that this intervention did not significantly increase fruit consumption, but it did significantly increase vegetable consumption over the period of a month by approximately .30 servings per day. The covariates of age, gender, physical activity, and BMI percentile were found to have no significant effects on fruit or vegetable consumption. Although the size of this effect is modest, our findings suggest that a parent health report might be a viable option for increasing vegetable consumption.

Compared to other pre-post designs targeting both fruit and vegetable consumption, the size of our observed intervention effect was significantly higher. A preschool parent intervention which provided parents with a tailored newsletter (giving them information about their child's intake and giving them tailored feedback on how to improve their children's consumption), four sixty-minute psycho-educational home visits, and provided children with a sing-along cassette and workbook only increased vegetable intake by .06 servings per day (Haire-Joshu et al., 2008). This increase was not considered to be a significant difference from baseline. The superior effect noted in the present study indicates that providing comparative dietary feedback and brief recommendations for improvement may be more effective than educational interventions. However, our intervention may have been more effective because we intervened with a more highly educated, higher SES group compared to Haire-Joshu's sample.

Compared to another preschool parent intervention, which targeted only vegetable consumption, our finding of a .30 serving of vegetables per day increase was significantly lower.

This intensive intervention study provided parents with four tailored newsletters and two motivational follow-up phone calls and resulted in an increase of vegetable consumption by 1.5 servings per day (Tabak et al., 2012). The reason why these authors provided a vegetable consumption only intervention was so as not to overwhelm the parents with too many changes. The results of the current study demonstrated a significantly smaller effect than Tabak's study, indicating that perhaps targeting only one food group (e.g., only vegetable consumption as opposed to fruit and vegetable consumption) might lead to a greater amount of change. Future studies could be designed to determine whether targeting only one food group leads to a more significant effect.

Randomized Controlled Trial (Study 2) Results

One significant limitation of the pilot study was the lack of a control group, thus a follow-up study was conducted with participants randomized into an intervention and a control group.

Fruit consumption. There was no significant change in fruit consumption over the course of the study for the intervention group; however, a slight decrease in fruit consumption was found in the control group. An interaction was found between gender and randomization groups indicating that male fruit consumption decreased in the control group, but not in the intervention group. Female fruit intake did not change in either group.

Several potential explanations for why the intervention did not foster increased fruit consumption deserve mention. Our non-significant finding for fruit consumption may be attributable to higher fruit intake at baseline compared to vegetable intake. This finding is not surprising considering that children tend to prefer eating fruits to vegetables (Blanchette & Brug, 2005). Because the average participant ate more servings of fruits than vegetables per day,

parents might have perceived that vegetable intake was more problematic and as a result they might have targeted vegetable consumption more than fruit consumption. Our finding that children consumed one serving of fruit per day on average is similar to that of other studies which found that on average, about 37% of children ate fruit once a day (Cooke, Wardle, Gibson, Sapochnik, Sheiham, & Lawson, 2004). Alternatively, this finding might be a result of parents being provided with aggregate fruit and vegetable consumption estimates, which make it difficult to determine whether to focus their efforts on encouraging fruit or vegetable consumption. Future studies may benefit from providing parents with separate fruit and vegetable consumption estimates to ensure that parents are aware of both their children's fruit and vegetable intake separately. Since the average participant only ate about one serving of fruit a day, this might help parents to see that their children's fruit consumption could also be improved.

The gender difference in fruit consumption is supported by previous research. Studies have shown that females tend to consume more fruits and vegetables than males (Rasmussen et al., 2006). In addition, other intervention studies have found that females increase their fruit and vegetable intake to a greater degree than males when receiving interventions that target teacher curriculum as well as parent engagement (Keyte, Harris, Margetts, Robinson, & Baird, 2012). The fact that there was no statistically significant decrease in the experimental group indicates that it is possible that this intervention helped males maintain their fruit intake over the period of a month. Further research should be conducted to determine whether this intervention promotes fruit consumption maintenance in males or if this was just a chance occurrence.

In addition, physical activity was associated with initial fruit consumption in the experimental group, but not in the control group. For every one unit increase in physical activity there was a .37 unit increase in fruit consumption. However, physical activity was not related to

the overall change in fruit or vegetable intake. Given that participants were randomly assigned to the experimental and to the control group, initial levels of physical activity should have been the same between groups. This finding seems to be attributable to chance rather than representing a meaningful difference between experimental groups.

Vegetable consumption. Vegetable consumption increased following the intervention for the experimental group when compared with a control group, with an average increase of approximately .65 servings over the course of the study for experimental group participants. This estimate was higher than the one found in the pilot study. One difference between Study 2 and Study 1 was that parents were required to complete the NCI Fruit and Vegetable Screener multiple times throughout the intervention in Study 2, which required them to re-evaluate their children's fruit and vegetable consumption on a weekly basis. It is possible that this weekly reminder resulted in a greater overall effect.

A systematic review examining behavioral interventions with varying intensity (e.g., individual classes, support groups and classes) provided in varying settings (e.g., schools, health care facilities, worksites, and communities) and with varying populations (e.g., children, adolescents and adults that were both healthy and at a high risk for chronic disease) found an average of .60 servings a day increase in combined fruit and vegetable intake (Ammerman, Lindquist, Lohr, Hersey, 2002), an effect commensurate with our findings. Another review examining interventions designed to promote fruit and vegetable consumption in children and adolescents found effects ranging from an increase of .30 to .99 servings of fruits and vegetables per day (Knai et al., 2006). Taken together, results from the current study can be considered comparable to other interventions designed to increase fruit and vegetable consumption among children and adolescents.

This intervention also produced similar effects to other preschool interventions. One study included four thirty-minute phone calls in addition to written materials to provide parents of preschoolers with information regarding how to increase fruit and vegetable consumption (Wyse, Campbell, Brennan, & Wolfenden, 2014). Compared to Wyse's study, which demonstrated increased fruit and vegetable consumption by an average of .70 servings, the less intensive intervention tested in the current study produced similar increases in vegetable consumption indicating that this might be a more cost effective method for increasing vegetable consumption.

Results from the current study were also similar to studies that targeted elementary school students, both of which were more intensive interventions. Direct comparability to these studies may be limited due to age and developmental differences. One intervention provided fourth grade children with a fourteen-lesson bi-weekly classroom intervention (including topics such as problem solving and taste testing) in addition to homework that provided them with skill building material (Reynolds, 2000). Parents were given seven interactive lessons to complete to help supplement the children's classroom learning. In addition, cafeterias were given ten intervention activities to improve fruit and vegetable consumption at school. Results from this study showed that children's vegetable consumption increased by .13 servings, a smaller effect than was observed in our study.

Finally, one study that targeted children between the ages of eight and ten years of age provided a one year intervention that included teacher training, school meal changes, physical education, and a classroom curriculum which promoted an increased fruit and vegetable consumption (Sahota et al., 2001). Results of this study showed an increase in vegetable consumption by .30 servings. Compared to findings from other clinical trials, the results of the

current study yielded a greater effect, despite the fact that the intensity level was less than what would be expected in an intervention with both intensive parent and teacher training. One possible reason for this finding is that parents were given information about their children's fruit and vegetable consumption, and then were required to re-evaluate weekly through the follow-up e-mails. It is possible that this intervention not only provided parents with information, but it also provided them with consistent reminders that encouraged them to continuously monitor their children's intake.

Overall Conclusions

Taken together, the two studies comprising this dissertation demonstrate proof of concept for a simple, cost-effective intervention for increasing vegetable intake in preschoolers and kindergarteners. This intervention produced increases in vegetable consumption commensurate with comparable intervention studies. Studies that have found increases in lunch time servings of vegetables of about .30 servings have characterized their findings as a "huge increase in vegetable consumption" considering that "vegetables are the most challenging food group to change in children" and that this increase also provided a "key increase in nutrients" (Sahota et al., 2001; Sweitzer et al., 2010). Wyse et al. (2014) determined that an average of .70 serving increase in fruit and vegetable consumption could result in a reduced risk of stomach, esophageal, and mouth/pharynx/larynx cancers by 15%, 31%, and 28% respectively. Thus, the results of this intervention might result in not only an improved diet, but also to a reduced risk of chronic diseases.

Because the methodology of this study is relatively simple, it could be implemented within a school setting, within a primary care setting, or it could be combined with a larger multi-component intervention. Because this intervention required collecting data from parents

on several occasions, it may be beneficial to automate survey distribution and scoring of the diet measures to make it easier to obtain and disseminate this information. One factor that could possibly help improve the intervention effect is targeting just vegetable consumption instead of both fruit and vegetable consumption.

Study Limitations

Several limitations to the present studies should be noted. One major limitation of both the pilot and the randomized controlled studies is the use of a measure for fruit and vegetable consumption that has not been validated in preschoolers and kindergarteners. The child version of the NCI Fruit and Vegetable Screener asks the same questions as the adult screener; however the instructions were adapted to account for parent report of child intake as opposed to an adult's self-reported intake. Although this measure has been validated and been found to be moderately reliable in adults (Thompson et al., 2002), uncertainty about its validity and reliability in preschoolers and kindergarteners remains.

Another limitation results from study sample characteristics. This study was conducted at a university preschool with a primarily Caucasian population, limiting the generalizability of these findings to other ethnic/racial groups. In addition, many of the children who attended the preschool were children of the professors at the university, thus generalizability to families with lower socioeconomic status may be limited. Studies have shown that behavior risk factor interventions are more likely to succeed in more affluent, well-educated populations (Jarvis & Wardle, 1999). Also, some bias might have been created because of the self-selection process that occurs in voluntary research. People who participated in this study might have been more interested in improving their children's diet than the average person. This might lead to a sample that possesses more motivation to improve their children's fruit and vegetable consumption. In

addition, this sample might have had more resources to enable them to improve their children's diet. Finally, both studies had a relatively small sample size, which might limit our ability to detect an effect.

Finally, this study was done in conjunction with a physical activity feedback study in which parents received information about their child's average daily amount of moderate to vigorous physical activity, as compared to a national recommendation of one hour of moderate to vigorous physical activity per day. In addition to receiving feedback on fruit and vegetable consumption, parents were provided recommendations of how to increase their children's physical activity. Because changes in physical activity may promote improvement in diet, the increase in vegetable consumption may not be solely attributable to the dietary portion of the intervention.

Future studies may want to evaluate the effectiveness of a health report with a larger, more diverse population to examine the generalizability of these findings. In addition, it may be beneficial to include follow-up time periods that go beyond the one-month follow-up to determine if these effects remain constant over time and if continuing tailored messages could continue to help shape and improve children's diet. Also, future studies could examine the feasibility of implementing this type of intervention in a primary health care setting. All children can benefit from an increased fruit and vegetable consumption and children go to their primary care medical providers regularly for well-child check-ups. Parents may be more willing to make changes when a medical doctor suggests them, thus replication in this setting may be warranted. Finally, some parents indicated that they would be interested in receiving feedback about other aspects of their children's diet (e.g., protein consumption). It may be possible to use a parent report to give parents feedback about other dietary changes that may be beneficial to the child.

Implications

Findings from this study support the efficacy of a simple method of increasing vegetable consumption among preschoolers and kindergarteners. Although the studies comprising this dissertation represent a relatively small open investigation and randomized trial, results provide initial evidence of effectiveness and support for conducting additional large-scale trials. This intervention may hold several advantages over existing interventions. As previously mentioned, many existing interventions use extensive resources, requiring a financial investment either on the part of the school or of the parent. Other interventions also require intensive training of interventionists, making sustainability difficult. The intervention method used in this study is one that can be used by school nurses, teachers, or researchers and requires little time, funding, or training. This method of improving fruit and vegetable intake may also be beneficial in reaching parents who do not feel that they have time to attend classes to improve their child's nutrition. This intervention offers a simple way of providing parents with pertinent information about their child while requiring minimal investment of parent time.

The purpose of this study was to determine whether a parent health report which provided information about a child's fruit and vegetable consumption compared to the national recommendation of five servings of fruits and vegetables per day as well as recommendations of how to increase fruits and vegetable consumption resulted in a greater fruit and vegetable intake in preschoolers and kindergarteners. Results from both the open trial and the randomized-controlled trial suggest that a child health report, delivered to parents, might be a beneficial tool to increase vegetable consumption in preschoolers and kindergarteners. Increases in vegetable consumption can lead to the establishment of lifelong habits of healthy fruit and vegetable consumption, but can also decrease risk for chronic diseases in the future.

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