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Reducing the Cost of Implementing the F.I.T. Game Healthy Eating Program in Diverse Schools While Observing Effects on Food Waste

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REDUCING THE COST OF IMPLEMENTING THE F.I.T. GAME HEALTHY EATING PROGRAM IN DIVERSE SCHOOLS WHILE OBSERVING EFFECTS ON FOOD WASTE.

by

Robert Gifford

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ABSTRACT

Reducing the Cost of Implementing the F.I.T. Game Healthy Eating Program in Schools with Greater Than 10% Diversity While Observing Food Waste Fluctuation Due to Intervention

by

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Children's insufficient consumption of fruits and vegetables (FV) is well-known. The FIT Game Healthy Eating Program employs gamification to boost FV intake in elementary schools. Earlier studies demonstrated increased FV consumption with limited student diversity. Subsequent research aimed to evaluate the efficacy of The FIT Game in more diverse schools (Chapter 2), explore its potential for reduced researcher involvement (Chapter 2), and investigate the impact of such interventions on FV waste (Chapter 3).

In Chapter 2, The FIT Game was tested in two phases across four Title 1 schools in the Salt Lake City area, predominantly attended by non-Caucasian students. The first phase compared FV consumption between an intervention school and a control school. Results showed a 13.43% increase in vegetable consumption at the intervention school, while the control school saw a 4.21% decrease, suggesting The FIT Game’s effectiveness. However, more accurate data collection methods are recommended for confirmation.

The second phase extended The FIT Game to the remaining two schools with a pre-programmed approach to cut costs and minimize researcher intervention. Both schools exhibited increased FV consumption, replicating the first phase's results. However, study design limitations were identified and more precise data collection methods should be use to assess the efficacy.

Chapter 3 focused on FV waste, using the same schools from Chapter 2. The intervention led to an overall reduction in FV waste. However, disparities were observed, such as a decrease in vegetable waste of 0.28kg while there was also a 5.35kg increase in fruit waste. Current literature was reviewed to identify trends in similar published work. This suggests that interventions like The FIT Game can sometimes lead to unintended trade-offs in waste reduction, highlighting the necessity for more thorough oversight and detailed reporting in future studies.

Chapter 4 reviews the successes and challenges encountered in the research, proposing directions for further investigation. These findings underline the potential of The FIT Game to improve FV consumption in diverse school settings and using pre-programmed approach that is less burdensome for schools to implement. The importance of additional studies with more precise individual-level data analysis is emphasized for future research.

(108 pages)

PUBLIC ABSTRACT

Reducing the Cost of Implementing the F.I.T. Game Healthy Eating Program in Schools with Greater Than 10% Diversity While Observing Food Waste Fluctuation Due to Intervention

Robert Gifford

It is well known that children do not eat enough fruits and vegetables. The FIT Game Healthy Eating Program is an interactive, story-board type narrative that has increased fruit and vegetable consumption in elementary school children. While The FIT Game intervention has shown progress in the past, the schools studied had minimal diversity and the intervention was time intensive and costly.

This research utilized The FIT Game intervention in four Salt Lake City area, Title 1, schools with a large amount of student diversity. The first portion of research was conducted in two phases. The first phase compared an intervention school, with The FIT Game program being implemented, to a control school without the intervention. The first phase resulted in increases in both fruit and vegetable consumption in the intervention school, while the control school had less consumption.

Phase two looked at conducting The FIT Game in the two remaining schools, but the narrative was already determined and did not advance based on the schools' consumption. Both schools showed improved fruit and vegetable consumption. However, because of the way data was collected, further studies need to be done to ensure that the increase is due to The FIT Game.

The second portion of research looked at how fruit and vegetable waste changes when programs like The FIT Game are implemented in schools. The same schools as the first portion of research were used for this as well. The results showed that even though that when fruit and vegetable consumption increase, the waste typically decreases, there is sometimes an overlooked compromise. In one school, while the vegetable consumption improved, the fruit consumption decreased while the fruit waste increased. At first glance, while the vegetable increase is promising, when you look at the weight of the food consumed compared to the increase of fruit wasted, the amount of fruit wasted weighs 6 times more.

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CHAPTER 1

THE NEED TO EVALUATE THE FIT GAME PROGRAM IN DIVERSE SCHOOLS

ABSTRACT

This study aims to assess the efficacy of the FIT Game Healthy Eating Program in increasing fruit and vegetable (FV) consumption among children in ethnically diverse schools, with a focus on implementing the program in a low-cost, low-burden manner.

The study involves a systematic review and meta-analysis of school-based interventions, examining their effectiveness in increasing daily FV consumption. It also explores the feasibility of gamification methods in encouraging healthy eating habits in children.

The study focuses on school-aged children, analyzing data from various school-based nutrition programs, including the FIT Game Healthy Eating Program.

The primary outcome measure is the increase in FV consumption among children, assessed through systematic reviews and direct observation methods in schools.

Preliminary results suggest that gamification and systematic interventions can effectively increase FV consumption in children. The study particularly highlights the FIT Game Program's success in improving dietary habits with minimal resource investment.

The findings underscore the potential of gamification strategies like the FIT Game Program in promoting healthy eating habits among children in diverse school

settings. This approach could be pivotal in addressing chronic disease rates and nutritional deficiencies in children, suggesting further exploration and implementation in varied educational contexts.

INTRODUCTION

Problem Statement

The rate of chronic disease and associated commodities is increasing at an unprecedented rate in our general population, specifically, our children's population.[1,2] It is well established that adequate consumption of fruits and vegetables (F.V.) greatly decreases chances of developing chronic disease.[3] There is various evidence showing that children do not consume enough F.V.[3] With schools providing meals to over 28.6 million students every day, school lunch appears to be an indispensable platform to provide an intervention to children and increase F.V. consumption.[4]

Between 2017 and 2018 the rate of obesity in children was 19.3%.[1,5] Obesity, type 2 diabetes, and nearly all associated comorbidities, also known as chronic disease, can be attributed in a large part to diet.[6] Specifically, the reduced consumption of F.V. in the modern-day American diet.[3] F.V. consumption contributes to the reduction of chronic disease due to their high amounts of antioxidants, fiber, vitamins and trace minerals, as well as displacing caloric high, nutrient poor foods in the diet.[3,6,7] There are other factors that play into the epidemic such as low amounts of physical activity, genetic pre-disposition and physiological traits however, their involvement is outside the scope of this research.[2,5]

The amount of fruit and vegetable consumption recommended by the USDA for children ages 2 to 8 are 1-2 cups of fruits and 1.5 to 2.5 cups of vegetables per day, depending on caloric needs. Children ages 9 to 13 require 1.5 to 2 cups of fruit per day and 2 to 3.5 cups of vegetables, also depending on caloric needs.[3] The USDA also conducted research about current consumption and reported that children ages 2-8 consume roughly .5-1.5 cups of vegetables per day currently, which is half to a whole

cup below the advised amount. While ages 9 to 13 are 1 to 1.5 cups deficient in both fruits and vegetables daily.[3]

In an attempt to increase access and consumption of FV the Healthy Hunger Free Kids Act of 2010 (HHFKA) set guidelines for public schools to follow in order to receive government reimbursement for meals provided to children.[8,9] These guidelines include standards for the variety and quantity of FV served for the school to meet the reimbursement requirements.[8,9]

However, these guidelines do not require consumption on the Children's part. Some sources even speculate that the National School Lunch Program (NSLP) and School Breakfast Program (SBP), which are associated with the HHFKA, has increased overall food waste.[10–12] With steps being taken to require FV provided to nearly 28.6 million children daily, it is important to implement strategies that both decrease food waste produced and increases FV consumption.[4]

What benefits are there from school-based gamification. Gamification is a newer term that is used to encompass many different types of interventions that include components of Game to engage learning and motivate behavior change.[13] One of several definitions of gamification is "… a process of enhancing services with (motivations) affordances in order to invoke gameful experiences and further behavioral outcomes."[14] A Gamification approach is an extremely attractive method to elicit behavior change as gamification can show both role-modeling and have the ability to be implemented in a low-cost method when planned correctly.[15]

School-based gamification programs can help children increase their FV consumption but can also become very costly due to using tangible rewards. Programs can also be time intensive for researchers to conduct.[13,14,16] One such

program that has been implemented is the FIT Game Healthy Eating Program (FIT Games), a school-based gamification approach to helping children to consume more FV at school. The FIT Games, which was created by researchers at Utah State University, has been used successfully in previous studies.[18-20]

The Fit Games. The FIT Game uses a static, comic storyboard method that follows a team of Heroes known as the F.I.T.s through the Universe to stop the villains, The V.A.T.s. So far, the FIT Game has been implemented and observed in 3 schools, with some implementations also attempting to increase PA. In past iterations, the FIT Game had successfully increased F.V. consumption by 44-99%.[17] These previous FIT Game implementations have required heavy handed support from University Staff and have only been implemented in schools where more than 90% of the student population is white/Caucasian.[17]

Figure 1. Image of the F.I.T.s

Figure 2. Image of the V.A.T.s

Figure 3. Slide from The F.I.T. Game When Students Failed to Meet Target Consumption.

Waste Is Unintentionally Increased With Interventions. With the implementation of the HHFKA, more FV are provided to students, but consumption does not follow suit, and there are concerns of an increase in food waste. Not only is there an increase due to the HHFKA but when researcher implement programs to incentivize FV consumption it is hypothesized that this gamification further increases the amount of food waste created.[10–12]

LITERATURE REVIEW

Systematic Review

A systematic review and meta-analysis looked at both single and multi-component interventions that spanned 27 different school-based programs.18 In their systematic review of the literature, they noted that all types of interventions were "estimated to improve daily fruit and vegetable consumption by an average of one-quarter to one-third of a portion".[18] The researchers also noted that their findings were consistent with previous reviews that reported an increase of .4 servings of FV per day.[18]

A limitation of this meta-analysis was the exclusion of interventions that counted 100% juice intake.[18] This can potentially exclude viable incentive programs who's only shortcoming was their inclusion criteria. A component of successful program interventions is offering incentives to children to evoke the desired behavior. There have been several programs created aimed at increasing F.V. consumption in school age children. Several of these programs will be thoroughly reviewed to understand successes and potential complications that may occur in the proposed research method.

Kids Choice. One such program designed to increase F.V. consumption is Kid's Choice. Researchers recruited 1st, 2nd, and 4th grade classrooms to observe consumption. Results were collected by using parent questionnaires and conducting direct lunch observations. The method of intervention was to give each child a card that had holes punched in it each time they were observed consuming a sufficient amount of fruits or vegetables. A sufficient amount was an 1/8th of a cup of either fruits or vegetables depending on the target that day, however the target was not disclosed to the children.[19]

Baseline consumption data was collected over six meals for the students involved. After baseline consumption was collected the researchers observed and recorded 18 meals. At the end of each meal, if the child consumed enough of the specific food group for that day they got a hole punch in their card. Once a week they were able to trade in their card with 3 holes for a small reward such as a pencil, eraser, or other small tangible item. Overall, the results reported were an increase of 1.0 cups of F.V. over the course of a week. This study showed that gamification has a positive outcome on F.V. intake however, there some concerns were noted.[19]

On days when F.V. consumption was observed and recorded, an additional fruit and vegetable was provided to students to increase variety. This could be a possible confounding factor since there is no way to observe if consumption would have increased if there was just more variety provided every day. Another difficulty in conducting this intervention in the future is both the monetary and time cost. It was reported that for each day of observations there were 10 observers present, for each of the 3 grades, for a total of 22 different meals.[19]

This is a rather large time commitment as it equates to 330-man hours, not including the time that prizes could be exchanged. The cost of tangible prizes is another potential issue, although they are small items and inexpensive individually, the cost would scale linearly as it was implemented at more locations or grades within the same school.[19]

Squire's Quest. In another study, researchers designed an intervention known as "Squire's Quest!" which was conducted across 26 elementary schools in Houston, Texas. The study's goal was to incentivize consumption of fruits, 100% juice, and vegetables (FJV). The program was designed as an interactive multimedia computer game in which the students participate in 10 sessions. During these sessions they follow along a story involving the kingdom of 5A Lot which was being invaded by the "Slimes" and "Mogs". As the children follow the story, they participate in challenges to help save the kingdom that were related to eating more FJV.[20]

During each session the participants were able to make a virtual recipe, eat another serving of FJV, or ask for their favorite FJV to be more available at home. At the beginning of each subsequent session the children reported if they had met their goal and if not, how they might increase their ability to achieve it.[20]

Data was collected during 4 non-consecutive days over two weeks both before and after the program's implementation. Researchers reported that the game resulted in a 1.0 serving increase between post-treatment and control. While this does show an increase of FJV consumption shortly after the intervention, the researchers only investigated the immediate impact of multi-component gamification implementation and were unable to report on long term effects. Data was collected by having the students perform a FIRSSt survey to report their consumption. This seems

to be a rather ineffective way of gathering consumption since the accuracy of the survey was 46% compared to the prior day's consumption.[20]

As emphasized previously by the meta-analysis researchers; while multicomponent interventions "tend to result in larger improvements" in FV consumption, they are more difficult to replicate than the single component interventions.[18] This is primarily due to the increased need of resources, funds, and "manpower".[18] "Squire's Quest!" places a demand on all three of the previously mentioned resources. It does seem that the researchers considered the need of manpower and created an interactive game, however since the game is played at an individual level it is taking a total 450 minutes, over the course of the intervention, from each student during the school day as well as requiring the teachers to sacrifice at least 450 minutes of their plans to accommodate the intervention.[20]

Along with the severe time commitment, only schools with enough computers for the children to access can participate in the intervention. Also to repeat or implement this intervention in a different way would be costly, requiring the design of a new computer program and story line as students playing the same game in repetition would likely have diminished returns. The validity of the results is also concerning as the survey provided was only 46% accurate to the prior day's consumption. The student also self-reported their consumption understanding that the more they consumed the better they progress in the story, this is a very good source of possible bias being introduced.[20]

The FIT Games. The FIT Game Health eating program has gone through several iterations of testing in the elementary school age population while attempting to address previous limitations and reduce the cost of implementation. While the FIT

Game has consistently demonstrated increases in FV consumption among children who play the game, it has only been under strict research protocols. These protocols consist of researchers being on premise for every day of intervention preparing for that day's intervention, taking pictures of food waste for each student, and analyzing data at the end of the day. This places a large burden on the researcher's time which is also costly.[17,21]

Another area that could be improved which was noticed in other studies is that the effects of the study were short term when reported.[18–20] Researchers at the Utah State University (USU) designed the gamification intervention to have a longer lasting impact on participants. This program uses role models and progression of the game as the incentives for FV consumption. This not only provides modeling for the students but also reduces the cost incurred. Also to avoid the need for tangible rewards, the FIT Game uses game currency in the form of points which then are used to buy upgrades which help the heroes in their quest.[17,21]

So far, the FIT Game has worked to increase FV intake by 44-99% in kids at participating schools, but with heavy handed support from University Staff. Furthermore, the program has only been implemented in Cache Valley, Utah where the student population is comprised of more than 90% white/Caucasian. This could potentially affect the success of the program when implementing it in diverse schools.[17,21]

The most recent implementation of the FIT Game Healthy Eating Program consisted of weighing the FV produce before lunch service and then after everyone had been served.[18] Once the participating students were finished eating lunch, they would take their trays to a designated disposal site supervised by trained researchers. They would then dispose of their remaining fruits in one waste bin, while the

vegetables were disposed of in another. The waste was then weighed to determine the amount of FV not consumed to calculate the amount consumed ((FV before service - FV after service) - FV disposed of = FV consumed).[17]

Along with this plate waste collection method trained researchers would take pictures of students' plates before and after consumption. This photo collection occurred 3 different times during the study with each photo collection occurring on 3 concurrent days. Additional researchers would then translate the FV photos collected into a percentage of FV consumed.[17]

The results of this iteration resulted in an increase of 44-99% FV consumption in participating students with their consumption remaining elevated 3 months after the intervention. However, there was still a high cost associated with the number of researchers and hours needed to collect, translate, and analyze the data collected.[17]

Why is the Fit Game heavy handed. The Fit Game's latest iteration still places a rather large burden on both the schools participating as well as the researchers conducting the observations. There are several man-hours required to image each plate before and after consumption, then analyze the percentage of consumption and compute whether it meets the daily requirement. While there was a plate waste measurement program in place, there was still pictures taken at a per student level to indicate if the consumption was met. If there is the ability to implement the Fit Game with only the plate waste method this would greatly reduce the burden of the program.[17]

How am I going to make it less heavy handed. The purpose of this study is to assess whether the FIT Game will increase the consumption of FV in an ethnically diverse

student population using lower burden procedures than have been used in the past. To adjust the FIT Game implementation to be less costly a Cafeteria Coordinator, who would hopefully be a parent or part time employee of the school already, will be hired and trained to be on premise and perform the preparations, record the served FV and the FV waste weights, and assist children in disposing of their waste properly.

Hiring a local individual to help implement the program would decrease associated costs of using University Staff and would reduce any novelty and bias created by having researchers on premises. Another attempt to reduce the costs of the FIT Game being implemented is to pre-program the progress of the school in the FIT Game story.

To pre-program the progression, we will perform the FIT Game in a school with a diverse student body composition. Their progress in the story will be recorded (i.e., 3 days of progress, 1 day of failure, 2 following days of progress etc.) and then that progression would be used for the following schools. This would further reduce the cost of implementation since, if it is successful, the food would not need to be weighed prior to, or after lunch.

With the FV waste being a school level aggregate, students will not be aware of how well the entire school consumed their FV. We will then be able to progress the school based on the initial school's progress. This removes the need to record and determine if the students met the daily target to progress. However, the waste will still be recorded during the study for research purposes.

This will also remove the time required to create specialized slides for the school if they do not progress on a different day. Previously, researchers would need to create a specific slide, or set of slides, asking the children at that school to consume more FV and help them defeat the V.A.T.s.

Food Waste. By using the waste weight method to record changes in consumption it also provides an opportunity to observe another effect of intervention in schools. How does intervention affect waste overall? With the introduction of the HHFKA researchers took the opportunity to look at schools and observe if requiring children to take a serving of fruits or vegetables correlated to more FV consumption.

In 2010 Researchers conducted observations at schools throughout Colorado to analyze how often fruits and vegetables were chosen during school lunch and of those chosen, were then consumed. Their findings reported that roughly 60% of elementary age children selected a fruit with lunch while only 45% selected a vegetable.[11] These percentages further decreased when observing middle school age children. Of the fruits and vegetables that were selected nearly 37% of all fruits and 30% of vegetables were uneaten and thrown away.[11]

Additionally, a group of researchers conducted a study of elementary and middle schools to observe how the new requirements of the HHFKA affected school cafeteria waste. Specifically, the researchers were looking at how the requirement of a serving of fruit or vegetable be selected on each tray would affect consumption and waste. The observations were conducted during the spring of 2012 and spring of 2013 so that the comparison could be between pre HHFKA and post HHFKA implementation.[22]

The findings showed that the number of trays containing no fruit or vegetable portions was reduced from 15.7% to 2.5%. Along with the number of students that had F.V. portions on the tray, they also had a larger average portion shifting from .69 cups to .89 cups. Although selection, and portion size, of FV increased, the amount of FV that was disposed of also increased moving from .25 cups/tray to .39 cups/tray.

Even more concerning however is that the overall consumption of F.V. went from .51 cups/tray down to .45 cups/tray which is counterproductive to the purpose of implementing the HHFKA.[22]

While the effect that the HHFKA had on overall food waste isn't surprising, what is unexpected is the decrease of overall consumption of the F.V. With the increase of F.V. selection being required, the increase of waste produced is expected assuming that the children not selecting the F.V. previously would still not consume the F.V. they are required to choose. The question that this research doesn't explore, and the second portion of the proposed research is, does incentivizing F.V. consumption also increase overall food waste, or does it follow a different trend?

SPECIFIC AIMS

S.A. 1

To assess the efficacy of the FIT Game for increasing children's FV consumption in an ethnically diverse school while the game is being implemented in a low-cost, low-burden fashion without direct aid from researchers.

S.A. 2

To observe school-level FV waste prior to and during the implementation of the game to assess if the FIT Game intervention influences the amount of FV wasted.

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CHAPTER 2

LOWERING THE EFFORT NEEDED TO IMPLEMENT THE FIT GAME IN DIVERSE TITLE 1 SCHOOLS

ABSTRACT

Objective: Assess the FIT Game Healthy Eating Program's effectiveness in increasing fruit and vegetable (FV) consumption in diverse schools and its implementation with reduced cost and researcher involvement.

Design: A two-phase study. Phase one evaluated the program in Title 1 schools with >90% Caucasian diversity. Phase two, implement a cost-reduced format using pre-programmed progression from phase one.

Participants: Four Title 1 schools in Salt Lake City, >90% Caucasian diversity, Data aggregated for school-wide analysis.

Intervention: Interactive comic-book style narrative presented to elementary school children during lunch service over the course of 9 weeks.

Main Outcome Measure(s): FV consumption percentage, calculated as served weight minus wasted weight, divided by served weight.

Analysis: Simulation Modeling Analysis (SMA) for mean consumption and 95% Confidence Intervals, suitable for short time series data.

Results: Phase one's intervention school increased FV consumption. Phase two, with pre-programmed progression, also indicated increased consumption in both schools, suggesting effective implementation with reduced resources.

Conclusions and Implications: The FIT Game Program effectively increased FV consumption in diverse and resource-limited school settings. Future research should

explore sustained consumption post-intervention and address factors like self-serve options and inherent waste.

INTRODUCTION

Fruit and Vegetable (FV) consumption is a critical source of nutrition because FV are nutrient dense foods that are low in calories[1]. Consuming FV instead of nutrient poor, calorie dense foods, will provide phytonutrients, minerals, and fiber necessary to sustain health and support growth in children.[2] The nutrients in FV help mitigate the chances of developing chronic disease such as diabetes, cardiac disease, hypertension, and obesity.[3,4]

Although the benefits of FV consumption are well known, children do not consume the suggested amounts of 2 cups of fruit per day and 2.5 cups of vegetables.[5] School age children in the United States can consume up to 50% of their daily calories at school, through school provided meals.[6] School provide an excellent platform to encourage FV consumption among students. Along with providing a large source of calorie intake for children, school may also be the only location that children in food deserts, or experiencing food insecurity, are presented with FV to consume.[7–9] To increase consumption, educating and incentivizing children to consume more nutritious foods at an early age is advantageous because the habits learned during childhood are likely to persist long into adulthood.[10,11]

To this end, promoting healthy eating habits among young children remains a priority in educational and health circles.[12,13] To assist with this concern, the Federal Government has focused on increasing consumption by introducing the Healthy, Hunger-Free Kids Act.[14–16] The Healthy, Hunger-Free Kids Act (HHFKA) provides guidelines for types, portions, and frequencies of fruits, vegetables, grains, proteins, and fats that schools must provide to students.[14–16] The HHFKA also increased access to free and reduced breakfast and lunches, especially to those children in “high-risk”

areas.[15–17] While this policy has been partially successful in increasing FV consumption, and has increased access to foods, researchers are investigating additional ways to increase FV consumption with a common element of incentivizing increased consumption with rewards.[18–21]

Research utilizing video games or tangible rewards has shown success in increasing FV consumption. One study which used a multimedia/video game intervention in elementary schools, increased fruit, fruit juice, and vegetable consumption among the children who participated in the intervention by a full serving at the end of the 5-week intervention.[19] A study using tangible rewards as incentive to increase FV consumption, known as "Kid's Choice," increased FV consumption ranging from 40% - 75% across 2nd to 4th grade levels.[22] Kid's Choice used a token system which could be exchanged for small rewards such as fancy pens, notebooks, and erasers. However, as noted by the researchers in "Kid's Choice" using tangible rewards, or video game platforms, can be resource-intensive, both in time and money which may exclude schools without the necessary resources from incentivizing FV consumption.[18,19,22]

The FIT Game Healthy Eating Program was designed to incentivize FV consumption effectively as other studies using costly rewards, but in a lower cost way.[23,24] The program uses gamification techniques to encourage children to increase FV consumption without the dependency on tangible rewards, and instead uses virtual rewards associated with progression in the game's narrative through a virtual points system.[23,24]

The program introduces students to a sci-fi narrative that features a group of intergalactic kids known as the F.I.T.s (Field Intensive Trainees). The F.I.T.s need the students at the school to help in their fictional mission to stop the V.A.T.s (Vegetation

Annihilation Team) from destroying all the vegetation in the universe. During their mission to stop the V.A.T.s they encounter barriers, difficulties, and puzzles that they need the student's help negotiating.

The story is presented over the course of 9 weeks in a comic-book, panel type narrative that is visible to children in the school cafeteria each day as they are eating lunch. The intervention consists of an episode of the story being projected on the wall of the cafeteria in a loop. The story becomes interactive as it is communicated to the children that their consumption of FV earns the school FIT points that are then used to earn progression in the narrative. The game is played at the school level, meaning children work together to eat more FV at lunchtime in the cafeteria so that the narrative will progress the next day. When the school meets or exceeds the 60th percentile of FV consumption over the past 10 days, they earn points which are used to progress the narrative. FIT points are redeemed in the story in several other ways including purchasing ship enhancements or items needed to progress in the story and assist the F.I.T.s.[23,24]

The FIT Game program has been implemented in several schools in different phases. The most recent of which focused on reducing costs from previous versions. Previously, teachers were asked to read a narrative each day in their classroom. This was effective however it also caused the intervention to be invasive to the school faculty.[23,24] Instead, the narrative was projected on the cafeteria wall for students to watch. The study was aimed at exploring a reduced cost method. The results of the study showed an increase of vegetable consumption of 100%.[23] Another report on the FIT Game looked at FV consumption three months after intervention. This study showed an increased fruit consumption of 89% and vegetable consumption of 118%.[23]

While successful in increasing FV consumption, researchers have identified that there are still parts of the intervention that could be improved. These areas include further reducing the financial cost and dependency on researchers. The program's success has also not been observed in a school with more than 90% Caucasian diversity.[23,24]

The current study was conducted to investigate these two questions. First, would the FIT Game be as successful in schools with a more diverse student population. Second, if the FIT Game could be implemented in a way that further reduced the cost of the intervention and reduce the need of researcher's direct intervention.

METHODS

Recruitment Strategies

All Title 1 (low income) schools in the Salt Lake City Area were considered to participate in the program. Selection was determined based on student diversity and the schools' overall willingness to participate and adhere to the study design as a researcher would not be on location for much of the intervention. Due to these requirements selection was narrowed down to the Davis and Canyons school districts. For each school that fit the needed criteria the principal was contacted by email asking about their willingness to have their school participate. The email reviewed previous studies' successes and outlined what equipment was needed, what participating in the study would consist of, and that there would be no monetary cost to the school.

The schools selected had the most diverse student populations and a point of contact for each school that would coordinate cooperation with faculty in the school.

Due to the intervention period being 9 weeks long, the time window to implement the intervention was narrow to avoid holiday breaks. The research protocol was reviewed and approved by the USU IRB and received an exempt status due to no individual or identifying information being recorded. All data collected was aggregate data representative of the school as a whole. The school's name (with abbreviation) and diversity are listed below in Table 1.

Table 1. Student Diversity by Percentage for Each Participating School.

School	Caucasian	Hispanic/ Latino	African American	American Indian	Asian	Pacific Islander	Other
Wasatch (WA)	63.00%	30.00%	4.00%	N/A	N/A	N/A	3.00%
Copperview (CV)	30.50%	57.20%	4.00%	1.30%	0.70%	2.70%	3.60%
South Clearfield (SC)	63.00%	23.00%	N/A	N/A	N/A	N/A	24.00%
East Midvale Elementary	43.00%	34.00%	12.00%	N/A	N/A	2.00%	5.00%

Measurement Instruments

Each day, the FIT Game episodes were displayed on the cafeteria wall using a laptop hooked up to a projector with the projection being a minimum of 4m X 4m. Two types of scales were used. A tabletop electronic kitchen scale with 1g increments and a limit of 5kg (Camry; Hong Kong, China) was used to weigh pre-portioned foods and food in bulk. If bulk food weight exceeded the scale's limits the food was divided into smaller portions to obtain the weight. A floor scale with readout accuracy of 170g and upper limit of 200kg (Smart Weigh; China) was used to weigh FV waste at the end of lunch service.

A station was established in each school to collect FV waste. At every station there were two 49.9L plastic trash cans. One trash can was used to collect fruit waste while the other was used to collect vegetable waste. Each trash can was wrapped with a red (fruit) or green (vegetable) vinyl tablecloth as a visual indicator. On the face of each trash can, on top of the tablecloth, was a .5m x 1m poster with the word "FRUITS" or "VEGETABLES" and images of the corresponding foods.

Data Collection Procedures

At all four schools in the study, a local individual was hired to be the on-site "Cafeteria Coordinator". The Cafeteria Coordinator completed the same job responsibilities as the researchers from the previous versions of the FIT Games. They were responsible for displaying the episode of the day on the wall and collecting the weights of FV required each day. It was also in the Cafeteria Coordinator's scope to

send the information back to the researchers daily so that the results could be analyzed, and progression could be determined.

The individual received one-on-one training with a researcher on how to properly weigh all items and direct students in disposing of their fruit and vegetable waste in the correct receptacles. There was a Cafeteria Coordinator present in all schools, with the only difference being no episodes displayed in the control school. The fruits and vegetables to be provided during lunch service were weighed before service in one of two methods to determine the starting weight (SW).

FV that were served in a pre-portioned way such as a bag of sliced apples, a banana, or veggie sticks in a cup, five separate portions would be weighed and averaged to determine the mean weight. This portion weight was then multiplied by all portions served during lunch to determine the correct weights for the consumption equation.

Alternatively, if the FV were being served in bulk, the bulk weight would be weighed before service. With this method, after lunch service, the remaining bulk (un-served portions) would be weighed in the same manner and subtracted from the original weight. This accounts for the pan's weight used to hold the food served and nullified its weight.

During lunch service the Cafeteria Coordinator directed students to dispose of their waste in identified trash receptacles, one for all fruit waste (FW), another for all vegetable waste (VW), and one for all remaining waste. Once lunch service was complete, any food left after service was weighed (AS). Consumption was then determined by the following formula, where waste is replaced with the variable being determined i.e. FW or VW: Consumption = SW – (Waste – AS).

Research Design

Research was conducted in two phases. The first phase was designed to determine the efficacy of the FIT Game in Title 1 (low income) schools with greater than 90% Caucasian diversity. During this time, the progress of the intervention school was recorded to "pre-program" the progress of the remaining schools in phase two. Phase two was designed to assess the efficacy of the FIT Game program when implemented in a lower cost manner. Pre-programing the progression of the story for the remaining schools reduce the need for researchers to be involved daily, lowering the barrier of adoption.

An example of this pre-progression is, if the phase one intervention school met their vegetable goals and progressed in the story on days 3,4, and 5 of the intervention, but then missed their goal on day 6, the following 2 schools would also progress in the story on days 3,4, and 5 regardless of their actual consumption. The pre-programming's purpose was to decrease the intervention's complexity and reduce overall cost.

At each of the four schools there was an 8–10-day period of baseline data collection where no intervention was implemented. During this baseline phase the children followed their typical lunch routine. No changes were made to the offering of FV, but the Cafeteria Coordinator was present and instructed children to dispose of their FV waste into the correct receptables.

During this baseline period the amount of FV served and wasted was collected and recorded. First, it establishes a baseline of consumption to later determine the daily consumption target for progression in the story. Second, this period acclimates the students to the presence of the Cafeteria Coordinator to limit confounding consumption data. Last, this period gives students time to adapt to the methods used

for proper food disposal (i.e. fruit and vegetable waste bins) so that collection during the intervention can be more accurate.

The daily target consumption of vegetables was set at the 60th percentile of the average of the last 10 days of consumption. The daily target changed each day based on the previous 10 days of consumption. The narrative advanced following each day that the children met or exceeded the target. For this study the target was based only on vegetable consumption only. Fruit consumption was also recorded for research purposes but did not contribute to the progression of the narrative.

The previous FIT Game research still had several time intensive and human interaction elements that would contribute to the difficulties of implementing the program. One very time-intensive piece was creating episodes when the target consumption wasn't met. This was addressed by pre-programming the story for phase two. Additionally, FIT points were calculated based on the number of grams over the target that were consumed, this was reduced to incrementing the points in various amounts day to day but keeping the amount of points a rare resource.

Other elements such as which squares to remove in a puzzle or which path to take in the story were also previously determined dynamically with the students interacting with staff or provided mediums. To remove this variability and need for researcher interaction, these choices were made by the researcher that created each episode for the next day. Once these choices were decided they remained consisted across all 3 schools that interacted with the program in both phases.

Phase One. For phase one, two schools were selected based on their availability to start the program as phase one needed to be several weeks into the program before

phase two could start. One school was randomly assigned as the control and another as the intervention group. Both schools were observed for 9 weeks.

After a baseline period of 9 days, a kick-off assembly was held. Researchers were on site to conduct the kickoff assembly. The assembly was used to explain to the students why the F.I.T.s need their school's help and how the school can assist the F.I.T.s in their goals. During this assembly it was made clear that the school, collectively, earned FIT points that could be used in the game and that the story could only progress if the school consumed enough FV daily. Intervention schools were told that they were competing against a fictional school on a different planet. The control school did not receive a kick-off assembly.

The intervention period consisted of 36-days. During this time, the children were not told what the target consumption was, only to consume more each day. If the consumption was not met, the following day was a tailored episode addressed specifically to the school, with the F.I.T.s asking that school by name for more help and to consume more FV.

Phase Two. The remaining two schools were introduced to the FIT Game program with a kick-off assembly in the same manner as the intervention school. Like phase one, the assembly was held at the end of the 9-day baseline period. However, during phase two, the narrative for both schools was not determined by their FV consumption. The narrative advanced according to the schedule set by the phase one school, previously recorded. The children and faculty were not informed that the narrative was pre-programmed but instead were told the same information as all previous schools, that their FV consumption assisted the F.I.T.s and to eat a little bit more FV each day.

Statistical Analysis

Data was collected and analyzed using the Simulation Modeling Analysis (SMA*)*. The SMA model was used because it is specifically targeted at short time series data (n <30) while protecting against type-1 and type-2 errors. The process bootstraps the original values a minimum of 5000 times. Bootstrapping generates a new dataset based on the original by randomly selecting values with replacement. Descriptive results were obtained including mean and 95% Confidence Interval (C.I.) values. To control the variation in weight between different portions of fruits or vegetables, the data collected was evaluated by the percentage of food consumed with the following equation. The unit of measurement was calculated as follows: percentage of food consumed = ((weight of FV served) - (weight of food wasted after children are finished eating))/ weight of FV served.

Where weight of food provided was BW (beginning weight) and subtracting the amount of food remaining at the end of service. Only one data point (consumption of food served) was collected per day per school. With one data point of aggerate consumption per day p-values were not determined.

RESULTS

The FIT Game intervention has a target goal of the consumption meeting or exceeding the 60^{th} percentile of the previous ten days. To this end, the amount of consumption is expected to gradually increase over the intervention. This indicates the most substantial increase in consumption would be at the end of the intervention. The last x number days of intervention were used to compare against baseline data where x is the number of days baseline data was collected for. In all the schools, x is

9; however, if the baseline was 10 days, the number of days at the end of intervention analyzed would also be 10.

Phase One

During phase one, the control school's (E.M.E.) baseline fruit consumption was 41.25% (95% C.I. 29.06% - 54.82%) of fruit served during baseline and decreased to 36.73% (95% C.I. 31.36% - 41.86%) of fruit severed at the end of the 36-day observation period. Vegetable consumption was 49.21% (95% C.I. 37.21% - 61.25%) of vegetables served during baseline and was 47.14% (95% C.I. 41.47% - 52.78%) of vegetables served at the end of the 36-day observation period.

For the intervention school (CV) of phase one, fruit consumption during baseline was 53.41% (95% C.I. 35.66% - 59.59%) Fruit consumption at the end of the 36-day intervention was 41.94% (95% C.I. 32.94% - 49.58%). Vegetable consumption shifted from 48.11% (95% C.I. 35.65% - 59.31%) during baseline to 54.57% (95% C.I. 45.91% - 62.31%) at the end of the intervention.

Menu days were matched during baseline and intervention days, and this allowed the opportunity to assess differences in the percent consumption of individual vegetables. For the original intervention school (CV), five (5) vegetables were served during baseline and at the end of the intervention in an identical manner. Percent consumption increased (48.55% – 75.47%) for each of the five individual vegetables (table 2).

Table 2. Comparison of Matched Vegetables During Phase One Between Baseline and Intervention.

Vegetable	Baseline	Intervention	Percent of increase	Value 1	Value 2	Mean
Veggie Sticks	29.07%*	56.35%	93.84%	32.57%	25.57%	29.07%
Broccoli	15.86%	75.47%	375.85%			
Green Salad	4.80%	48.55%*	911.46%	61.82%	35.29%	48.56%
Cucumbers	50.80%	63.11%	24.23%			
Raw Carrots	38.63%	57.34%	48.43%			
	* = is calculated mean from two data points during that period					

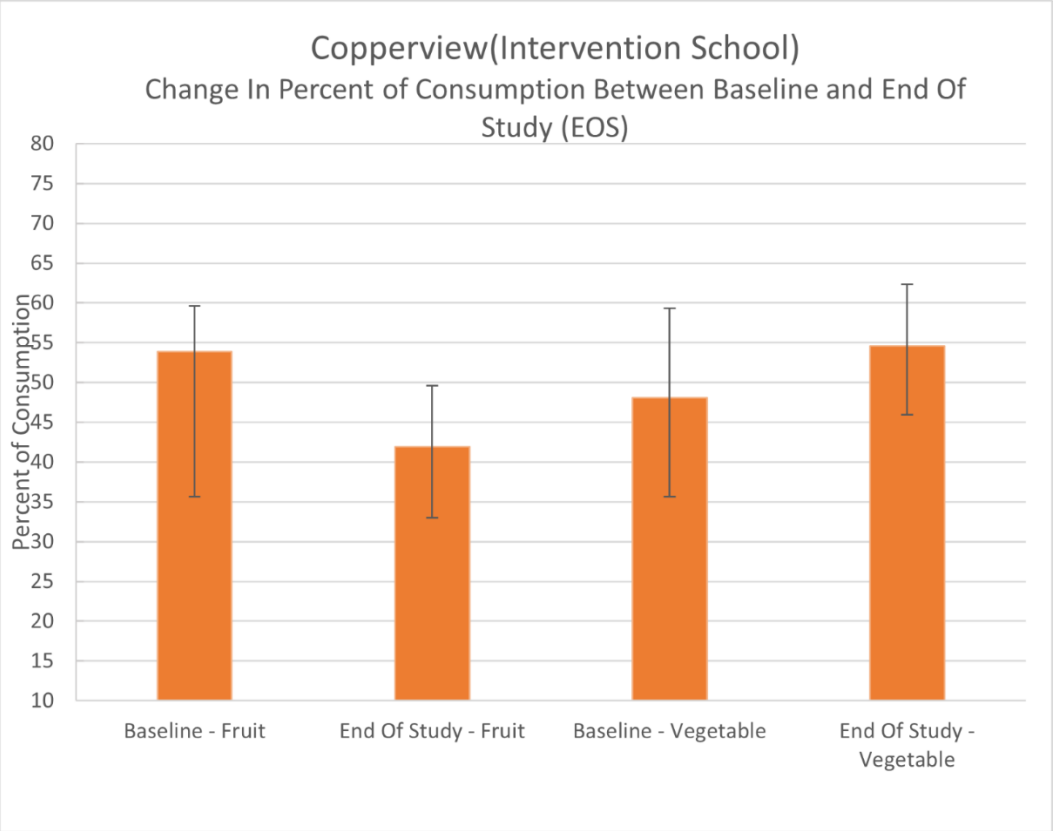

Figure 1. Intervention School Consumption Change Between Baseline and End of Study.

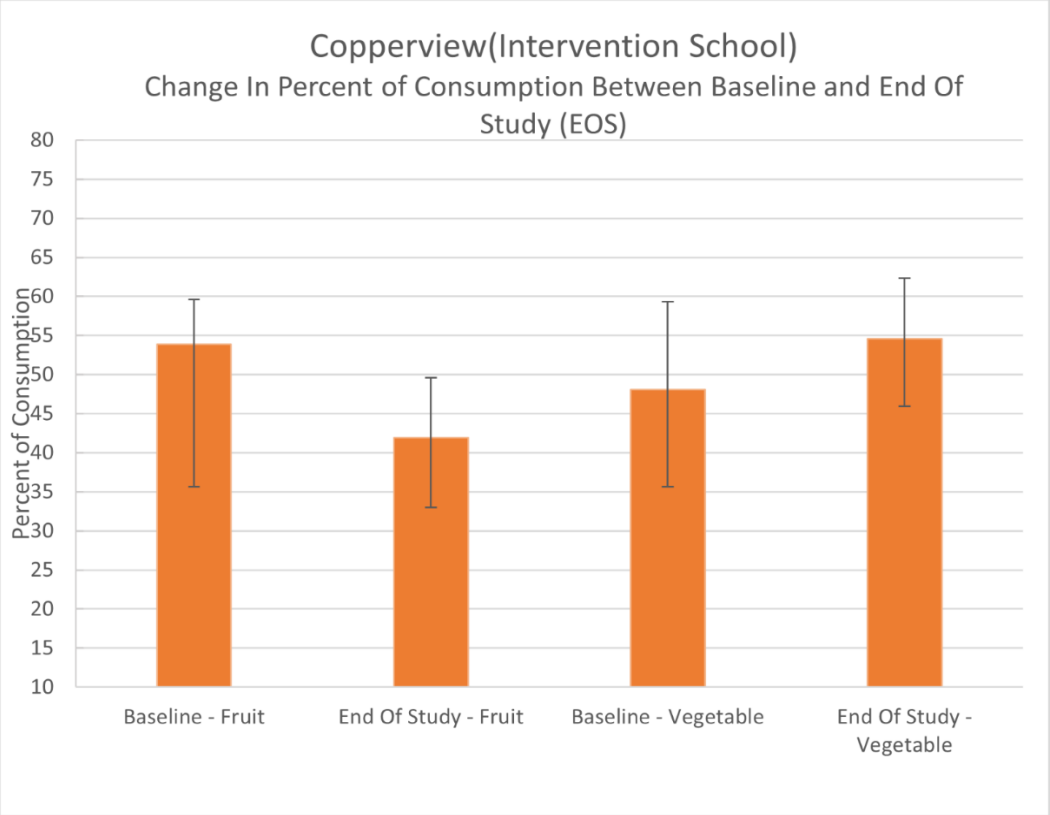

Figure 2. Control School Consumption Change Between Baseline and End of Study.

Phase Two

In phase two the progression of the game was pre-programmed. Progress mirrored the progress of phase one intervention school. In the first school (S.C.) the baseline (n=9) fruit mean consumption was 64.58% (95% C.I. 58.33% - 70.42%) and increased to 66.39% (95% C.I. 59.74% - 73.23%) at the end of the intervention period. Vegetable consumption increased from 38.98% (95% C.I. 20.02% - 48.26%) at baseline to 45.65% (95% C.I. 38.34% - 52.43%) after the intervention.

The second school in phase two (WA) had a baseline collection of nine days. Mean fruit consumption increased from 39.58% (95% C.I. 28.20% - 51.70%) to 50.76% (95% C.I. 38.30% - 62.42%) after intervention. Vegetable consumption also

increased from 47.26% (95% C.I.31.12% - 63.16%) to 66.32% (95% C.I. 60.65% - 72.06%) at the end of the intervention. Both schools' intervention period was 27 days. Despite the goal of identically mirroring the progress of the original intervention school, the program had to be shorted to 27 days account for extended weekends and a long holiday break.

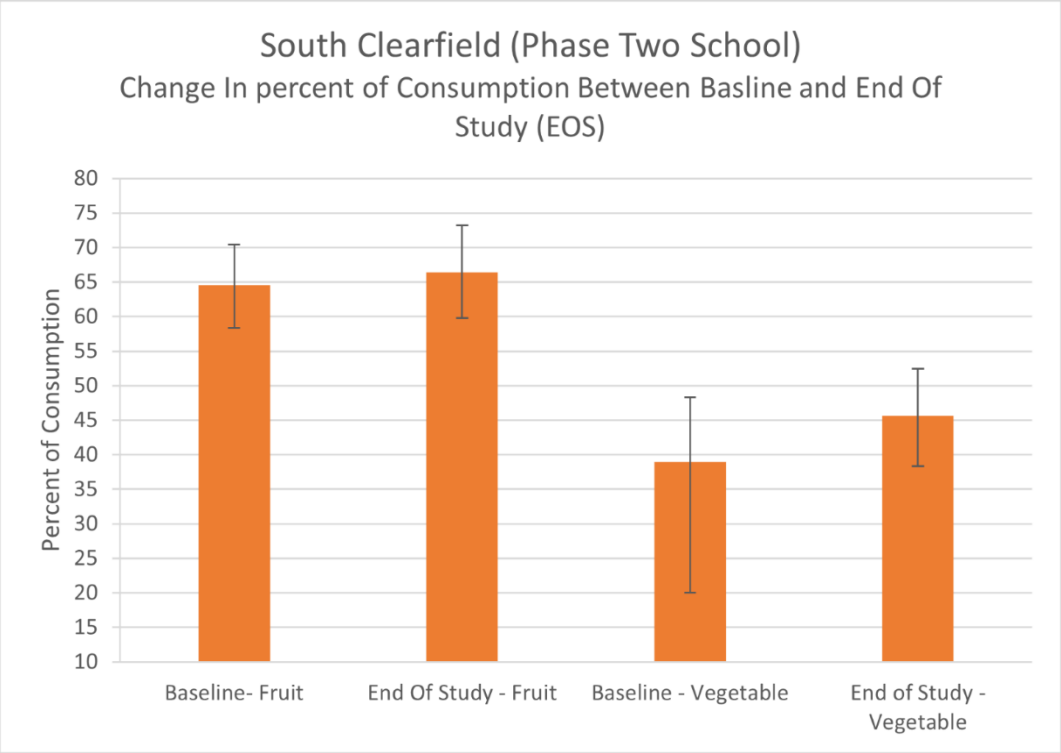

Figure 3. Phase 2, School 1, Consumption Change Between Baseline and End of Study.

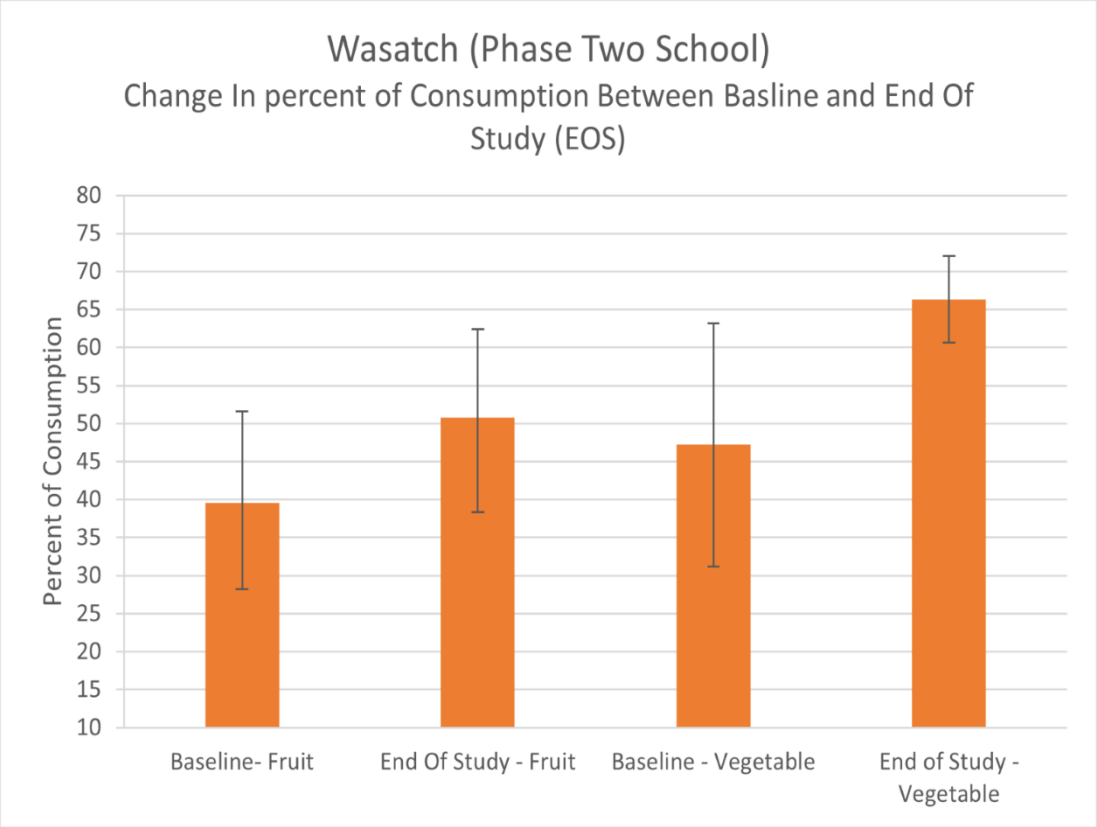

Figure 4. Phase 2, School 2, Consumption Change Between Baseline and End of Study.

DISCUSSION

For phase one results, the intervention school had an increase of mean fruit (+1.28%) and vegetable (+13.43%) consumption over baseline. A decrease in fruit (-10.96%) and vegetable (-4.21%) consumption was observed in the control school during the same time. These results are consistent with several other gamification interventions which demonstrated the effectiveness of the intervention against a control in schools where the game was administrated by research personnel and that had relatively low socioeconomic or racial diversity.[18,23,25] This mimics, with more conservative results, what was seen in the most recent iteration of the FIT Game,

research reported an increase of 69% and 181% consumption when the intervention was present and a decrease in consumption when the intervention was not present.[23]

The results of Phase one of this study was similar to previous FIT Game studies suggesting that the intervention increased FV consumption in schools with greater diversity. However, an important note is the inability to determine if the increase is statistically significant due to the limitations of the data collection process. Therefore p-values were not determined and instead 95% C.I. were utilized. It is important to note that C.I. does not indicate the same thing as a p-value but only indicates the range in which the true mean would be present.[26] While the C.I. indicates where the true mean is, a p-value indicates the probability that the results were due to something besides the intervention. Due to this difference, it can not be said that any results in this study were statically significant or directly due to the intervention since a p-value was not calculated.

In Phase two of the study, where the game was pre-programmed according to the results observed in phase I, FV consumption increased in both schools. Vegetable consumption had the largest increase with SC increasing by +17.11% and WA increasing vegetable consumption by +40.33%. With phase two results mirroring that of phase one and the previous FIT Game, it indicates that the pre-programmed version of the FIT Game can successfully increase FV intake with reduced resources.[23] These findings should be further investigated as to why there was an increase despite their progression through the story being detached from their personal progress. These findings raise further questions. Perhaps the children participating in this study were too young to understand their contribution to the overall group or if this pattern would be seen in other groups too.

It is uncertain how the accelerated rate of the FIT Game intervention affected the results. To reduce the length of the story, key story elements and decisions were kept, but episodes with repetitive themes (such as being stuck at a puzzle for 3 days) were removed. In total 8 days were removed from the phase two schools compared to the length of the story in the phase one schools.

An unanticipated confounder of data collection was the presence of a "salad bar" or self-serve options for cold fruits and vegetables that was present in all schools. Salad bars affected the portion sizes each student consumed since a student would be able to take double, or more, the amount anticipated and waste a larger portion if it wasn't consumed as compared to pre-portioned and non-self-serve options. It has also been indicated that more food is wasted when there is a self-serve option, and raw vegetables are often uneaten and wasted more than cooked vegetables.[28–30,31] This confounder also impacted the data that was collected. Since the results were calculated as the percentage of food provided that was consumed, unnecessary waste would impact the percentage, and in turn, the C.I., and cause wider variation from day to day.

Another limitation of the study was the presence of inherent waste. Food such as bananas or apples have inherent waste, like the peel and core that are not consumed. This introduces another confounder where even when 100% of the edible portion is consumed, there is waste produced and in turn, we would not see 100% consumption in our calculations. This confounder has been addressed in other studies with their suggestion being to calculate and subtract the amount of inherent waste from the data. [27,28] This calculation proved difficult given the self-serve option at some schools and the study being focused on reducing data processing from day to day. Due to this confounder the data was observed as percent of food served

consumed and did not analyze portion sizes. Along with these limitations there were inherent limitations in the study design that were unavoidable. The study was targeted at observing the FIT Game implemented in a low burden method which in turn reduced what could be measured and how. For example, this removed the ability to analyze waste on a per student basis since this would increase the burden of the intervention.

This study had 3 key strengths contributing to its success in implementation. Firstly, it provided a "proof of concept" for the FIT Game being effective in schools with more diverse student populations. Secondly it provided the groundwork and validated the approach to implement the FIT Game program in a lower cost manner. Lastly, the way in which data was collected and analyzed was chosen specifically due to the design of the study. The waste weight method was used as it allowed the Cafeteria Coordinator the best way to accurately collect data while also being the least demanding to implement. Assessing consumption based on total amount of food served, that was consumed, as a percentage was selected to account for inherent waste (peels, pits, portion cups etc.) and the variations in portion size weights from day to day. This gave the ability to assess the consumption from a day serving green salad to a day serving steamed broccoli objectively, despite the two foods having vastly different weights.

IMPLICATIONS FOR RESEARCH AND PRACTICE

This study identified several possible confounders in implementing the FIT Game in a more "hands-off" approach. It also provided evidence to support that the FIT Game program may be effective in schools with a larger portion of diversity, and

in a lower cost manner with only one individual on premise to present the episode and collect waste.

While the FIT Game program increased consumption, previous studies showed that consumption decreased after the program ended.[24] With the success of implementing the program in an easier way, researchers could investigate designing the FIT Game to be reoccurring over the course of the school year. Another avenue researchers could take is identifying a way to account for inherent waste and self-serve portions and continue to observe the FIT Games' effect in schools with more accurate data collection such as collecting additional data points or using a more direct data collection method.

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CHAPTER 3

EXPLORING CONSUMPTION INTERVENTION'S AFFECT ON FOOD WASTE

ABSTRACT

Objective: To investigates the impact the potential impact of FV consumption interventions (including the FIT Game) on FV waste in schools.

Design: A two-phase intervention using the FIT Game, a narrative gamification approach, was implemented in four Salt Lake City schools. Waste measurement techniques and the Simulation Modeling Analysis (SMA) method were used for data analysis.

Setting: Four elementary schools in Salt Lake City area.

Participants: Students from four schools participated, with diversity > 90% Caucasian.

Intervention: Interactive comic-book style narrative presented to elementary school children during lunch service over the course of 9 weeks.

Main Outcome Measure(s): The study focused on measuring FV waste, utilizing waste weight methods and SMA for analysis.

Analysis: Data analysis involved the SMA method, with a focus on short time series data and percentage calculations of FV consumption and waste.

Results: In the first phase, the intervention school showed increased vegetable consumption and decreased vegetable waste but increased fruit waste. In the second phase, both schools demonstrated decreases in fruit and vegetable waste.

Conclusions and Implications: The research indicates that interventions like the FIT Game can influence FV waste patterns in schools. While there were increases in

vegetable consumption, they were accompanied by increases in fruit waste, suggesting a trade-off. These findings emphasize the importance of considering both consumption and waste in school-based nutrition interventions.

INTRODUCTION

Fruit and Vegetable (FV) consumption is shown to reduce the chances of developing chronic diseases such as cardiovascular disease, diabetes, hypertension, and kidney disease.[1–4] Despite these benefits, children do not consume enough FV, 1 in 3 children do not consume fruit daily, and 1 in 2 do not consume a daily vegetable.[5,6] This lack of FV consumption exposes children to the chronic diseases that FV protect against such as cardiovascular disease, stroke, cancer, and obesity.[7,8] The CDC reported, between 2017 – 2020, 18.9% of children were obese.[4,6,7,9]

Knowing how beneficial FV consumption can be in preventing chronic disease, it is important to find ways to incentivize children's consumption. A promising avenue includes incentivizing children to consume more FV.[10–12] Schools provide up to 50% of children's caloric intake. Therefore, schools provide an attractive platform for intervention to take place while also having the potential to influence eating habits.[12–16]

However, a common issue with school lunch programs is the amount of food waste that is produced. Food waste, especially fruits and vegetables, indicates that students are consuming fewer nutrients than needed such as vitamin A, D, and Iron.[17] The amount of consumable food waste produced by school programs has been recorded by some sources in the range of 21%-45%.[18] While other sources ranging as high as 73.3%.[19–21] The largest portion of this waste typically being vegetables, with fruits being second.[17,19,22]

This is a large social and economic concern as this contributes to the 133 billion pounds of consumable waste that the US produced in 2012.[19] In another metric, this was calculated to cost $161 Billion.[19] This excess waste from the school system is an unnecessary strain on the entire food chain including water and land used

to grow foods, transportation to school, preparation, and disposal of consumable food.[13,15,19]

The school system has been identified as an opportunity to reduce the overall waste produced by the U.S. As such, there have been several interventions researching ways to reduce school food waste.[15,19,23,24] Studies have been conducted targeting the reduction of waste produced such as increased training for staff[19] , providing tasting spoons[23], and more direct intervention methods such as the “Brighter Bites” intervention.[25]

While these studies were successful in reducing waste; their primary target was reducing school food waste, and there is little research looking at FV consumption interventions and their impact on waste. One FV consumption intervention of note is the FIT Game intervention which has shown several examples of promising success.[12] The FIT Game intervention is an interactive narrative that uses aspects of gamification methods, such as providing virtual rewards, to increase FV consumption.[12,26,27] The narrative is told by presenting episodes of the story to students daily, projected on the cafeteria wall. The Fit Game Healthy Eating Program has shown repeated success in incentivizing FV consumption in school age children.[12,16] In one study the Fit Game Program showed an increase of vegetable consumption by 100%[12] while another study of the intervention showed an increase fruit consumption of 89% and vegetable consumption of 118% three months after the intervention.[16]

Similar to the waste intervention studies however, the FIT Game targets increasing consumption and does not monitor the effects on FV waste. Therefore, this paper's objective is to investigate the effects of FV consumption interventions on consumable FV waste.

METHODS

The FIT Games

The FIT Game Healthy Eating Program tells the story of an intergalactic team of kids known as the Field Intensive Trainees (F.I.T.s). Their mission is to traverse obstacles, barriers, and puzzles in their attempt to stop the Vegetation Annihilation Team (V.A.T.s) who are trying to destroy all the vegetation in the universe.

The story is a comic book-like panel narrative presented in daily episodes over 9 weeks. These episodes are projected on the cafeteria wall on a loop during the lunch service so that everyone can see the full episode. It's communicated to the children that their consumption of FV is what aids the F.I.T.s in their mission against the V.A.T.s and to incentives that consumption. The episodes act as a virtual token/reward to the children. Each day that the children consume the target amount of FV (the target is typically unknown to the children) they are rewarded with the next episode. However, if they miss the target they get a personalized message for the F.I.T.s asking the children to keep helping and consume a bit more fruits and vegetables each day. Similar to previously mentioned studies, while these interventions showed substantial success in incentivizing FV consumption an objective not analyzed was if the intervention had any effect on waste.

In the Fall of 2018, The Fit Game Program intervention was conducted in four Salt Lake City Schools to investigate two research questions. The aim of the research was to first assess the efficacy of the FIT Game Healthy Eating Program in schools with diversity > 90% Caucasian. The second was to observe the effect of the FIT Game Program on FV waste during intervention. The program implementation is

explained in detail in a separate paper. However, a brief overview is needed to understand the methods and assessments used to analyze FV Waste.

The study was conducted in two phases, the first phase was to observe the efficacy of implementing the Fit Game Program in elementary schools with diversity >90% Caucasian. Two schools were recruited, with one school being the control and the other receiving the intervention. Both schools had FV consumption data collected to assess the success of the intervention compared to the control. Phase one was also used to "pre-program" the progress of the schools in phase two. This pre-programmed progression of the story was recorded and used to determine if the Fit Game Program could be implemented in subsequent schools in lower cost, less researcher interactive way.

Two schools were recruited to participate in phase two. During this phase the progression, unknown to the students and staff, was already determined based on how the intervention school in phase one progressed. An example of this is, if the phase one school meet their target on day 2, 3, and 4, but then failed to meet their target on day 5, the phase two schools would get episodes reflecting that they meet their goal on days 2, 3, and 4, but missed their goal on day 5, regardless of their actual consumption.

To conduct research at each school a local community member was hired to act as the "Cafeteria Coordinator". The Cafeteria Coordinator was tasked with preparing the collection point, setting up and displaying the daily episode, collecting daily FV weights, and relaying this data back to the research team for analysis and progress tracking. The coordinator received specialized training from a researcher on accurate weighing procedures and guiding students to dispose of their fruit and

vegetable waste into the appropriate bins. While there was a coordinator at each school, the position at the control school differed as there were no episodes to display.

Waste Collection Process

To determine consumption, the waste weight method was used.[28] For this method the food that would be served that day was weighed, once it was prepared, by the Cafeteria Coordinator before service, to the nearest gram (g). After service, all food that was returned to the kitchen (unserved) was weighed. This weight was then subtracted from the original weight. The result from this subtraction represented the actual served weight (ASW).

Two types of scales were used for data collection, a tabletop scale and a floor scale. To measure consumable food before and after service, a tabletop electronic kitchen scale from Camry (Hong Kong, China), with a 1g increment and a 5kg maximum, was employed. When the weight of the bulk food exceeded the scale's capacity, the food was separated into smaller quantities and weighed.

To weigh bulk foods, the food was weighed before and after service in the same container, this removes the weight of the container from the served weight. If the food being served was pre-portioned, five (5) separate portions would be weighed and averaged. This weight would then be multiplied by the number of units that were portioned. This same weight was then multiplied by the number of units returned after lunch.

To weigh the FV waste after lunch service a floor scale from Smart Weigh (China), with a 170g accuracy and a 200kg maximum limit, was used. This was located at a collection station where all students disposed of their waste. There was a collection station set up in each school which included two 49.9L plastic bins - one

for fruit waste and the other for vegetable waste. To aid in differentiation, the bins were covered with vinyl tablecloths, red for fruit and green for vegetable waste. Each bin was labeled with a0.5m x 1m posters indicating “FRUITS” or “VEGETABLES”, accompanied by images of these food items. In addition, there was a third 55g bin for remaining trash. The Cafeteria Coordinator was located at the collection station during lunch to ensure plate waste was disposed of in the correct locations.

During lunch service the Cafeteria Coordinator directed students to dispose of their waste in identified trash receptacles, one for all fruit waste (FW), another for all vegetable waste (VW), and one for all remaining waste. Once lunch service was complete, any food left after service was weighed (AS). Consumption was then determined by the following formula, where waste is replaced with the variable being determined i.e. FW or VW: Consumption = SW – (Waste – AS).

Game Progression and Analysis

Consumption data was calculated and used to determine the future consumption target. The target was determined based on the 60th percentile of the last 10 days of FV consumption. There was a target determined for both fruits and vegetables separately however, only the vegetable consumption was used to assess story progression. This target was only used in phase one since the schools in phase two progressed at the pre-programmed pace. The amount of waste for any given day was the complement percent of the consumption.

The Simulation Modeling Analysis (SMA) method was used to analyze the collected data. The SMA method was developed to analyze short time series data ($n<30$). This method uses bootstrapping with resampling to create a minimum of 5000 sets of new data points while protecting against type-1 and type-2 errors.[12,29,30]

The consumption data was analyzed with this method and the waste results reported are determined based on the SMA calculated consumption data.

10,000 sets of new data points were calculated when consumption was analyzed with the SMA method. Descriptive results were used which included mean and 95% Confidence Interval (C.I.). To control for the variance in weight of fruits and vegetables consumption and waste, consumption and waste were turned into percentages of the food served for that day using the following equation: percentage of food consumed = (weight of food wasted after children finished eating)/ weight of total FV served.

Due to this percentage calculation, p-values were not obtained. However, using the percentage of food consumed (or waste) accounts for fluctuations in number of children eating lunch since if fewer children eat lunch on a specific day, there will be less total food served.

RESULTS

Phase One

During phase one the control school (EME) was observed for 45 days. This was to mirror the same length of time the intervention school was observed, a baseline period of 9 days and a 36-day intervention period. During the baseline period (9 days) fruit waste was 34.9kg (58.75%) while vegetable waste was 2.48kg (50.79%). Waste at the end of the 36-day intervention (length of the intervention school's intervention period) was 44.25kg (64.53%) for fruits and 2.65kg (52.92%) for vegetables. This is an increase of 26.77% (9.35 kg) for fruit waste and 6.75% (.17kg) for vegetables.

Waste during the baseline period for the intervention school (CV) was 15.99kg (46.59%) for fruits and 2.54kg (51.89%) for vegetables. At the end of the intervention period fruit waste was 21.34kg (55.81%) and vegetable waste was 2.25kg (44.82%). This represents a 33.44% (5.35kg) increase in fruit waste and a decrease of 11.51% (0.28kg) for vegetable waste.

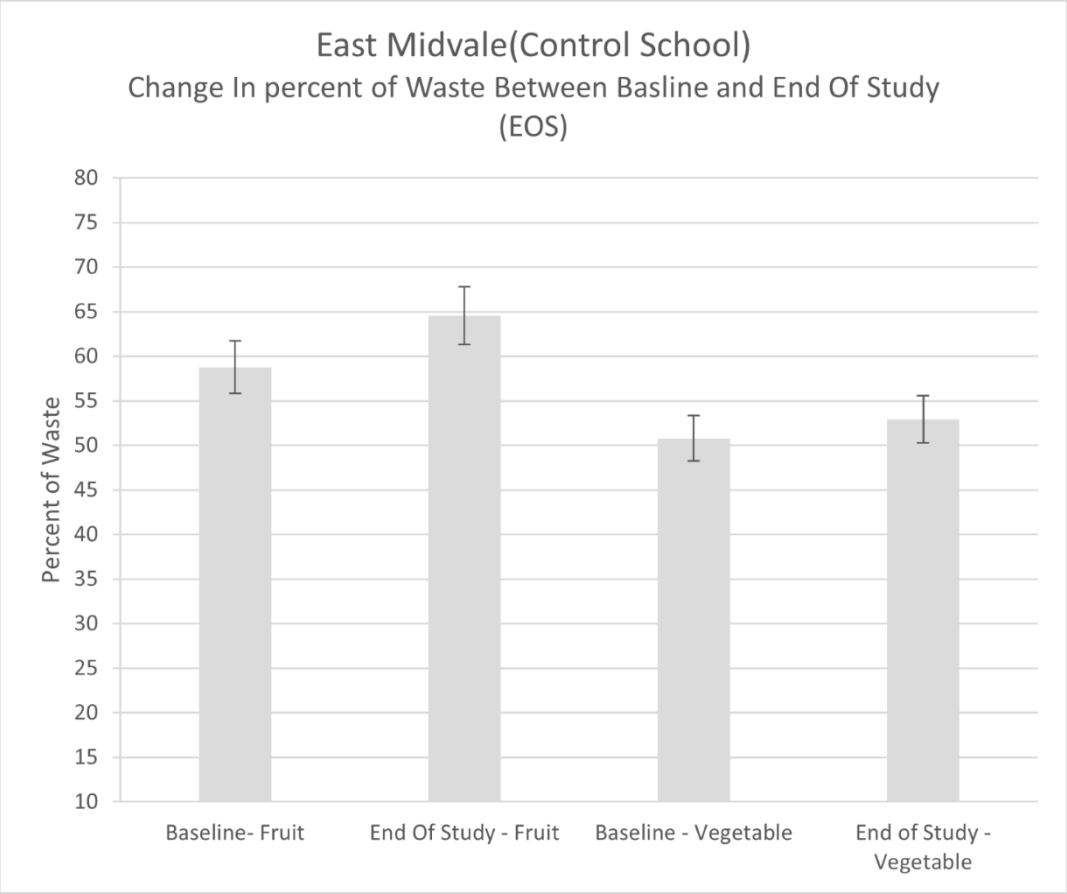

Figure 1. Control School Waste Between Baseline and End of Study.

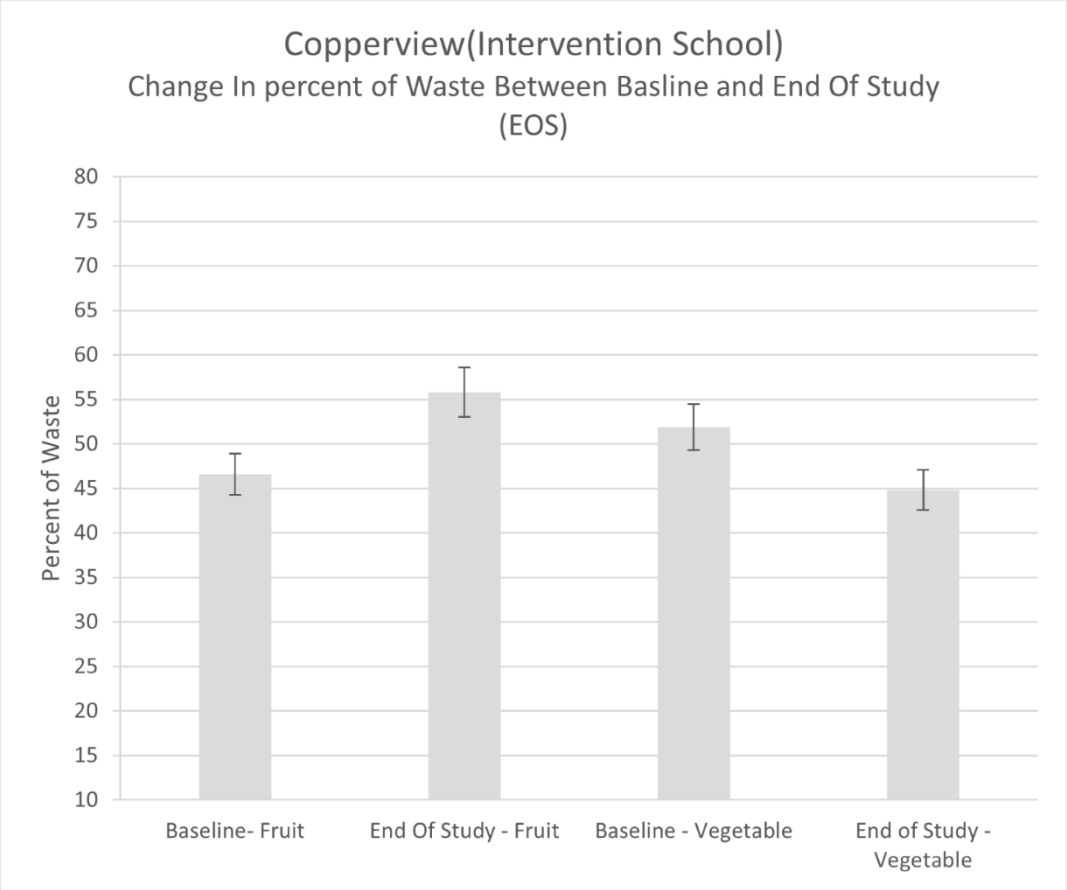

Figure 2. Intervention School Waste Between Baseline and End of Study.

Phase Two

For phase two, both schools were observed for the same length of time of 38 days (9 days of baseline data collection and a 29-day intervention period). During baseline, the first school for phase two (SCE) fruit waste was 18.56kg (35.42%) and vegetable waste of 6.14kg (61.03%). At the end of the 29-day intervention period, the fruit waste was 15.10kg (33.85%) and vegetable waste was 4.44kg (51.29%). This is a decrease in fruit waste of 18.64% (3.46kg) and a decrease in vegetable waste of 27.74% (1.70kg).

The second school during this phase (WA) had a baseline fruit waste of 17.36kg (60.42%) and a vegetable waste of 7.28kg (52.74%). At the end of

intervention, the recorded fruit waste was 13.93kg (47.08%) and vegetable waste was 4.99kg (34.25%). This is a total decrease in fruit waste of 19.77% (3.43kg) and vegetable waste of 31.48% (2.29kg). All consumption data is displayed in figures 6-9.

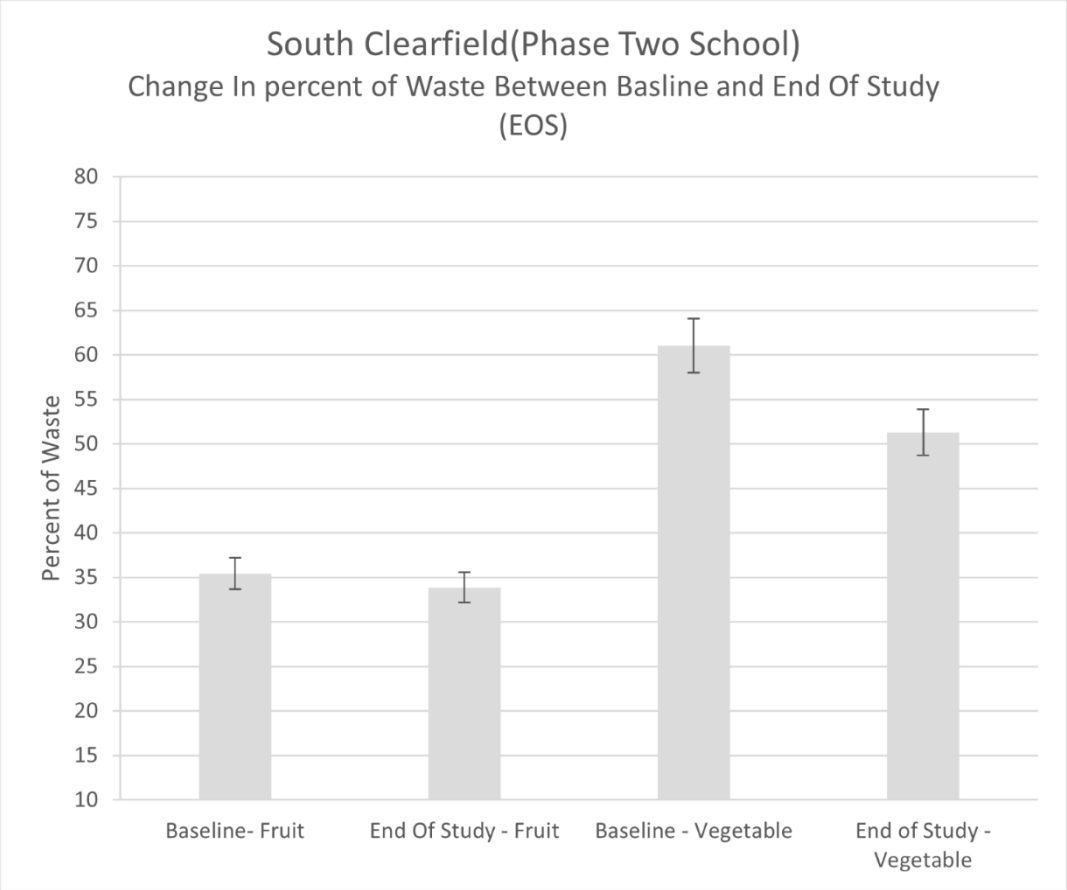

Figure 3. Phase 2, School 1, Waste Between Baseline and End of Study.

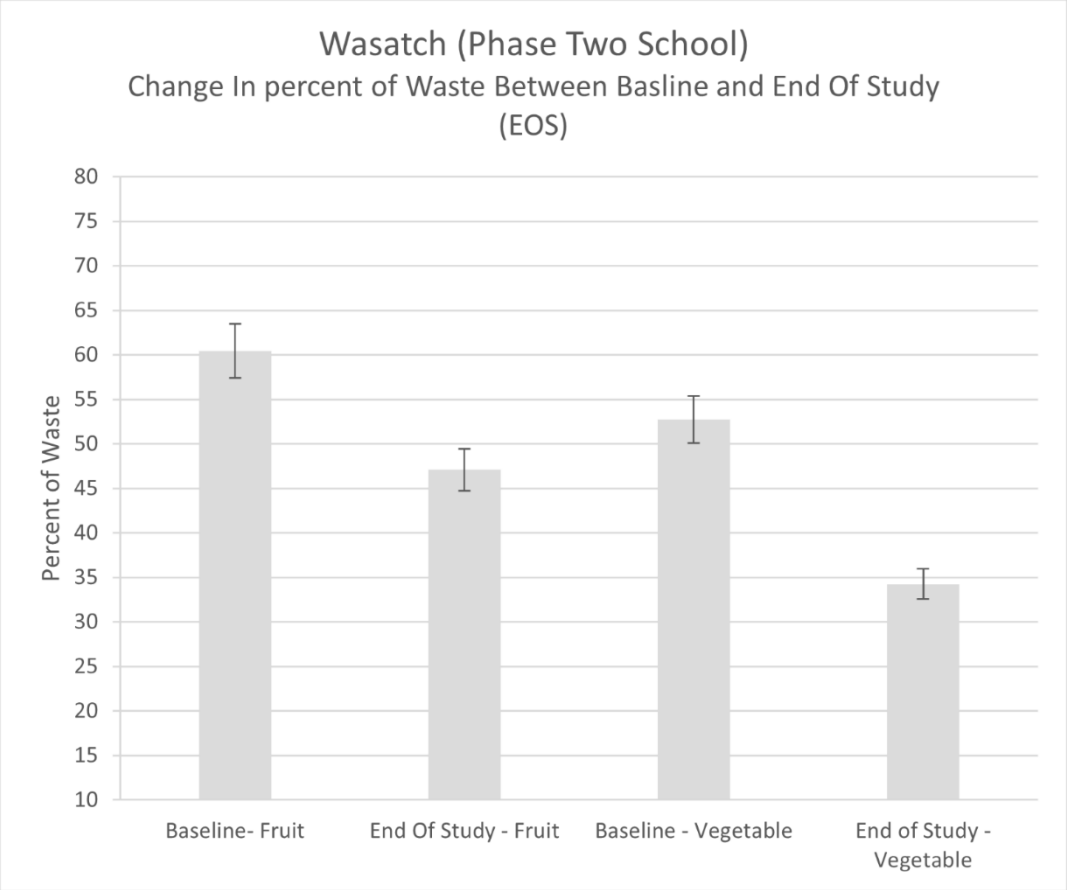

Figure 4. Phase 2, School 2, Waste Between Baseline and End of Study.

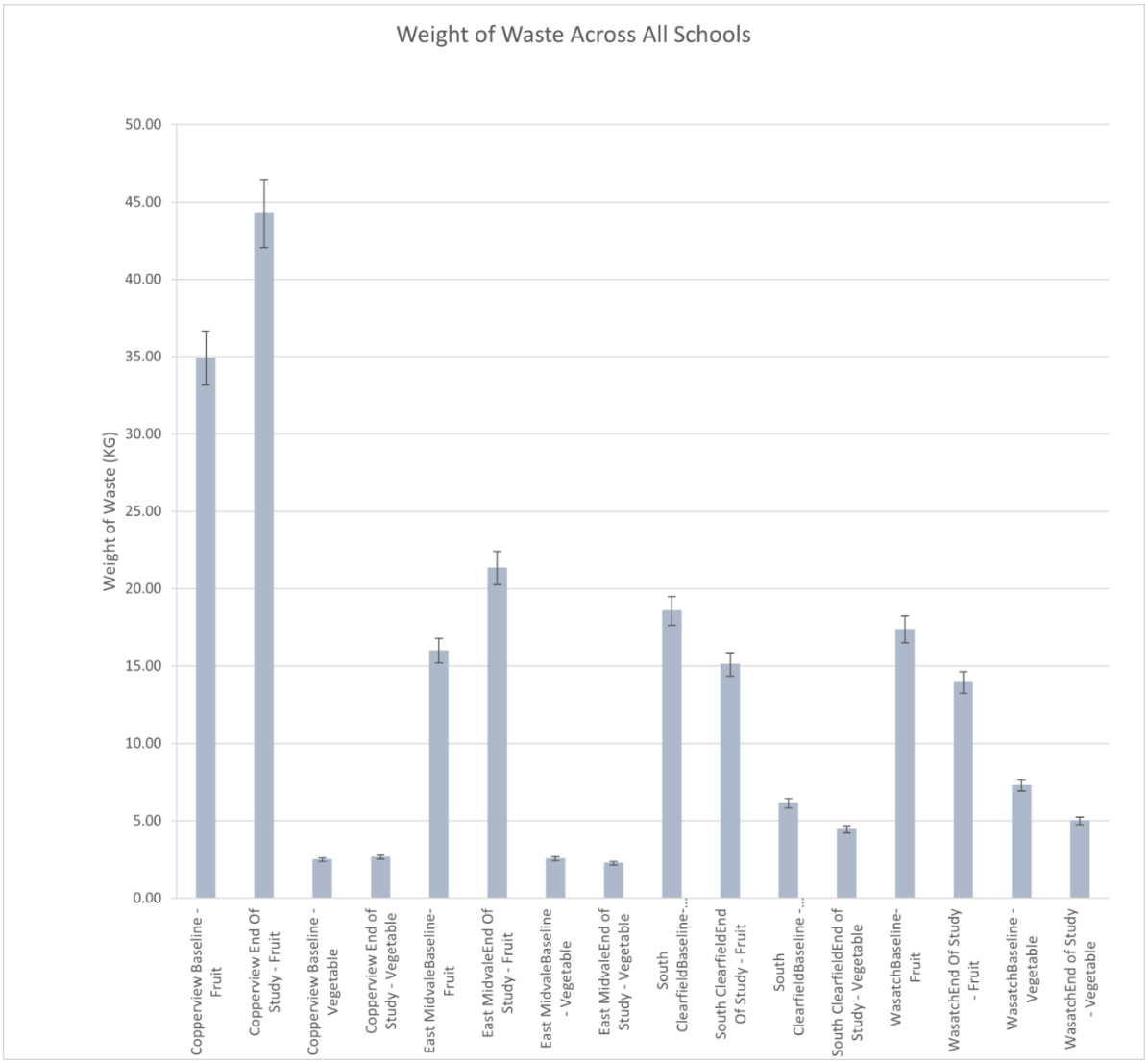

Figure 5. Weight of Waste in KG Across All Phases and Schools.

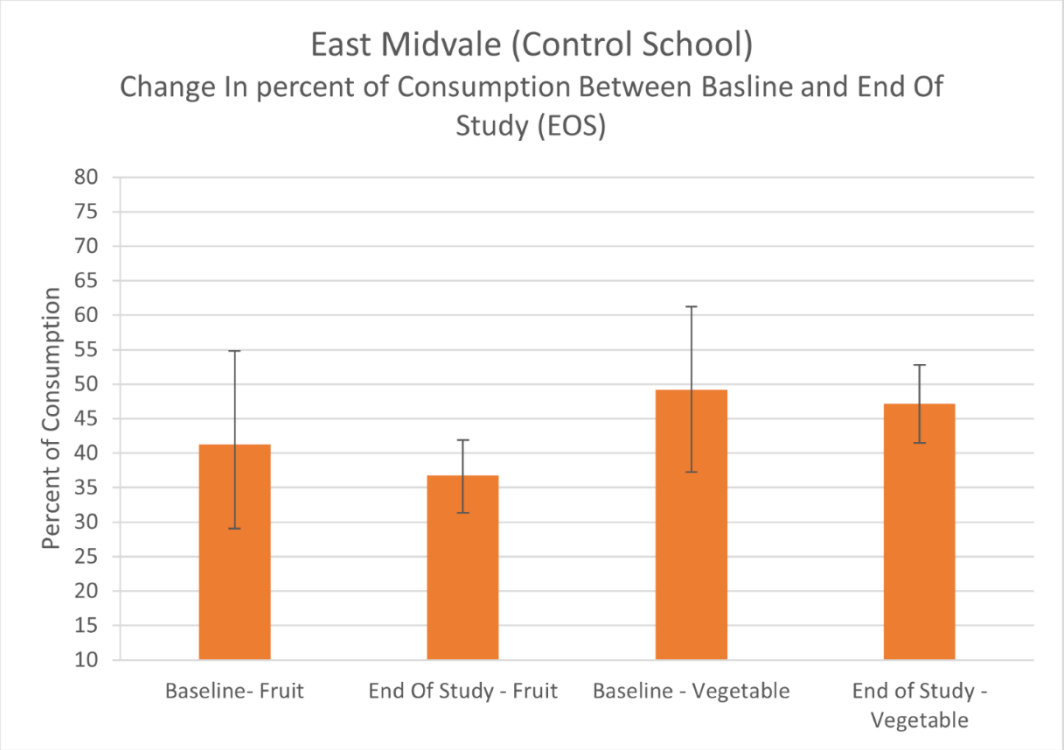

Figure 6. Control School Consumption Change Between Baseline and End of Study.

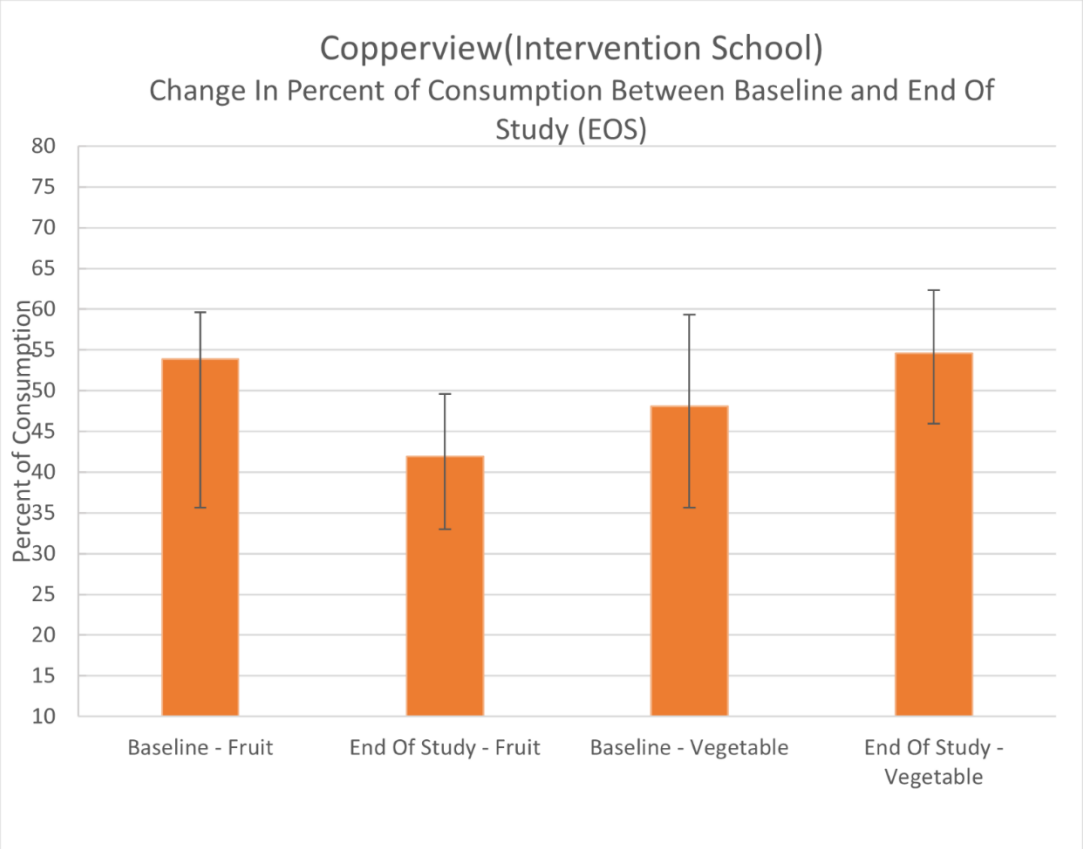

Figure 7. Control School Consumption Change Between Baseline and End of Study.

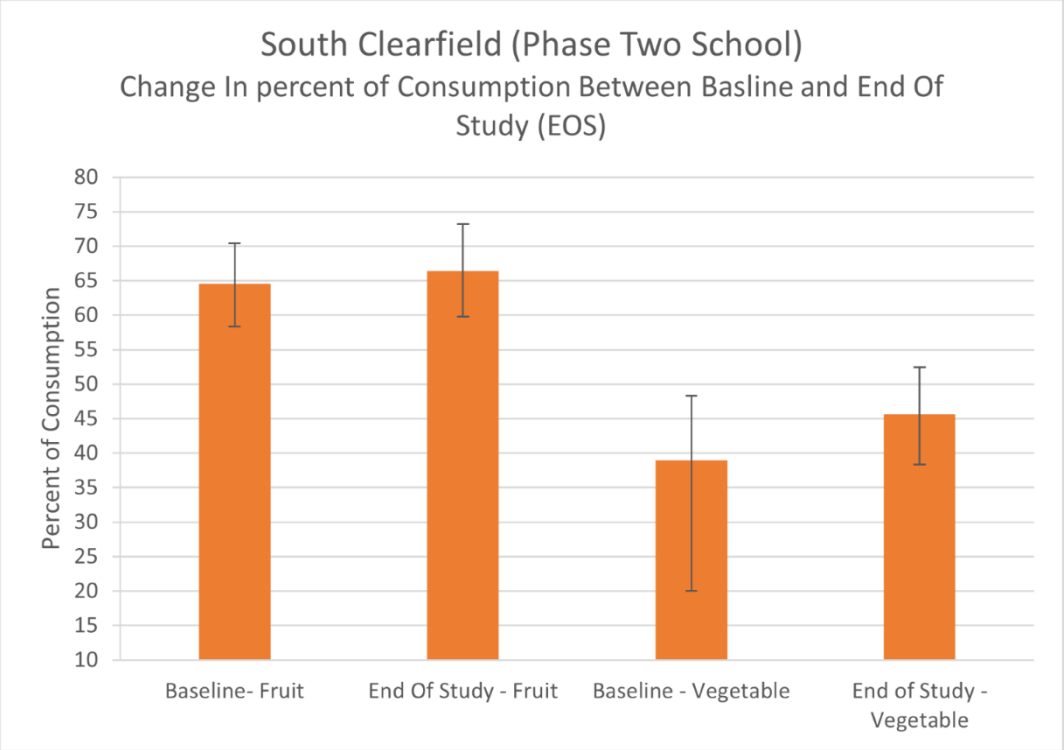

Figure 8. Phase 2, School 1, Consumption Change Between Baseline and End of Study.

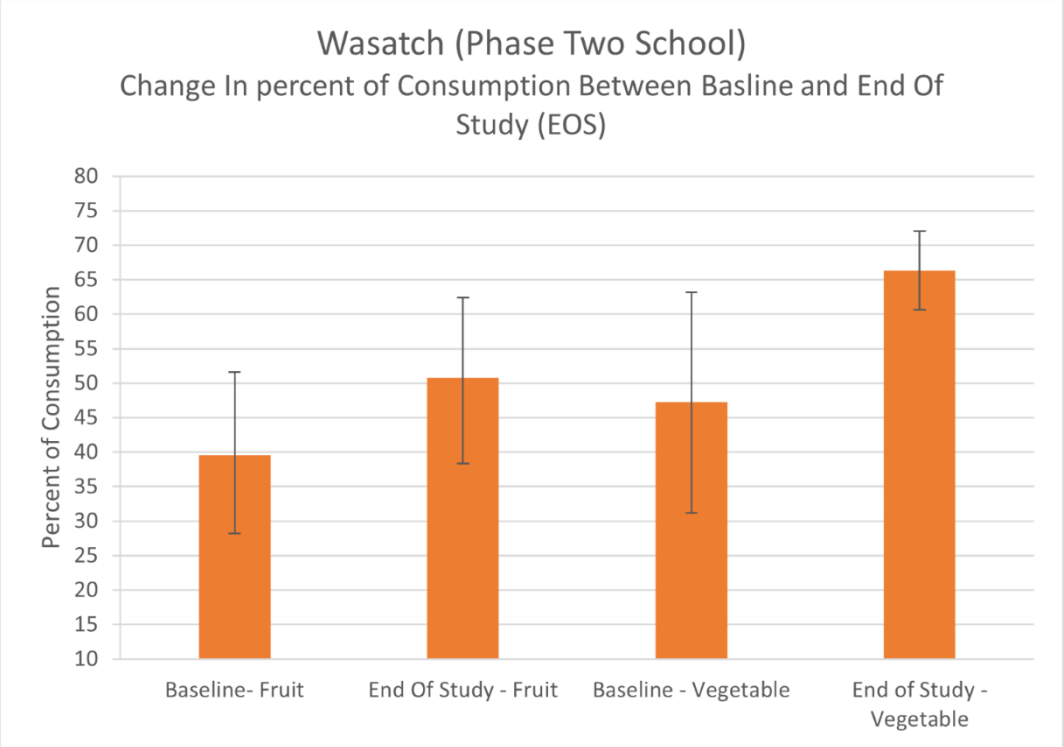

Figure 9. Phase 2, School 1, Consumption Change Between Baseline and End of Study.

DISCUSSION

For each school, the waste produced followed the inverse trend of consumption. When consumption goes up for a food group, the waste produced for that group decreases. The opposite is seen as well when consumption goes down, the waste produced increases. When considering intervention's effect on the waste produced, these results support that consumption interventions do affect waste. What is of note, however, is the effect on consumption and waste for a school as a whole.

When looking at the intervention school (CV), there was a decrease of vegetable waste of 11.15%. This is correlated with an increase in vegetable consumption of 14.70% (see table 2). When this change is considered in isolation this is a positive outcome and the intervention was a success. In the consumption study, vegetable consumption was the only target used to progress through the story and determine success in increasing consumption; fruit was observed for thoroughness but did not affect story progression. The students did not know this, so there should be no effect on which foods they ate more of. They were also able to progress through the story without increasing fruit consumption.

However, when looking at fruit and vegetable consumption as well as waste, there are tradeoffs that need to be considered. During the study, fruit consumption decreased by 17.26% while vegetable consumption increased by 14.70% (see table 7). At first glance, the main point to consider appears to be comparing the benefits of an increase in vegetable consumption with a decrease of fruit consumption. However, the impact on waste should be considered as well.

With the decrease of fruit consumption, fruit waste increased by 33.44%. When looking at the amount of change in waste as a percentage, it does not consider

how much the waste produced weighed. The decrease in vegetable waste was 11.15% which equates to a decrease of 0.28kg vegetable waste produced. On the other hand, the increase in fruit waste was 5.35kg. This presents a much larger tradeoff to consider. To make the consideration more equal, the total change in weight can be divided by the percent in change. This then represents the weight per percentage point and the values can be compared more directly.

When this is calculated 1% in vegetable waste weighs 0.025kg and 1% in fruit waste weighs 0.16kg. In other words, 1% of fruit waste weighs more than 6x what vegetable waste weighs. This highlights the point that weight should be observed as well as percentage of change when assessing waste or consumption. With this result, it seems pertinent to observe if other research targeting interventions have an impact on waste.

A meta-analysis was conducted in 2020 by Metcalfe et al. to review FV intervention's effect on consumption and waste at the school level.[18] The meta-analysis targeted research that influenced school aged children's fruit and vegetable consumption using "nudges".[18] The definition of a "nudge" used was the definition provided by Thaler and Sunstein as, "any aspect of the choice architecture that alters people's behavior predictably without forbidding any options or significantly changing their economic incentives.[31] The meta-analysis identified 29 published studies that fit their criteria. Of the 29 published studies, only 4 (13%) reported effects on food waste, three reported undesired negative effects on FV waste while the last reported a neutral effect.[21]

An additional 21 studies were identified in the published literature by conducting a PubMed search. The PubMed search included the following keywords "Intervention" + "waste" + "school" + "Fruits" + "Vegetables", Of the 21 studies

identified, 3 implemented an intervention aimed at increasing FV consumption and measured the change in waste.[32–34] Another study observed how changes in the National School Lunch Program, regulated by the Healthy Hunger-Free Kids Act, affected FV waste.[35] Results of 3 out of 21 studies(14%) echo the results reported in a 2020 meta-analysis with potential increase of waste during FV intervention.

With the results from both the PubMed search and meta-analysis revealing less than 15% (7/50) of studies publishing effects on FV waste, FV waste is often not reported or considered. Since there was a tradeoff of increased vegetable consumption with increased fruit waste in the phase one intervention school, other research should be looked at to see if there is a similar trend.

Additionally, a similar trend was seen in the research conducted by Elsbernd et al,.[8] The intervention consisted of serving red and yellow peppers first, before other components of the student's meal. While selection of peppers increased by 669% and consumption increased by 309% it was also observed that waste was increased on intervention days by 53%-64%. While the research's target, increasing vegetable selection and consumption, was achieved there was an unintended side effect. The increased waste highlights the fact that consumption is limited, and researchers need to assess if the tradeoff is worth the benefits.

IMPLICATIONS FOR RESEARCH AND PRACTICE

This information can be used to inform researchers and administrators of factors that can be overlooked during consumption interventions. The conducted research highlighted that successful interventions can still have unintended side effects. As seen in the intervention school, during phase one, while the target, vegetable consumption, increased there was an increase in fruit waste as well. Both

items need to be compared and determine if the benefits outweigh the consequences. Also of note, during this time the school's fruit consumption increased by 0.69% from baseline to intervention. However, the increase in fruit waste was 33.44% which is far greater than the associated increase in consumption.

Researchers and administrators should also be cognizant of how much the corresponding counter parts weigh. In the same school, while fruit waste increased by 33.44%, vegetable waste decreased by 11.51%. If weight was not assessed these numbers may appear to be offset by each other. However, when weight is assessed, it is revealed that the fruit waste was 19 times greater than the vegetable waste.

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CHAPTER 4

HOW DO THESE RESULTS IMPACT FUTURE FIT GAMES

ABSTRACT

Objective: This research aimed to assess the implementation feasibility and effectiveness of the FIT Game Healthy Eating Program in diverse schools, and its impact on fruit and vegetable (FV) waste.

Design: The research involved a two-phase intervention using the FIT Game. Phase one tested the program's effectiveness in schools with diverse student populations. Phase two explored a low-cost, low-burden implementation strategy.

Participants: Students from four schools in the Salt Lake City area.

Main Outcome Measure(s): The study focused on measuring FV consumption and waste, using quantitative assessment methods.

Results: Phase one indicated that the FIT Game was effective in diverse populations, with increased vegetable consumption observed. Phase two showed positive results with pre-programmed progression, raising questions about the children's comprehension of their contribution to the narrative. Waste analysis in chapter three highlighted that interventions could inadvertently increase consumable FV waste.

Conclusions and Implications: The FIT Game intervention can be effective in diverse school settings and implemented in a low-cost manner. However, it also emphasizes the importance of considering potential increases in FV waste as an unintended consequence of consumption interventions. Future research is recommended to explore the program's applicability in post-COVID educational settings and its potential as a low-maintenance intervention for independent school implementation.

PROJECT SUMMARY

The purpose of this research was to explore several questions that emerged from previous FIT Game interventions. There were three main questions that needed to be addressed. The first question was whether the FIT Game intervention could be implemented in a lower-cost, lower-burden manner and still be effective. The second question concerned the effectiveness of the FIT Game intervention in more diverse schools than previously observed. Lastly, the study examined whether the FIT Game intervention influences FV waste.

Chapter two addressed the first two questions arising from previous FIT Games. Each question was addressed in a different phase of the study. Phase one examined whether the FIT Game was as effective in diverse school populations. For this, two schools in the Salt Lake City area were selected for their diverse student body populations. One school served as the control, while the other underwent the intervention. The control school was observed for the same length of time. The results were then compared at the end of the intervention.

The results from phase one support the effectiveness of the FIT Game in diverse school populations. The control school showed a decrease in fruit consumption of 10.96% and a decrease in vegetable consumption of 4.21%. The intervention school had a change in fruit consumption of +1.28% and an increase in vegetable consumption of 13.43% to a mean of 54.57%. While not to the same magnitude, this mirrors the trend reported in the previous FIT Games, which had increases of 69% for fruit and 181% for vegetables. [1] Of note, in previous FIT Game interventions results are reported as increases in grams and do not look at the percentage of food served that was consumed.

During this study, it was decided to look at the percentage of consumption to account for variations in FV serving weights. While the change in vegetable consumption is difficult to quantify in numbers of servings per student, when individual items were paired from baseline to end of intervention there is increased consumption across all pairs. This includes increases of broccoli consumption of 375.85% and green salad consumption of 911.49%.

Table 1. Comparison of Matched Vegetables During Phase One Between Baseline and Intervention.

Vegetable	Baseline	Intervention	Percent of increase	Value 1	Value 2	Mean
Veggie Sticks	29.07%*	56.35%	93.84%	32.57%	25.57%	29.07%
Broccoli	15.86%	75.47%	375.85%			
Green Salad	4.80%	48.55%*	911.46%	61.82%	35.29%	48.56%
Cucumbers	50.80%	63.11%	24.23%			
Raw Carrots	38.63%	57.34%	48.43%			
	* = is calculated mean from two data points during that period					

The second question, regarding whether the FIT Game can be implemented in a low-cost, low-burden manner, was addressed in the second phase of Chapter two. The FIT Game was implemented in two additional schools in the same geographical location and with similarly diverse student populations. However, in phase two, the schools' progression through the story was pre-programmed and did not depend on the students' actual day-to-day consumption. The results of phase two mimicked those of the previous phase, with increases in vegetable consumption of 17.11% in school one and 40.33% in school two. The reason for this success is undetermined currently and

raises additional questions, Are the children too young to understand how their individual efforts factor into the group? Do the children not fully understand how much is a bit more each day? Or even, are the children too young to remember and compare how much they ate the previous day and the story progress for the current day?

Chapter three investigated the remaining question: whether interventions such as the FIT Game affect the amount of consumable FV waste produced. Waste data was collected from the schools during the FIT Games, and additional studies and their FV waste was analyzed. While several interventions were identified that increased FV waste, it was also revealed that this metric is often not observed or recorded. The findings in chapter three suggest that the effects on consumable FV waste should be monitored, as there can be unintended consequences.

WHAT WENT WELL

A significant portion of the success of this research is attributable to the nature of The FIT Game Healthy Eating Program and how researchers improved it. The FIT Game has been implemented several times in past years, and at the end of each round of research, questions were asked, and improvements were made. Improvements such as increasing the number of gamification aspects[2] , decreasing the time requirements on school faculty[1], and validating a less intensive collection process.[1] Thanks to this incremental improvements implementing the FIT Game, some difficulties were avoided that were seen in previous research.

For the current round of research, the questions posed were effectively addressed. The results from Chapter two showed a similar positive effect on FV consumption when the FIT Game intervention was conducted in schools with more

diverse student bodies. The results also demonstrated that implementing the FIT Game in a lower-cost manner still had a positive impact on increased FV consumption.

There were some tradeoffs made due to the research design. By implementing the FIT Game using a bulk collection and results method it removed the ability to have more fine-grained data. Using a group-level assessment method it removes the ability to look at the effects of the game on individuals.

In Chapter three, the waste results were successfully analyzed, showing that interventions, even when displaying positive effects on consumption, can increase consumable FV waste. The research highlighted in this section emphasized the complexity of assessing FV consumption interventions. Not only should consumption be assessed but the process as a whole including the effects on waste. This point was made possible by collecting and assessing fruit waste; even though it wasn't used to progress in the story.

WHAT DIDN'T GO WELL

During the research, unexpected difficulties arose in the collection and comparison of data points. Each school, although in similar districts, served food slightly differently. For example, while all schools offered a "salad bar," the amount of time students had to choose from it varied. Additionally, some schools did not limit the number of portions a student could take from the salad bar. For instance, a student could select three half bananas and only eat one, leading to the remaining two being discarded. Students being able to take more than a portion of each food introduced difficulty in assessing consumption and waste in servings. It removed the ability to report results in x% of a serving since as each student didn't get a standard serving.

Shortly after the research was conducted, the worldwide pandemic of COVID-19 in 2020 occurred. This pandemic led to school closures, social distancing measures, and other changes to daily life. This put a halt to further FIT Game interventions and the collection of additional information.

WHERE TO GO FROM HERE

While the results from the FIT Game intervention show promise in increasing school-aged children's FV consumption, new circumstances following the COVID pandemic require consideration before implementing the FIT Game intervention again. Since the effects of Covid-19 were broad, there are many portions of the school system that may vary from pre-Covid such as the number of students attending online learning, the method in which food is served, or if there are any changes in what is served. Assessing the ability to implement the FIT Game intervention and its results on FV consumption is necessary to confirm whether the structure of the FIT Game is still viable or alternatively, no longer viable.

Another avenue of research is understanding why pre-programming the progress during the FIT Game story was successful in increasing FV consumption. It's unclear whether children at this age grasp how their individual consumption impacts the overall progression of the story. In other words, do children at this age understand that the day before they consumed all their vegetables, but today the story didn't progress. While it was hypothesized that there would be a similar increase with pre-programming, the reasons for its success should be investigated.

Once the efficacy of the FIT Game is observed in the current post-COVID school system, methods of distributing it could be considered. With the second phase of intervention using pre-programmed progress, implementation was straightforward.

The progress was predetermined, and the story episodes already created. The only requirements for implementation were the school's willingness to participate, a computer and projector to show the daily episode, a kickoff assembly to inform the children, and someone on-site to collect and record FV waste.

The collection of FV waste and the two-week baseline period were only required to collect data from the intervention. Without these requirements, the FIT Game could be compiled into a distributable program that schools could implement. The efficacy of the FIT Game in this format would need to be determined to ensure a continued positive effect on FV consumption without the collection station and baseline. If the efficacy of the intervention remains valid, it could become an attractive, low-cost, low-maintenance intervention for schools to implement independently. The FIT Game could include a document outlining all steps for setup and implementation, and the story episodes could be distributed to schools in a downloadable zip file or mailed on a USB.

While the results shown during this study were more modest for several reasons such as the collection method, self-serve salad bars, and consumption being measured as a percentage of what was served, the question of if the FIT Game would be beneficial for schools is raised. Based on the success of previous studies, and the trend reported during this study, the FIT Game is an attractive way to increase FV consumption. Increased FV consumption is advantageous, regardless of the degree of the increase. The FIT Game also showed a reduction in FV waste when a fruit or vegetable's consumption increased. Due to the several potential benefits of the intervention, the FIT Game would most likely still be beneficial to implement.

While the research of the FIT Game answered the questions it set out to address, uncontrollable situations, specifically COVID-19, raised new ones. Before

further progress can be made in advancing the FIT Game Healthy Eating Program, its efficacy in the current school system needs confirmation. However, if it still holds the same positive influence seen previously, the program has the potential to be an easily distributed, low-cost, low-maintenance intervention for schools to use in the aid of increasing FV consumption in children.

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Appendices

Appendix A. Table of Student Diversity by Percentage for Each Participating School.

School	Caucasian	Hispanic/ Latino	African American	American Indian	Asian	Pacific Islander	Other
Wasatch (WA)	63.00%	30.00%	4.00%	N/A	N/A	N/A	3.00%
Copperview (CV)	30.50%	57.20%	4.00%	1.30%	0.70%	2.70%	3.60%
South Clearfield (SC)	63.00%	23.00%	N/A	N/A	N/A	N/A	24.00%
East Midvale Elementary	43.00%	34.00%	12.00%	N/A	N/A	2.00%	5.00%

Appendix B. Comparison of Matched Vegetables During Phase One Between Baseline and Intervention.

Vegetable	Baseline	Intervention	Percent of increase	Value 1	Value 2	Mean
Veggie Sticks	29.07%*	56.35%	93.84%	32.57%	25.57%	29.07%
Broccoli	15.86%	75.47%	375.85%			
Green Salad	4.80%	48.55%*	911.46%	61.82%	35.29%	48.56%
Cucumbers	50.80%	63.11%	24.23%			
Raw Carrots	38.63%	57.34%	48.43%			
	* = is calculated mean from two data points during that period					

Appendix C. The FIT Game "One Pager" Sent Out to Schools for Recruitment.

The FIT Game Healthy Eating Program

A big problem:

Fewer than 90% of children in the U.S. eat the recommended amounts of vegetables for a variety of reasons. Though vegetables are available to children in every school lunch funded by the national school lunch program, they often are not selected or end up in the trash bin. Children who eat less than recommended amounts of vegetables are at risk for overweight, obesity, and chronic disease.

A fun, low cost and burden solution:

The FIT Game Healthy Eating Program is a school-wide game-based approach to helping school-aged children eat more and waste less vegetables at school. The FIT Game program was developed and tested by researchers at USU. It has been successfully played in 7 schools in the Cache and Logan school districts and has consistently helped kids to increase their consumption of vegetables by 50-90%, even when measured three months after the game ends.

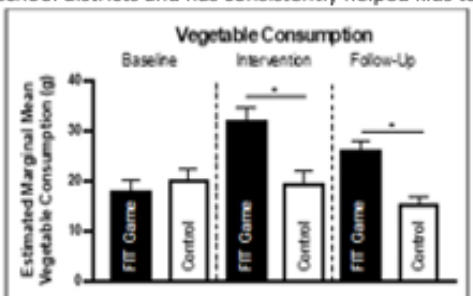


Figure 1. Estimated marginal mean grams of vegetables consumed (+SEM) in the FIT Game and Control schools. Follow-up data collected 3 months after the conclusion of the Intervention phase, in which the FIT Game was played, or not (Control schools).
* $p < .001$

How is the game played?

The FIT Game is played collectively by all children at a school over a period of 9 weeks. The game is a science-fiction story that children watch in the cafeteria as they are eating lunch. The heroes of the story are known as the FITs (see figure). In the game, the FITS attempt to find and capture the villainous VATs or vegetable annihilation team, who are destroying vegetation across the fictional universe. The game teaches children the benefits of eating vegetables in a fun and engaging way. Children earn the privilege of watching a new episode of the FIT Game by eating the prescribed amount of vegetables on the previous day. If children fail to eat the prescribed amount of vegetables, instead of seeing the next episode of the game, they receive a message from the heroes of the game that "children of (name of your school here), we need your help to capture the VATS, eat a few bites more of vegetables today than you did yesterday." Children are motivated to eat more vegetables day after day because they are interested in the game and want to help the FITs.

What is required from you?

A projector and screen, or large T.V. in the cafeteria is needed to display the comic-book style narrative each day the game is played. Everything else is provided by us! This program requires no classroom time, and little time or effort from teachers or school personnel.

Children are served their regular school lunch as determined by your nutrition director. Our staff will work with your school nutrition director to collect information on how much vegetables are served each day, and will collect and weigh vegetable waste. Data is collected at the school level; no information is collected from individual children.

Contact Dr. Heidi Wengreen, Professor of Nutrition at 435-797-1806 or Heidi.wengreen@usu.edu for more information. We are looking for 4 schools in the Provo, Salt Lake City, or Ogden areas to play our game in 2019-2020.

Appendix D. Memorandum of Understanding (MOU) Distributed to Participating Schools.

UtahState UNIVERSITY

DEPARTMENT OF NUTRITION AND FOOD SCIENCES
College of Agriculture
750 North 1200 East
Logan, UT 84322-8700
Telephone: (435) 797-2126
FAX: (435) 797-2379

Memorandum of Understanding

Between
Dr. Heidi Wengreen, Professor of Nutrition, Utah State University
And
[Partner School]
April 17, 2019

Purpose:

The purpose of this memorandum of understanding (MOU) is to record the mutual interest of Dr. Heidi Wengreen, Professor of Nutrition at Utah State University and [Partner school] in implementing the FIT Game Healthy Eating program at [Partner school] in the 2019 -2020 academic year.

The role of Dr. Heidi Wengreen's research team representing Utah State University are as follows:

1. Introduce and describe the FIT Game to the school teachers, food service workers, parents, and other people as deemed appropriate in a way identified by mutual agreement between the parties involved.
2. Handle all aspects of implementing the game at [Partner school] including setting up and taking down the necessary equipment for playing the game and collecting the needed measurements.
3. Report back to the school administrators about the outcomes of the game including average vegetable intake at designated periods of time.
4. Provide documentation of the approval of this research study by the USU Institutional Review Board.

The anticipated role of [Partner school] is as follows:

1. Facilitate communication between the researcher and the parents of the children attending the school for the purpose of obtaining consent for children to participate in the research.
2. Allow research staff to obtain information about how much vegetables are served to children at the school during the designated period of time. This may require research staff to coordinate obtaining this information from the school's food service workers, or weighing food prior to it being served in the cafeteria of the school.
3. Allow the research staff to collect the vegetables that kids do not consume and instead throw away in the cafeteria during the designated period of time.
4. Provide a screen and projector, or other digital display where the program can be viewed by all children at the school during the lunch period during the designated period of time.
5. Schedule a day for the research staff to deliver a 20-minute assembly to the students of the school before the game is played.

The details of the agreement, including the dates of implementation will be discussed in full and planned prior to the summer break of the 208-2019 school year. The terms as discussed here may be changed during future discussions with both parties.

_____ _____

Dr. Heidi Wengreen, Professor of Nutrition Authorized representative of said partner school

Appendix E. FIT Game Manual v3.

FIT Game Manual

The FIT Game is played at the school-level and is designed to help kids eat more fruits and vegetables. Playing the game requires school personnel to measure the amount of fruits and vegetables served and wasted eat day. Obtaining these measurements is relatively easy and requires just a few additional steps to the daily food preparation and clean-up routines. Children who play the FIT Game eat more and waste less fruits and vegetables at school, and are developing habits that support health now and in the future.

Table of Contents:

Equipment Needed

Items needed for the measurements of fruit and vegetables. These items will be stored in the kitchen

(2) 14 gallon garbage bins: one for fruit waste and one for vegetable waste

(2) 14 gallon garbage sacks

(1) Bathroom digital scale: for weighing garbage bins

(1) Small digital scale: for weighing pre-portioned servings

(1...) Aprons: one for each volunteer

(1...) Hair nets: one for each volunteer

(1...) Pair of latex gloves: one for each volunteer

Items needed for the presentation of the FIT Game. These items will be stored in the cafeteria.

Device to access Google Sheet: phone, tablet, etc.

Google Sheets link to input data

Most recent download of .ppt presentation

Laptop computer: this will be stored on school's stage

Projector: stored with the laptop

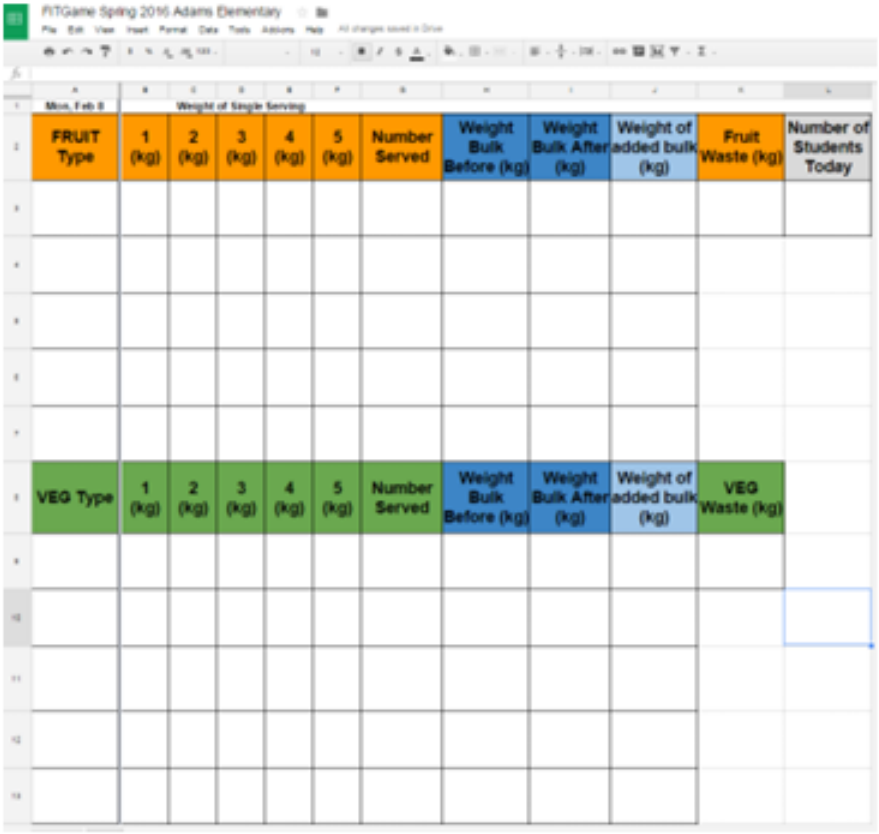
Step 1 – Preparing the Cafeteria

1. Set up fruit/vegetable waste bins by school's daily waste bins. Line both with garbage sacks.

Step 2 – Obtain the Pre-Service Weights

a) Wash hands, and then put on gloves, a hair net, and an apron.

b) Log into the Google Sheets document using the link that was sent to you. It should look like this:



Note: data entry points are summarized on page 5.

c) **Record fruits and vegetables to be served that day by name in the respective columns**. You can find this on the school's monthly menu (usually hung in the cafeteria and kitchen). Keep in mind some days may differ from the menu based on leftovers, so be sure to double check this with the school food service staff.

Record legumes (black/pinto/kidney beans) as vegetables.

Do not include: juice, potatoes (including mashed potatoes, French fries, or Tator Tots), ketchup or tomato sauce.

d) Obtain weights of fruit/vegetables that have been pre-portioned using the small digital scale found in the kitchen.

These items will be served in a little plastic cup or similar container. These will already be prepared by the time you arrive.

Take 5 weights of each type of fruit and vegetable and record each weight separately in kilograms (i.e. if applesauce, celery and carrots are each served in their own cups, you should have 15 measurements: 5 measurements for each item). Take weights of the fruit or vegetable and the cup together. The weight of the cups will be accounted for in the spreadsheet.

e) Obtain independent item weights using small digital scale.

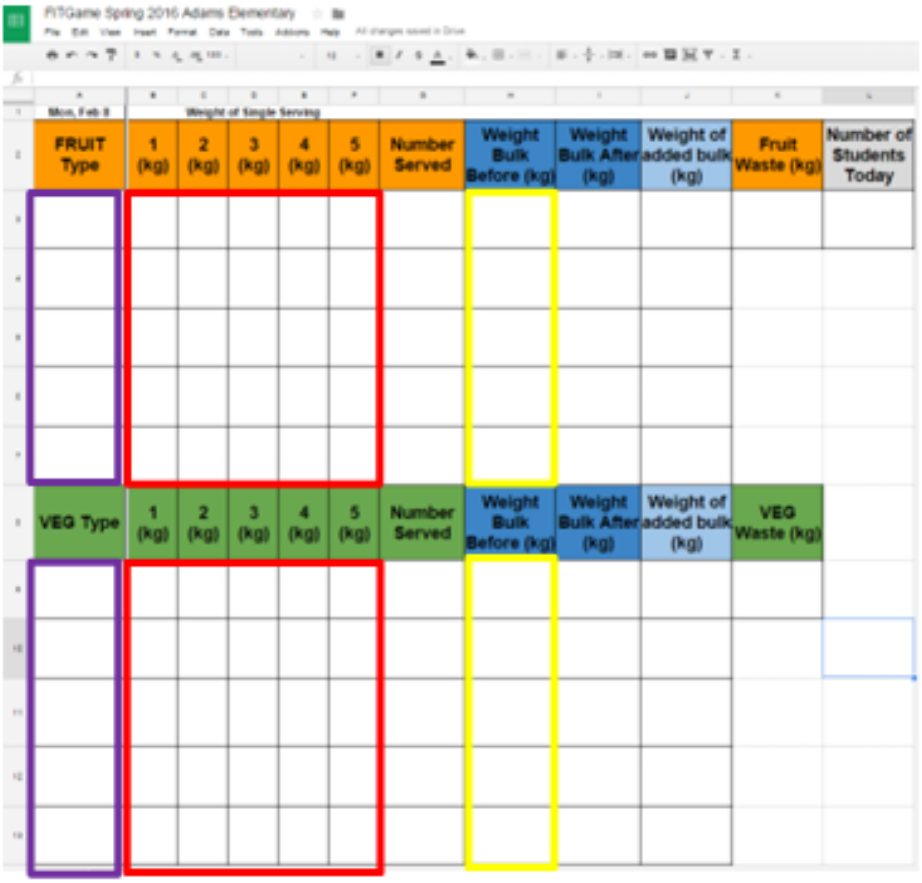
These are items that can be weighed individually (i.e. whole bananas, oranges, apples, peaches, etc.). Follow the steps above, with 5 sample weights for each type.

For items that have a peel, pit, core, or any other inedible portions (such as a banana peel, peach pit, apple core) record 5 sample weights of peel, pit or core (you'll need to wait to do this until after the kids start throwing them away) and record the weights under the same section in the columns marked "Weight of Single Serving".

f) Obtain bulk pan weights using large digital scale.

These are items that are "scooped" onto the children's trays (like green beans, mixed vegetables, peas, black beans, broccoli, salad, etc.). They are usually cooked in bulk (2-4 big metal pans)—make sure to weigh all of the trays. The weight you record should include the weight of the tray. You should have one weight in each excel box/cell for each pan of bulk items, even if the pans are the same type (i.e. for 2 pans of green beans, under the column "Weight Bulk Before" you would record the weight of the first pan; the weight of the second pan would go underneath.

Summary of Data Entry Points:



Purple Box: Step C

Record fruit/vegetable item names

Red Box: Steps D and E.

Record 5 sample weights of each pre-portioned and individual item.

Yellow box: Step F

Record weights of all bulk items, including pan weights.

Step 3 - Pre-Service Equipment Set-up

1. **Setting up the presentation materials**

   Each day's .ppt slideshow will available on the Fit Game website. Make sure that you download it onto a flash or directly onto the designated FIT Game computer.

   Move the laptop and projector from the designated storage site to the projection site. Position and power on.

   Lower the school's projector screen.

   Load the .ppt presentation and begin the slideshow (F5) before the children arrive for lunch. It will loop continuously throughout the lunch period.

Step 4 - During Lunch/Collection

1. **Sort fruit/vegetable waste**

   Put on your gloves and apron. As the kids come to throw away their food, help them sort out that day's fruit and vegetable (including the peels, pits, cores etc.) into the appropriate bins. The plastic storage containers items were served in are okay to be collected. The rest of their school lunch can go in the big school waste bin. Help the kids in this task as needed.

2. **Voting**

   Periodically during the game, students will be required to vote on how the game should progress. They will come to you with their choice as well as answers to riddles and mystery messages. Acknowledge their answer but do not affirm.

   As you collect the waste, you may talk to the students but do not provide encouragement to them to eat more fruit and vegetable. This would provide an unwanted bias to our data.

Step 5 - After Lunch

Note: a summary of after lunch steps can be found on page 8.

1. **Obtain the end weights of the bulk pan items.**

   You may need to do this before all the children are done eating. Lunch workers are fast and efficient and you'll need to get the after weights before they throw it away. You may need to notify the workers to wait until have the pan weights before discarding the waste. If the pan was empty, weigh the pan and record that weight. Your end weights should never be "0".

2. **Record any extra bulk pan items that may have been added during service.**

   Sometimes an item will run out and the lunch workers will have to add more. Make sure you are aware of how many pans were used total. This number can also be found on the lunch workers' daily log.

3. **Weigh and record the fruit and vegetable waste separately using the big digital scale.**

   The weight you record should include the weight of the waste bin. Once you have the weight, take the garbage bags to the school's dumpster.

4. **Record the number of each pre-portioned and independent items served.**

   This number will be recorded on the lunch workers' daily log. You can find this in the kitchen by the lunch workers' office or by asking one of the workers.

5. **Record the number of children that ate school lunch that day.**

   This is also found on the lunch workers' daily log.

6. **Turn off the presentation equipment and return all materials to storage area**

7. **Make sure all data has been collected and save to Google Sheets using internet connection.**

   Most cafeterias have poor cell service. Make sure your data has saved to Google's database before you close out.

Summary of Step 5 – after lunch

A. Weigh and record weight of fruit waste and vegetable waste separately.

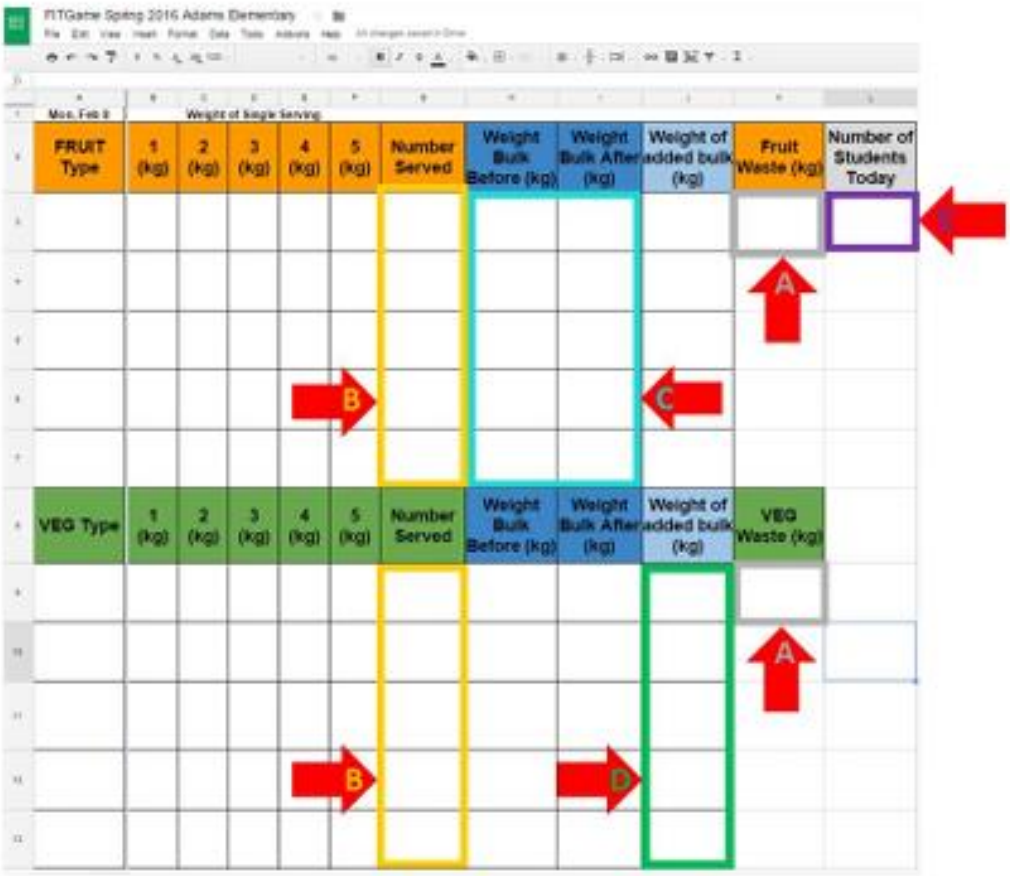
Using the lunch workers day report (found in the kitchen):

B. Get the number of each pre-portioned and independent item that were given out.

C. Make sure you have all the before and after weights for each bulk pan item.

D. Record any extra bulk pans that may have been added during service. Sometimes they will run out and need to add more bulk pans during lunch.

E. Record the number of kids that ate lunch that day.



If they run out of fruits/vegetables during service and add types (without you getting the weight before lunch):

- If Pre-portioned: Add the type to the list, weigh 5 samples (as in step 5 or step 6) and the number served.
- If Bulk: Ask how much was added (from boxes/cans) and weigh the leftovers.