

FRUGGIE – A board game to combat obesity by promoting healthy eating habits in young children

Annika Huprikar¹, Judi Luepke¹, Linyuan Jing²

¹Deerfield High School, Deerfield, Illinois

²The Geisinger Institute, Danville, Pennsylvania

Summary

Obesity is a significant health concern for children in the United States. One way to combat obesity is to start the education of eating healthy at a younger age. This study explored whether an interactive board game could provide that education to young children. Fruggie is a board game that is designed to test whether children learn and retain the importance of healthy eating habits. By integrating family time in playing a board game alongside answering health and nutrition related trivia questions while eating real food as part of the game, Fruggie is meant to promote awareness of healthy eating habits in children at an early age. Participant families played this game for six months with their young children between the ages of 3-7 years. The study tested whether children improve and retain their interest in eating fruits and vegetables because of the use of real fruit and vegetables in the game to more permanently change attitudes about healthy eating. Results showed that children developed a liking for fruits and vegetables, and none regressed. Half maintained their level of enjoyment for fruits and vegetables during the research period, while the other half had a positive increase. The game was able to increase the desire to eat fruits and vegetables and reduce aversions the children may have had to eating fruits and vegetables before being introduced to the game.

Received: December 11, 2017; **Accepted:** May 10, 2018; **Published:** June 13, 2018

Copyright: © 2018 Huprikar, Luepke and Jing. All JEI articles are distributed under the attribution non-commercial, no derivative license (<http://creativecommons.org/licenses/by-nc-nd/3.0/>). This means that anyone is free to share, copy and distribute an unaltered article for non-commercial purposes provided the original author and source is credited.

Introduction

The purpose of this study is to effectively communicate the benefits of healthy eating to younger children with the hopes of permanently changing their attitudes about the choices they make at meal times. This can also decrease the chances of children suffering from unhealthy weight gain in adulthood. Obesity has

become an American epidemic, with over 12.7 million children considered obese (1). This translates to 1 in every 6 children suffering from obesity. From 1980 to 2014, the obesity rate amongst 6-11 year-olds has increased from 7% to 17.5%, respectively. In the younger age group of 2-5 years, as of recently, 8.9% of this population is obese, with 2% being significantly obese. No state has an obesity rate lower than 10% among high school students (1). It has also been established that children who start out obese will likely be obese in their adulthood (2). Long-term obesity can lead to other chronic diseases such as heart disease, type II diabetes, stroke, or cancer (2).

There are several causes of obesity, including an imbalance between food intake and energy use caused by unhealthy life styles, unhealthy food choices, medical conditions, genetic syndromes, and endocrine disorders. Some medicines used to treat depression and anxiety are also known to cause weight gain. While there are several causes of obesity, the ones that can be controlled are unhealthy food choices and lifestyles (3).

In an article about childhood obesity in the Chicago Tribune, Dr. Linyuan Jing from the Geisinger Institute in Pennsylvania reported that obesity is detrimental to the health of children, (4) and that signs of heart disease have appeared in obese children as young as 8 years old. Jing hopes that parents are determined to help their children keep a healthy weight in order to reduce risks of heart disease.

There has not been conclusive data on what is effective in combatting obesity among young children. Most programs that target obesity are initiated in schools since that is a place where children spend a majority of their time. The benefits of administering programs at school therefore have many positives as a place for initiating interventions. As presented in the International Journal of Obesity, approximately 90% of 5-19 year old U.S. children attended school in 2005 (5). Per the U.S. National Library of Medicine, National Institutes of Health, schools tend to be the best places to learn about nutrition and healthy eating, since close to 50% of school children in the United States participate in the National School Lunch Program (NSLP) (6). The schools that participate in the NSLP require their schools meals to

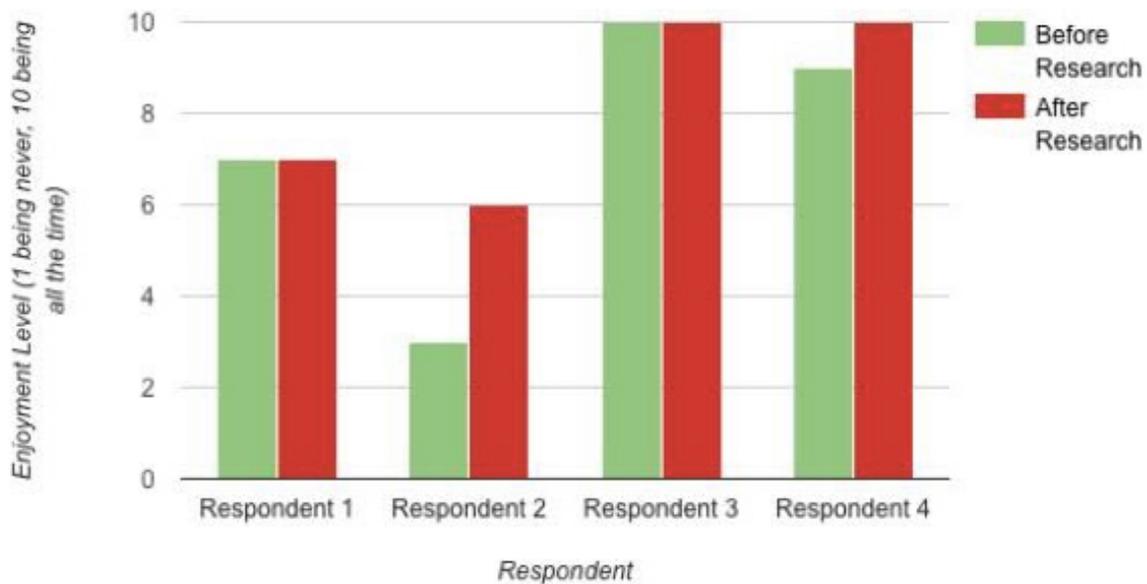


Figure 1. A bar graph depicting the participants' change in level of enjoyment towards fruits and vegetables before and after the research period.

follow the Dietary Guidelines for Americans, in terms of the intake quantities of proteins and vitamins. It has also been observed that parental involvement and leading by example positively impacts children's dietary habits (6).

There are several strategies that can be employed to prevent obesity. There are state and local programs that distribute information about obesity prevention; several community efforts, such as Salad Bars to Schools, that encourage healthy living and eating; and collaborative efforts by schools, hospitals, and childcare centers to increase awareness about healthy eating (7). There are several collaborations, such as the National Collaborative on Childhood Obesity Research, whose mission is to create strategic alliances to develop tools to reduced obesity.

The aim of this study was to test whether children at a young age can learn and retain the importance of eating healthy through an interactive board game that uses real food, and apply this knowledge to their daily lives. The hypothesis was that eating habits of young children can be transformed through engagement in an interactive board game designed to promote healthy eating habits. The game, which was designed for this study, would emphasize the consumption of healthy foods by using real fruits and vegetables in the game, while teaching about consumption of sugar in moderation. The participant's families would play this game over a period of 6 months with their young children of ages 3-7 years.

Results

There were 10 children who played this game over

the course of 6 months. The respondents are the parents of the children. The children were between the ages of 3-7 years. There were four 3-year olds, three 5-year olds, one 6-year old, and two 7-year olds. The enjoyment level for fruits and vegetables and the change in attitude of the children was determined by responses on a scale of 1-10 and also by other qualitative responses that the participants noted. The quantitative data including the measurements on the 1-10 scales are shown in the figures below. **Figure 1** shows that all the children maintained or improved their level of enjoyment for eating fruits and vegetables.

Overall, the children maintained their liking for fruits and vegetables and some recorded an increase in their level of enjoyment for fruits and vegetables over the course of the study (**Figure 1**). Half of the children maintained their level of enjoyment during the research period, while the other half of the children had a positive change in their level of enjoyment for fruits and vegetables (**Figure 1**). The standard deviation of this distribution is 1.41, implying that there was a consistent difference in the before and after research results. A paired t-test was also performed on this data. The t-value was 2.5385, and the p-value was 0.03179 with a confidence interval of 95%. Since the p-value is less than 0.05, this is a statistically significant result. This suggests that the null hypothesis ("after" mean minus "before" mean equals 0) is false and that the alternative hypothesis is true because the true difference in means is not equal to 0. The rating in the "after" condition increased, so there is evidence to suggest that there is improvement in the

% of Time Children Demonstrated Retention of What They Learned from the Game	Number of Children
Less than 10	0
10-25	0
25-50	0
50-75	5
75+	5

Table 1. A table representing the percentage of time that the children exhibited retention of the game's objective of eating healthy.

kids' level of enjoyment for eating fruits and vegetables. In playing the game, children's desire to eat fruits and vegetables increased, and previous aversions that the children may have had to eating fruits and vegetables were reduced. **Table 1** clearly demonstrates that the children retained what they learned. **Table 2** shows that having real food as part of the game was the most influential in communicating the message of healthy eating.

All of the children demonstrated retention of what they learned at least 50% of the time, and half of the kids even demonstrated this more than 75% of the time (**Table 1**). Retention of what was learned in the game was measured by allowing the respondents to enter their choice of percentile ranges from the ones shown above. In terms of the most effective component of the board game that communicated the intended message behind the game (measured on a scale of 1-4, with 1 being the most effective and 4 being the least), the participants found that having real food to eat proved the most effective (**Table 2**). Having access to edible fruits and vegetables while playing made the concept of healthy eating feel more "real" and applicable, which improved comprehension of the essential message and generated more retention. The effectiveness of the various components of the board game was determined by the ranking for them provided by the respondents based on their observations during the research period. **Figure 2** shows that the peak effectiveness of the board game can be reached in three months.

The average board game effectiveness consistently rose in the first three months, before settling at 8.25,

on a scale of 1-10, with 1 being never effective, and 10 being always effective (**Figure 2**). For the last three months of the research, the average value remained at 8.25, hence the plateauing of the line in the graph above. This indicates that the board game effectiveness can be reached at the three-month mark. The effectiveness was measured by having each respondent enter a value between 1-10 for each month, with 1 representing no interest or connection between the board game and the message of eating healthy, and with 10 being very effective in communicating this message and having the greatest interest level. The values were then averaged for each month to determine the average board game effectiveness over the course of the 6 months. **Figure 3** shows the prototype of the board game and **Table 3** shows the frequency of initiative taken by the children to play the board game.

Over the course of the six months, the children took the initiative to play the board game at least 50% of the time (**Table 3**). Half of the kids took the initiative 50-75% of the time, 20% took the initiative for 75-90% of the time, and the remaining 30% took the initiative to play the game for more than 90% of the time.

From the participants' responses to the question in the survey, which asked if the children were seeing a connection between the board game and healthy eating, it was concluded that there was a 100% connection made, since all responded "Yes" to the question. For the participants who had a transformational change in their eating attitudes, their percent of retention was greater,

	Respondent 1	Respondent 2	Respondent 3	Respondent 4
Board Game Format	4	3	3	3
Having Real Food to Eat	1	2	2	1
Trivia Questions	3	1	1	2
Family Time	2	4	4	4

Table 2. A table displaying the ranking of the board game's components in terms of effectiveness from the participants' perspectives.

and they had reduced their aversions to specific fruits and vegetables that were present before the research started. Based on the respondents' observations, every child had an aversion to a particular vegetable in the game, and 50% of the children had an aversion to a particular fruit in the game. After the research period, the children with the aversions accepted the fruit and/or vegetable that they had previously disliked. The participants who already had and maintained a good attitude towards healthy eating throughout the research added a new fruit/vegetable to their palate that was previously disliked before the research. Playing with

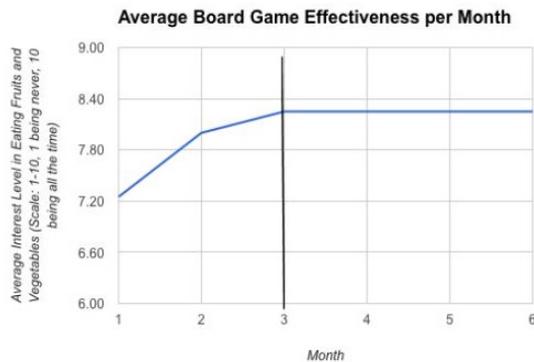


Figure 2. A line graph revealing the optimal duration to play the game based on the effectiveness of the board game.

food made healthy eating easier to understand and apply to the children's daily lives, as shown through the participants' responses; 80% of the kids had a $\geq 75\%$ change in attitude towards healthy eating.

Participants noted that having a candy penalty reinforced the attitude about eating sugar in moderation and making choices about consuming sugar. If a player has progressed far enough in the game, this means he/she has eaten fruits and vegetables and can afford to take a candy penalty. Also, it was observed that the children are willingly eating fruits and vegetables and were even adding it to their meals in other foods. They look forward to eating healthy.

Discussion

Incorporating Fruggie in young children's lives increases affinity to fruits and vegetables and promotes the idea of healthy eating. The message of healthy eating is communicated in an engaging and exciting way, rather than through an instructional lesson. The children understood how to make realistic choices about eating healthy and moderating sugar intake. Interestingly, having real food to eat was only slightly more effective than the presence of trivia questions. This was a surprising outcome because the trivia questions require more thinking and more attention, which is typically not observed in young children.

This study had a few limitations. An error in the intake of fruits and vegetables could have occurred if there was a varying size of the chopped food and the type of fruits and vegetables being used to play. However, this was accounted for by having my local grocer chop the fruits and vegetables the same way every week. The same fruits and vegetables were used throughout the research, to have more consistency in the game-play each week and in the data. Another possible source of error that was not explored was the possibility of children naturally liking fruits and vegetables overtime without the

intervention of the game. Additionally, the experimental sample size was fairly small.

Future experiments with this board game include getting additional participants involved in the research, thus conducting more studies to gather more data. The goal is also to distribute this game to pre-kindergarten and elementary schools to play this game during the designated "snack time," for greater impact. Creating a mobile application for this game may allow it to reach more people, and collect data on an increased number of users. The intent is to conduct another research to compare results from playing an interactive board game that uses real fruits and vegetables to a mobile game that provides a similar education, but without family interaction or real fruits and vegetables, to see if there is a difference in effectiveness.

Prevention of an unhealthy diet by formation of healthy eating habits at a young age can in turn lead to a prevention of obesity and weight gain-related issues later in life. Fruggie, an interactive board game with real fruits and vegetables, was able to successfully communicate the importance of healthy eating to young children. Their mindset of eating fruits and vegetables grew, and the board game allowed the children to see the consequences of their eating choices through trivia questions and candy penalties. The retention of their learning showed the effectiveness of the board game. This game promoted the concept of healthy eating and increased the interest level in eating fruits and vegetables and trying new foods that the children might have had an aversion to before. Fruggie positively transformed children's attitudes and frequency of consuming fruits and vegetables.

Methods

To format the board game, Microsoft® Excel was used by treating each cell as a space on the game. Each space contains either a solid color or an action that is to be performed. The action of "Trivia" requires the player to pick up a Trivia card and answer the question displayed on it. These questions are reflective of healthy eating and contain questions applicable to life situations, such as analyzing the proper exercise activities to maintain a healthy lifestyle and the nutrition facts about fruits and vegetables. A Microsoft® Word label template was used to format the questions. Other spaces on the board ask the players to eat a certain fruit or vegetable, which can involve some simple arithmetic to compute how much of a food the players should eat. Lastly, there are spaces that require players to make the decision to either indulge in candy and go back a certain number of spaces as a penalty, or not eat the candy and remain on that space. To create the 3D game pieces in the shapes of fruits and vegetables, Shapeways® 3D Printing Service and

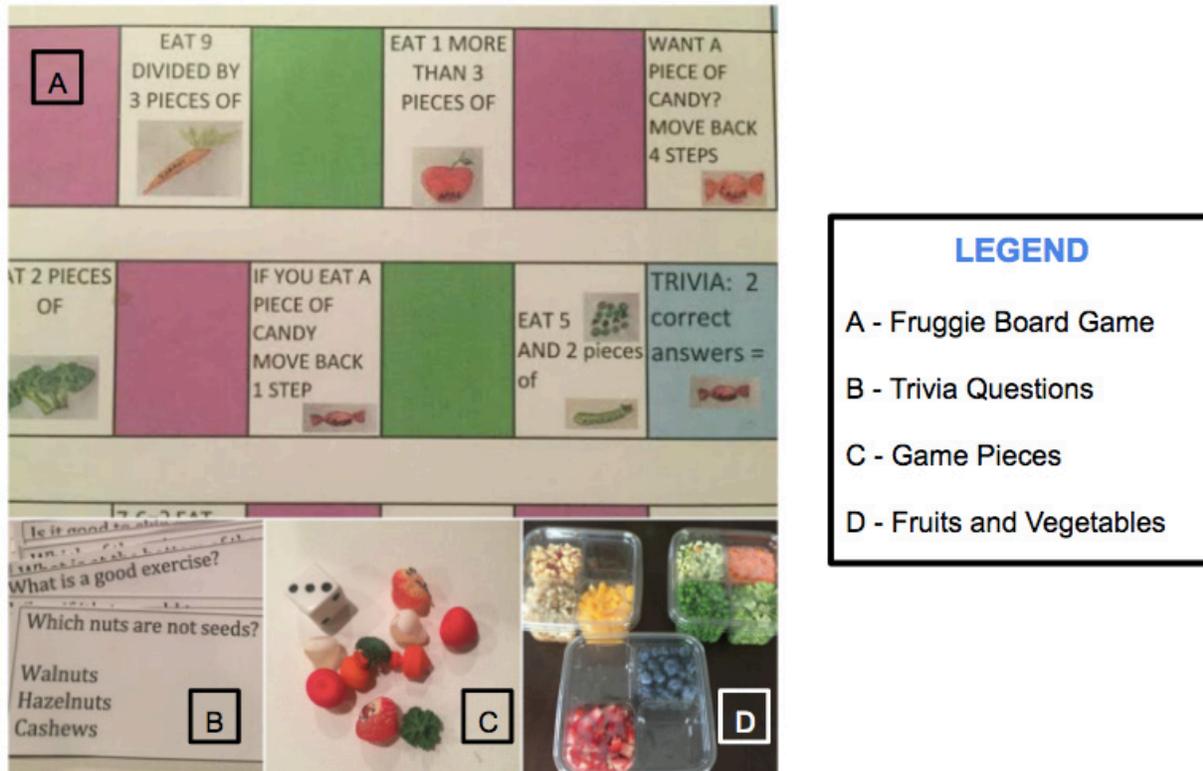


Figure 3. A prototype of the board game Fruggie

Thingiverse© were used.

To gather participants for the research, Mrs. Judi Luepke helped to invite and enlist families with children between the ages of 3-7. A handout was created and sent out to the community to broadcast this opportunity and find participants. Once there were enough volunteer families, a brief information session about the research was conducted and instructions to play the board game were discussed. The families were told to play the game at home, and the parents were asked to make observations and record data about their children's experience and behavior while playing the game. In addition, they were

% of Time Children Took the Initiative to Play the Game	Number of Children
Less than 10	0
10-25	0
25-50	0
50-75	5
75-90	2
90+	3

Table 3. A table exemplifying the percentage of time that the children took the initiative to play the board game.

asked to note changes in attitudes and behavior from before the research to after the research period ended. The participants were asked to record observations and changes on a weekly basis. Four families volunteered for this game and ten children were part of this research.

These four families were accepted since they had children in the target age group needed for the research.

The prototype of my board game was shared with Dr. Linyuan Jing. She provided guidance on the optimal research duration as well as the weekly frequency that the game should be played by the participants. The research was to last six months, and the game was to be played at least 1-2 times a week by each family.

The localWhole Foods Market© provided the chopped fruits and vegetables on a weekly basis for the research participants. The fruits and vegetables included strawberries, blueberries, oranges, apples, pears, carrots, zucchini, broccoli and peas. The intent was to make sure that the food was prepared on an allergy-free surface. The participants were also supplied with store-bought M and M's©, to serve as the candy element in the game.

To gather results, SurveyMonkey© was used to anonymously collect data from my research participants and the data was tabulated in Microsoft© Excel. The questions were tailored to gauge impact on the children's eating habits and development of attitudes towards

healthy eating. The respondents filled out the surveys anonymously and the questions asked in the survey were designed to elicit responses that would provide comparative data for before and after the research period.

Acknowledgements

I would like to sincerely thank my two mentors, Mrs. Judi Luepke and Dr. Linyuan Jing. Mrs. Luepke was a crucial support for me all throughout the research process by providing invaluable guidance every step of the way. I appreciate her dedication to the field of science and research. Dr. Linyuan Jing, contributed to my research from the time of inception of my idea by responding to my request to discuss my idea with her after I read about her research in the Chicago Tribune. She was very supportive and gave me helpful suggestions on the board game design and how to structure the research. I would like to thank all of the research participants for their time. I would like to thank my family for their unwavering support.

References

1. Obesity, State Of. "Obesity Rates & Trends Overview." Obesity Rates & Trends Overview: The State of Obesity. Trust for America's Health & the Robert Wood Johnson Foundation, n.d. Web. 23 Feb. 2017.
2. CDC. "Adult Obesity Causes & Consequences." Centers for Disease Control and Prevention. Centers for Disease Control and Prevention, 15 Aug. 2016. Web. 03 Mar. 2017.
3. NIH. "Explore Overweight and Obesity." National Heart, Lung and Blood Institute. Web. 1 Mar. 2017. <https://www.nhlbi.nih.gov/health/health-topics/topics/obe/causes><https://www.nhlbi.nih.gov/health/health-topics/topics/obe/risks>
4. Association, American Heart. "Obese Kids Young as Age 8 Show Signs of Heart Disease." News. American Heart Association, 10 Nov. 2015. Web. 16 Feb. 2017.
5. International Journal of Obesity. "Preventing Childhood Obesity: What Works?" Web. 2009. <https://www.nature.com/ijo/journal/v33/n1s/full/ijo200922a.html>
6. US National Library of Medicine. "Influences on the Development of Children's Eating Behaviours: From Infancy to Adolescence." National Institutes of Health. Web. 7 May 2009. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2678872>
7. CDC. "Strategies to Prevent Obesity." Centers for Disease Control and Prevention. Centers for Disease Control and Prevention, Web. 27 Oct. 2015.
8. <https://www.cdc.gov/obesity/strategies/>