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## The Impact of Nutrition Education on Serving Size Comprehension in College-Age Female Students

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*THE IMPACT OF NUTRITION EDUCATION ON SERVING SIZE COMPREHENSION IN  
COLLEGE-AGE FEMALE STUDENTS*

AN ALL COLLEGE THESIS

College of St. Benedict/St. John's University

In Partial Fulfillment

of the Requirements for All College Honors

by

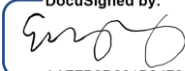
*Carisa Hilton*

*May 2020*

**The Impact of Nutrition Education on Serving Size Comprehension in College-Age Female  
Students**

**By Carisa Hilton**

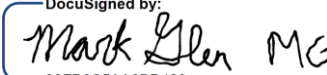
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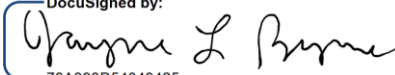
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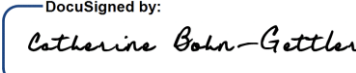
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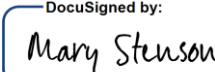
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### **Abstract**

**Background** - Nutrition Facts labels are a low-cost informational tool with the potential for encouraging healthful purchasing and eating habits. The use of nutrition labels on packaged foods can promote healthier dietary choices; however, systematic reviews show that consumers may not frequently use nutrition labels to make food choices and do not effectively measure an appropriate serving size, leading to nutrient over-/underconsumption.

**Objective** – The goal of this study was to investigate how female college students use the Nutrition Facts label and measurement tools to estimate one recommended serving size, and if varying nutrition education tools improve serving size accuracy in this population.

**Methods** – Participants (females, age 18-24, n=32) completed a serving size assessment and survey regarding Nutrition Facts label use at baseline (pre-) and post-intervention. After baseline testing, participants were randomly assigned to an educational treatment group (social media, handout, or video) or control group for one week before returning for post-intervention data collection.

**Results** – The overall accuracy of serving size estimation among most foods in the assessment did not improve by time or treatment options; Cheerios was the exception and improved in accuracy over time ( $p=0.017$ ). During baseline assessment, the analysis revealed that for five of the eight foods assessed, utilization of the packaging did not improve the accuracy of the portioned serving size. Participants in treatment groups Strongly Agreed (41%) and Agreed (41%) that their assigned educational material was beneficial to their ability to

accurately estimate a serving size. Of the participants (n=14) who reported “Strongly Agree” when assessing how beneficial the assigned education material was for estimating serving size accuracy, the majority of these responses (36%) were from the handout treatment group.

**Conclusion** - Comprehension of serving sizes was influenced by the clarity of the nutrition label, unit of measurement, and the interest of the individual to use serving sizes. There remains a need for further investigation on the most effective nutrition education method(s) for improvement of serving size accuracy in specific populations.

## Introduction

Differentiating between portion and serving sizes can be challenging. Even though almost all packaged foods present Nutrition Facts labels, consumers struggle with serving size comprehension, which leads to misinterpretations or inattention to the available information. For example, Milk's Favorite Cookie, the Original Oreo®, has a serving size of three cookies, which may surprise consumers. Three cookies are equivalent to 160 Calories, 135 mg of Sodium, and 25g of Total Carbohydrates. The risk of misunderstanding serving size information found on the Nutrition Facts label can lead to inappropriate nutrient intake, whether it be excess or deficiency.

During the 1960s, the amount of processed foods in the marketplace began to increase and manufacturers often made misleading claims about their products. Consumers were confused by marketing and worried about the trustworthiness of their food. In response to this, the 1969 White House Conference on Food, Nutrition, and Health recommended that the Food and Drug Administration (FDA) consider developing a system to identify the nutritional qualities of food (1). Such a system would allow consumers to follow recommended dietary guidelines rather than eating indiscriminately.

The FDA's first nutrition facts label regulation was in 1973. The final version of these regulations was published in 1990, following the Nutritional Labeling and Education Act of 1990 (1). For the first time, nutrition labeling became mandatory on most packaged foods (1).

Nutrition labels are an informational tool with the potential for encouraging more healthful purchasing and eating habits. In the United States (U.S.) population, consumer use of Nutrition Facts labels on packaged foods has been related to healthier dietary choices (1). However, systematic reviews show that consumers may not frequently use nutrition labels to

make food choices. In May 2016, the U.S. Food and Drug Administration (FDA) released rules to update the Nutrition Facts panel format and content to make labels more understandable, and the most recent label update was recently taken into effect in January of 2020. These changes were made to reflect scientific developments on the role of diet in disease risk, and to update servings sizes to better align with actual dietary intake (1).

Overconsumption or underconsumption of certain nutrients can lead to chronic diseases, which can be influenced by the packaging of the food items or consumer literacy related to the Nutrition Facts label. Overconsumption of food items can lead to excess intake of certain undesirable food components, while underconsumption can reduce the intake of beneficial nutrients. Lack of knowledge or usage of Nutrition Facts guidelines may lead to imbalance in dietary patterns, but if used correctly, using the Nutrition Facts label can support consumers to best estimate and guide their daily intake to better meet their nutritional needs.

The objective of the current research study was to investigate the relationship between accuracy of serving size comprehension and use of tools for estimating serving size, and the influence that an assigned nutrition education method has on improving this relationship in a population-based sample of young adult college females.

## **Background**

Measuring Nutrition Facts label usage in young adults is particularly crucial given the importance of establishing long-term dietary habits for chronic disease prevention. Previous studies in young adults have reported that females, as well as individuals with higher nutrition knowledge or education may be more likely to use Nutrition Facts. For dietary quality, self-

reported general label use (not necessarily Nutrition Facts) was related to consuming more fruits and vegetables and fiber, and less fried foods, but not dairy or calcium (2).

Consumer perceptions of accurate serving size estimations are impacted by personal or product-based influential factors or needs. The consumer's abilities, the Nutrition Facts label, or the product packaging are contributing factors to potential inaccuracies in the consumer's estimate of the appropriate recommended serving size. In a controlled trial where participants were asked to determine if a particular product was more healthful and were given no information regarding which specific nutrients to consider in their decision making, on average, higher nutrition knowledge ( $P = 0.002$ ) and higher numeracy (defined as the ability to apply numerical concepts) ( $P < 0.001$ ) were associated with higher accuracy. The associations reveal that age may be an additional factor to consider in determining nutrition literacy. Additionally, greater attention to the labels (longer viewing times) was also associated with greater accuracy, on average ( $P < 0.001$ ) (3).

When considering modifying the Nutrition Facts label to better reflect a reasonable serving size while remaining consistent with sound nutritional guidelines, the FDA had to consider the risk that alterations to the serving sizes on the packaging could have on consumers' perceptions of what is appropriate for meal or snack consumption. Larger serving sizes could increase consumption if consumers use the serving sizes displayed as a reference point for their consumption, or larger serving sizes that depict increased values of negative nutrients (e.g. calories) could lead consumers to perceive foods as less healthy and thus reduce consumption (4). Some evidence even suggests that variability in how serving sizes are set across manufacturers can result in an unintended consequence of increasing consumption on a per-package level (3).



The graphics on a product's packaging are influential on the consumer's perception of serving size. For example, "suggested serving size" labels and "gluten-free" or "fat-free" claims printed on the boxes deter consumer's from looking at the Nutrition Facts Label and rather using the product graphics as their guide (5). Portion size depictions on the front of 158 cereal boxes were 65.84% larger (221 vs. 134 calories) than the recommended portions on Nutrition Facts panels of those cereals. Boxes that displayed exaggerated serving sizes led consumers to pour 20% more cereal, which was 45% over the suggested serving size, compared to pouring from modified boxes that depicted a single-size portion of cereal matching suggested serving size (6). These cereal packaging designs with serving size biases can have a negative effect on consumers' perceptions of an accurate serving.

In addition, product packaging can come in single-serve packages or larger packages with multiple servings within. In one study, participants did not address serving size information when they perceived a product to be a single serving (7). The hypothesis was that participants would make more serving size assumption errors on a Nutrition Facts label interpretation task when assessing packages that appear as a single serving but contain multiple servings, compared with products that appear as a multi-serving and contain multiple servings. This resulted in participants misinterpreting the nutritional and caloric content of foods that were single unit foods with multiple servings (7). And likely, the small package size in the products that appeared as a single serving and contained multiple servings condition led participants to interpret the products as single servings, underestimating nutrient and caloric content. If participants thought products that appeared as a single serving and contained multiple servings was a single serving, they would have been less likely to consult serving size information on the label. Individuals tend to only look at the Nutrition Facts Label if it is necessary for decision making, otherwise,

consumers utilize their innate nutrition intuition and tend to not consider the available information.

Consumers can use information from the Nutrition Facts labels to help guide their intake. The size of the serving on the food package influences the number of calories and all the nutrient amounts listed on the top part of the label. By paying attention to the serving size, especially how many servings there are in the food package, one can determine how much of that item is essential to meet the daily recommended intake for their nutrients. However, it is unknown how to best educate consumers on the importance of use of the Nutrition Facts Label, especially the serving size.

Research has determined that the social media landscape in which teens reside looks markedly different than it did as recently as a few years ago. In the Pew Research Center's 2014-2015 survey of teen social media use, 71% of teens reported being Facebook users. Other platforms used by teens were Instagram (52%) and Snapchat (41%). Yet, in 2018, three online platforms other than Facebook – YouTube, Instagram and Snapchat – were used by sizable majorities of this age group. In the 2018 survey of social media use, 85% of teens used YouTube, 72% used Instagram, and 69% used Snapchat, while only 51% used Facebook (8). These trends suggest that teens are becoming more comfortable with online use. And research looking at the availability of mobile learning versus learning in the traditional sense reveal that learners exposed to the convenience of mobile learning scored significantly higher than those who received traditional education learning through handouts or lectures (9).

Significant gaps remain in understanding how to improve Nutrition Facts use and how nutrition label users compare on broad dietary outcomes in compliance with the Dietary Guidelines for Americans. A better understanding of the types of barriers and resistance that

consumers have regarding serving size measurements and the gaps in how the Nutrition Facts label may benefit the consumer could encourage greater label use. This better understanding will help to align educational materials with the needs of consumers.

## Methods

### Participants

The participants were a convenience sample of 32 females, aged 18-24 at the College of Saint Benedict (CSB) in St. Joseph, Minnesota. The majority of participants were college seniors (50%), non-nutrition majors (87.5%), who had not taken a nutrition course in their undergraduate studies (69%). There was a 0% dropout rate during the course of the study. Table 1 represents the participant demographic information.

Table 1.

Participant demographics (n=32).

		# of Participants	% of Participants
Academic Year	First Year	11	34%
	Sophomore	1	3%
	Junior	4	13%
	Senior	16	50%
Academic Major	Nutrition	4	12.5%
	Non-Nutrition	28	87.5%
Course History	Yes, taken a Nutrition course in undergrad.	10	31%
	No, have not taken a Nutrition course in undergrad.	22	69%

**Design**

This randomized educational intervention study on serving size comprehension recruited participants via a mass email that was sent to the all CSB students. To encourage participation, participants had an opportunity to randomly receive one of five \$25.00 Target gift cards upon completion of the study. The data collection for this study included the pre-intervention (baseline) assessment, a nutrition education intervention, and a post-intervention assessment.

During the pre-intervention assessment, participants were asked to complete a survey that prompted them to provide demographic information (last 4 digits of Banner ID number, year in school, major, and identify if they had taken a Nutrition course) and information about their use of nutrition labels. After survey completion, participants completed a serving size activity. This activity evaluated their ability to accurately portion out one serving size of various foods when a Nutrition Facts label was available and measurement tools were provided. Participants were asked to measure out one serving size of eight different foods. The instruments available for use were a digital kitchen scale that displays ounces, grams, and pounds, and measuring cups: 1 cup, 1/2 cup, 1/3 cup, and 1/4 cup, and measuring spoons: 1 tbsp., 1 tsp, 1/2 tsp, 1/4 tsp (See Figure 1 below). During this activity, participants were free to use the tools to portion out the serving size of eight different food items, but the researcher did not encourage or discourage the use of the tools. The eight food items were: Cheerios, orange juice, dried macaroni and cheese, dried brown rice, pinto beans, grapes, baby carrots, and popcorn (See Table 2 below).

Figure 1.

Designed layout for food groups 1-4 of the baseline and post-assessment sessions.



Table 2.

Foods assessed and one recommended serving size.

	Food Assessed	One Serving Size (Amount)
1	Honey Nut Cheerios™	¾ cup (28g)
2	Orange Juice	8 fl. oz. (240mL)
3	Kraft® Macaroni and Cheese	2.5 oz. (70g)
4	Dried Brown Rice	½ cup (43g)
5	Pinto Beans	½ cup (130g)
6	Grapes	1 cup
7	Baby carrots	3 oz. (85g)
8	Skinny Pop® Popcorn	3 ¾ cups (28g)

During the serving size activity, the researcher observed participants and recorded information about their use of product packaging and measurement tools while completing the activity. For example, the researcher recorded whether or not the participant viewed the nutrition label for each food measured or if the participant used a measuring tool when estimating the serving size.

Upon completion of the pre-intervention assessment, the participant was randomly assigned to one of three nutrition education intervention groups or a control group that received no nutrition education. Participants in the nutrition education intervention groups received a physical handout (n=8), a link to a video (n=8) (10), or access to a social media account (n=8). The control group (n=8) received no nutrition education. The handout was an 8.5 x 11 educational paper outlining the benefits of utilizing serving sizes and the risks of eating more than the estimated serving size. The video was found on YouTube.com and outlined topics similar to the handout, with an emphasis on serving sizes for fruits and vegetables. For the social media group, the researcher posted serving size information at 3:00 PM CDT daily on Instagram that reflected the information found in the other tools. The participant's use of the educational option they were assigned was assessed during the post-intervention assessment. This was evaluated through the participant's perception of how beneficial their treatment was compared to the accuracy of their serving size estimations.

One week after the pre-intervention assessment, the participants returned to complete the post-intervention assessment. This assessment utilized the same serving-size activity as the pre-assessment, as well as a similar survey, with a few added questions. The extra questions asked participants to evaluate the effectiveness of their nutrition education intervention tool, if

applicable. The data collected was analyzed using SPSS. Repeated measures ANOVA was used to compare means of accuracy among treatment groups at both time-points in data collection.

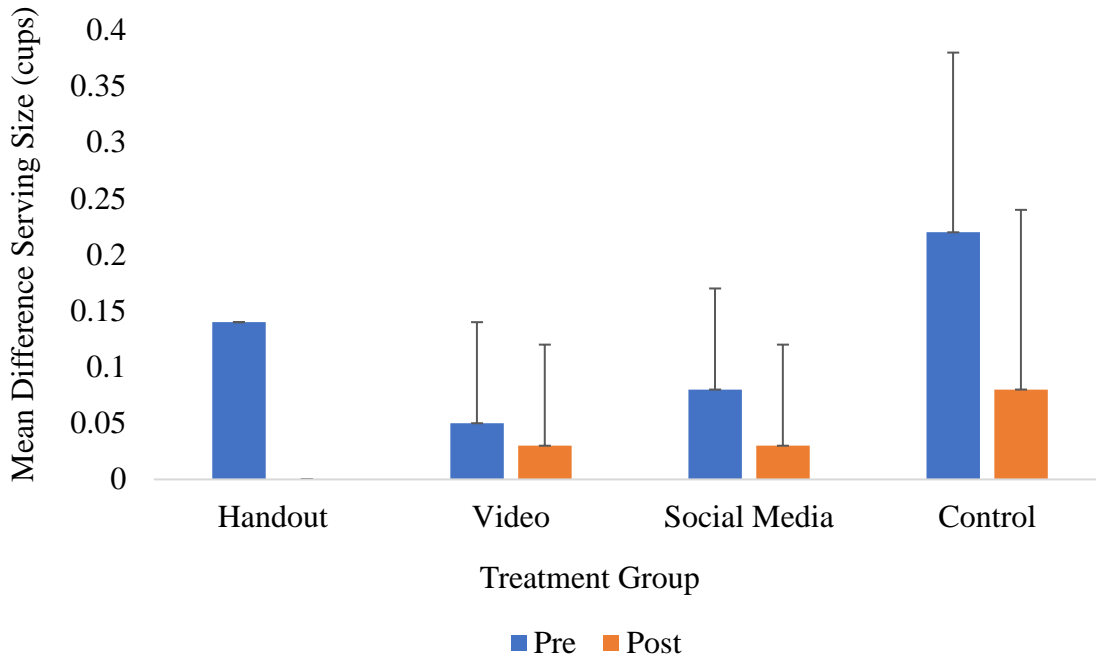
## **Results**

### **Serving Size Accuracy: Baseline, Treatment, Post-Intervention Assessment Measurement**

The data assessment process began with evaluating all eight food groups to all four treatment groups to determine the improvement in accuracy between baseline and post-assessment among treatment groups. The first group of results represent the participants' accuracy of serving size and use of the Nutrition Facts label during the baseline assessment activity. When comparing participant accuracy by treatment group before and after the intervention, the overall accuracy of serving size estimations among most foods did not improve by time or treatment. In Figure 2, Cheerios was the exception and improved in accuracy over time, but there was no difference among the treatment groups. The Y-axis represents mean difference in serving size and the orange bars represent post-intervention assessment and express smaller differences in mean accuracy. For Cheerios, accuracy improved. Of the treatment group comparisons, results indicate that the handout group was more accurate on measuring the serving size of Cheerios during post-assessment.

Figure 2.

Mean difference in Cheerios portion size from serving size.



\* Time Significant  $p = 0.017$

To better understand the varying levels of accuracy with participants, the percentage of participants who utilized the Nutrition Facts labels during assessment was calculated and compared to the percentage of participants who accurately estimated the serving size (see Table 3). The percentage of participants utilizing the labels did not necessarily impact the accuracy of serving size.



Table 3.

Comparing participant utilization of the Nutrition Facts panel and accuracy of serving size.

	Food Group	Utilization of Packaging	Accurate Serving Size
1	Honey Nut Cheerios a	63%	63%
2	Orange Juice c	59%	41%
3	Macaroni & Cheese c	63%	47%
4	Brown long grain rice c	66%	56%
5	Pinto beans b	63%	69%
6	Grapes c	50%	44%
7	Baby Carrots b	59%	63%
8	Popcorn c	63%	31%

a Utilization of packaging consistent with accuracy of serving size.

b Utilization of packaging improved accuracy of serving size.

c Utilization of packaging did not improve accuracy of serving size.

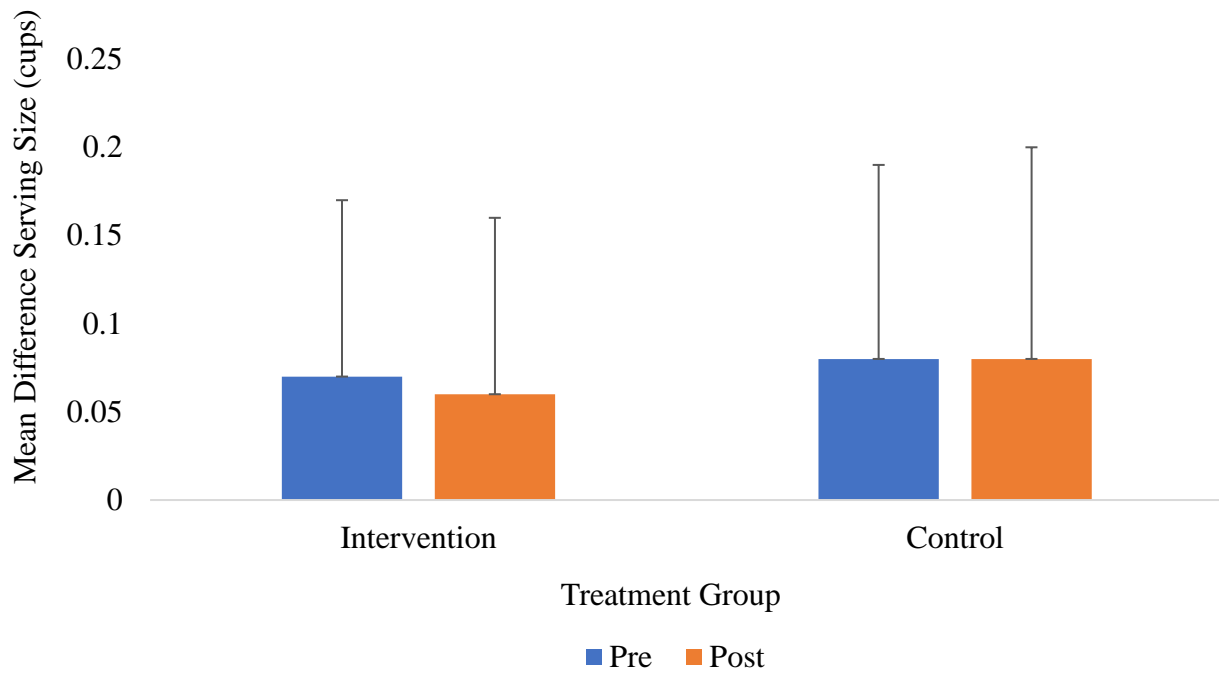
After comparing all intervention options between pre- and post-intervention assessment, participants with an intervention (handout, video, social media) were pooled (n=24) and compared against the control treatment (n=8). Significance was found in two foods (brown rice time significant  $p = 0.053$ ; popcorn treatment significant  $p = 0.073$ ). With these comparisons, brown rice accuracy differed significantly between time points but not by treatment. Popcorn accuracy was significant between intervention and control treatment groups, but not over time points.

In the brown rice group, results showed significance between pre- and post-interventions, indicating that participants decreased in accuracy in estimating serving sizes by not improving

accuracy between the pre- and post-interventions (see Figure 3). And when comparing only pre- and post-intervention accuracies, all participants decreased accuracy in the brown rice group over time, regardless of treatment or control. Overall, serving size accuracy of brown rice did not improve between pre- and post-assessment, regardless of intervention or control group.

Figure 3.

Mean difference in brown rice from serving size.

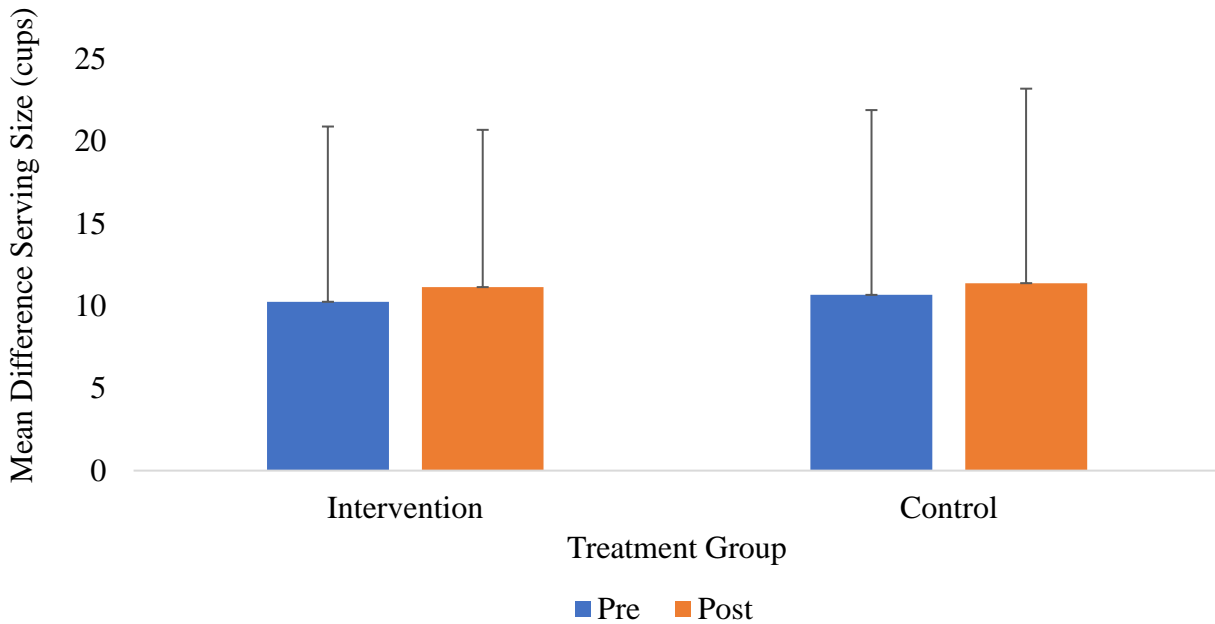


\* Time Significant  $p = 0.053$

In the popcorn food group, results showed significance between treatment groups. However, this significance represents that participants did not improve serving size accuracy between the intervention and the control treatments (see Figure 4). When comparing only intervention and control groups, all participants decreased accuracy in the popcorn food option, based on treatment and not time of assessment. Serving size accuracy of popcorn did not improve between intervention and control groups, nor between pre- and post-assessment.

Figure 4.

Mean difference in popcorn from serving size.



\* Treatment Significant  $p = 0.073$

### Assigned Nutrition Education Tools and Accuracy of Serving Size Estimations

The second group of results investigated the perceived effectiveness of the assigned educational materials. Participants both Strongly Agreed (41%) and Agreed (41%) that their assigned material was beneficial to their ability to accurately estimate a serving size, as shown in Figure 5. Of the participants ( $n=14$ ) who responded “Strongly Agree” when assessing assigned education material to serving size accuracy, most of the responses (36%) are from the Handout treatment group, as shown in Figure 6. When asked how much time was spent reviewing the material during the intervention period after baseline assessment and before post-assessment, 58% ( $n=14$ ) of participants reviewed their assigned education option for 1-5 minutes (See Figure 7).

Figure 5.

Participant responses from all treatment groups to the statement, "The material I was given was beneficial to estimating the accurate serving sizes."

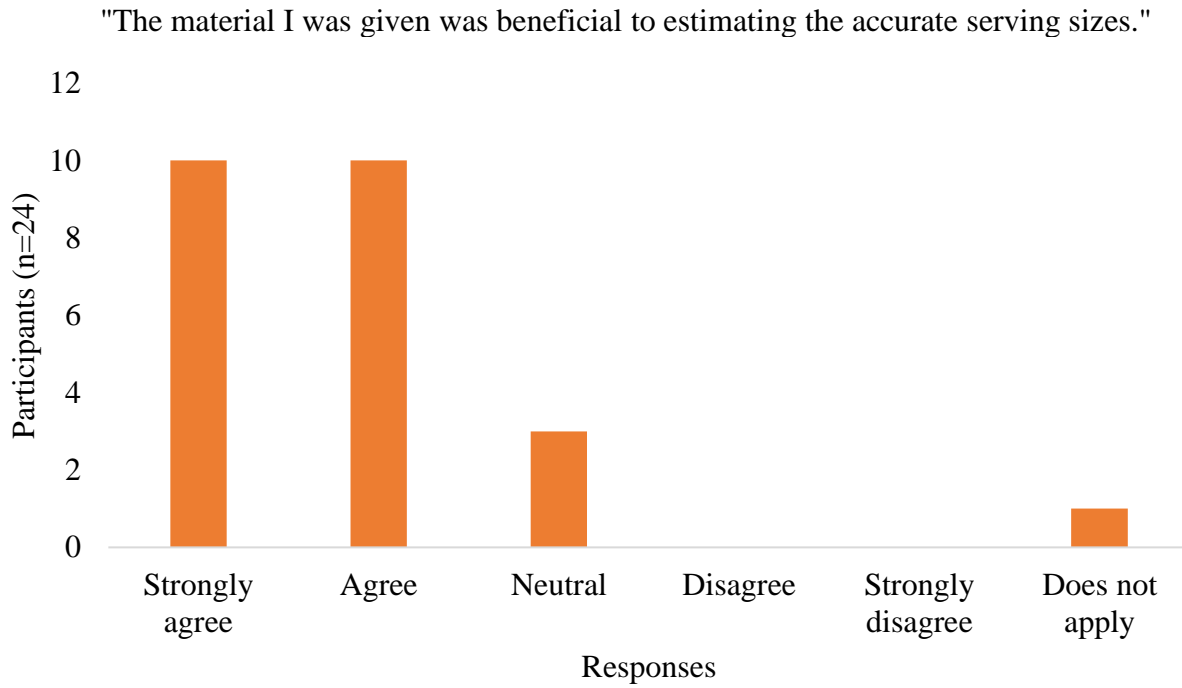


Figure 6.

"Strongly agree" response between treatment groups.

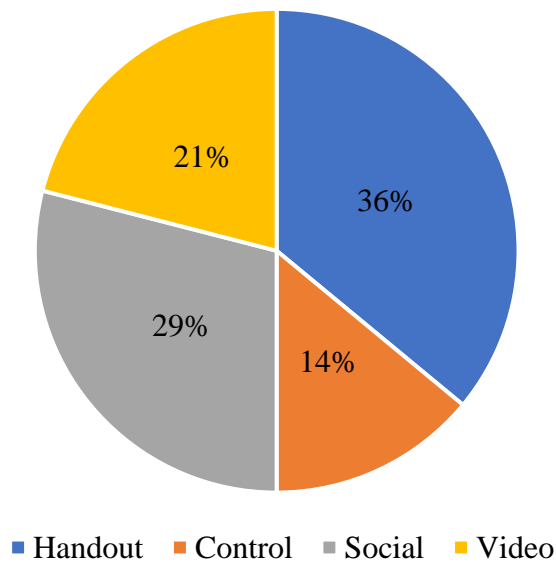
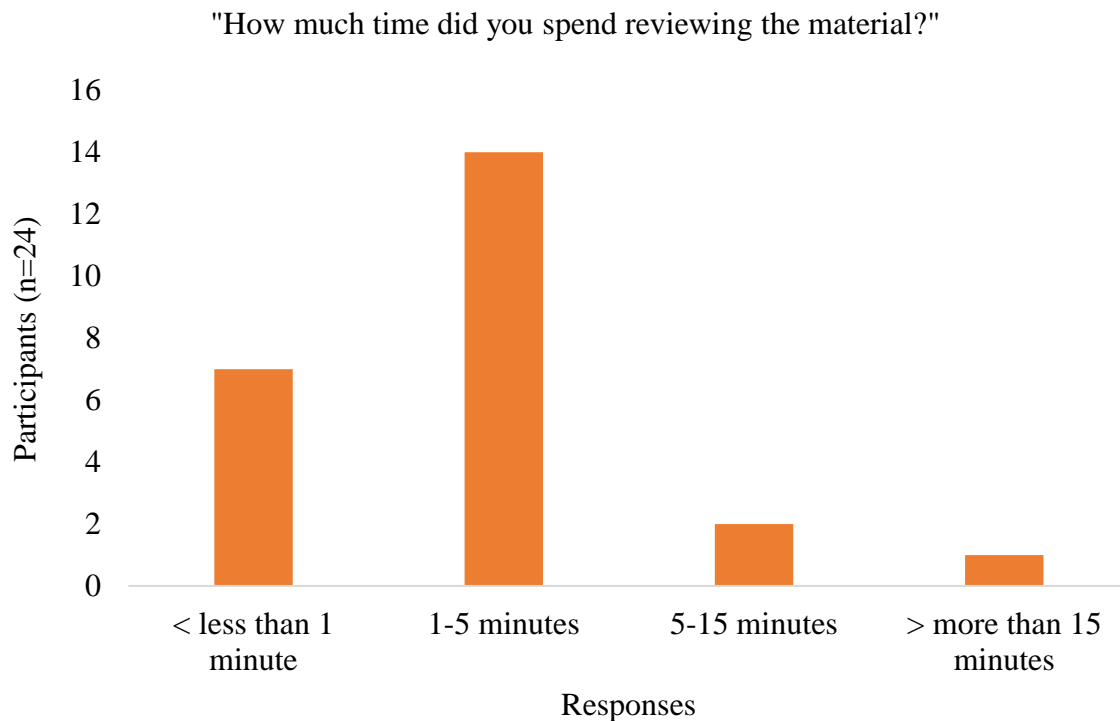


Figure 7.

Amount of time participants assigned to a treatment group (control group responses excluded) spent reviewing assigned education material (n=24).



### Participants Reasoning for Using Serving Sizes

Lastly, participants were asked to respond to a series of questions regarding their motivations for using serving sizes from the label (see Table 4). The most common motivating statement chosen was that participants did not want to overeat (63%, n = 20). Another popular reason for using serving size labeling were the desire to achieve nutrient adequacy (n = 14).

Table 4.

Participant responses in favor of using serving sizes (n=32).

Statement	# of Responses
My friends/family do.	5
I count calories. It is easier to count with measurable serving sizes.	6
It is enjoyable to me to portion.	3
Accurate serving sizes contain the adequate nutrients I need to reach daily intake goals.	14
FDA recommended, so it must be good to do?	8
I don't want to overeat.	20

### Discussion

Achieving nutritional adequacy is difficult for adults of all ages and understanding serving sizes can help. The purpose of this study was to evaluate the impact of a nutrition education material on serving size accuracy. Participants in this study measured serving sizes with significant accuracy at baseline, which may have contributed to the lack of impact of the nutrition education on accuracy. Participants frequently referred to the Nutrition Facts labels during data collection, which may suggest why participant accuracy was so high and little improvement was seen at the follow-up assessment. Most participants agreed or strongly agreed that their treatment was beneficial. Of those who strongly agreed, the largest percentage were in the handout treatment group. The handout provided information on measuring serving sizes and, according to some participants, the visual was quick and easy to read. Previous studies indicate that providing basic, simple information is the easiest way to hold consumer attention when providing nutrition education regarding food (4). Yet, the YouTube video, while simple to understand and less than ten minutes long, required participants to revisit their mailbox to find

the email with the embedded video link, which may have lessened the convenience of the tool. And the social media account could be viewed simultaneously with other accounts that the participants do not associate with nutrition, making the information possibly harder to retain or deem important. In addition, the handout treatment group had the highest percentage of participants who had never taken a nutrition course before, which could have led to increased knowledge of how to use the information provided and interest in the study.

Ultimately, the presence of the Nutrition Facts label can contribute to consumer nutrition literacy. College-aged students are at an age of gaining independence, often making food-choices completely independently for the first time in their lives. This population may look to food labeling for guidance without realizing the implications.

Although serving sizes can be useful, other labels and marketing on food products can influence intake too. Portion size depictions on the front of cereal boxes that are 64.7% larger than recommended portions on Nutrition Facts label can mislead consumers to think the serving size is more than what is actually recommended which may lead to overeating (6). Widespread misunderstanding of serving sizes indicates need for change to both Nutrition Facts label education and information presented on the packaging (12). The common thread of these past findings and this current study is that participants can often estimate a proper serving size within the guidelines of the provided tools, however, in some cases, the Nutrition Facts labels can be misinterpreted.

In the current study, the results revealed inaccuracies in the serving size estimations across multiple categories. In the brown rice and popcorn food groups, regardless of time or treatment, the accuracies of estimated serving size did not improve. This can be perceived to be due to the Reference Amounts Customarily Consumed, or RACCs, found on a food label and the

inconsistency of the metric and volume serving size measurements, because each of these serving sizes displayed on the packaging in this study did not appropriately reflect the RACCs (13). According to the RACCs for grains, the reference amount is 140 g prepared; 45 g dry. In contrast, on the packaging used for the study, the brown rice displayed  $\frac{1}{2}$  cup (43g). And when measured,  $\frac{1}{2}$  cup of dried brown rice does not equal the advertised 43 g dry rice. It equals 62g dry rice. Additionally, the RACC for popcorn shows a reference amount of 30g, while on the packaging used for the study, the popcorn displayed  $3\frac{3}{4}$  cups (28g). With the popcorn, participants interpreted the  $3\frac{3}{4}$  cups to mean 3 cups and  $\frac{3}{4}$  cups, while it actually should be measured as  $3\frac{3}{4}$  cups. When misinterpreted, the consumer measures 56g of popcorn for a serving, which doubles the nutrients found in the intended serving size; thus, doubling the calories, sodium, carbohydrates, and fat amounts unintentionally. This emphasizes the importance of ensuring that consumers read the Nutrition Facts label appropriately so as to not unintentionally overconsume.

One limitation of the study is that participants had limited time to interact with their nutrition education materials. One week may not be enough time to address the challenge of habitual change. According to a study on motivational interviewing, the likelihood that change will occur is strongly influenced by what people say about the change, in that statements that reflect motivation for and commitment to change do predict subsequent behavior change (14). In this study, the participants did not perceive a problem and did not necessarily have motivation to change their dietary lifestyles with the tools provided. Participants, even with 47% reviewing the material for less than a minute over the intervention week and 69% of participants feeling that they had accurately portioned the serving size amount during the assessment activities, did not improve their serving size estimations. Therefore, self-efficacy was hard to determine, and the



participants did not have any reason for reading the educational handouts because there was no goal for habitual changes beyond compliance with the study.

Another study limitation is that accuracy of serving size estimations were not compared with the quality of the participants' typical dietary habits; a 24-hour dietary recall was not collected. In addition, while common foods were chosen for the assessment, the participants may not have been familiar with the foods they were presented with for portioning. Lastly, all participants were evaluated during a school week. While the assessment only took about 10-15 minutes to complete, the participants may have not been focused on the task at hand and could have been thinking about other commitments. There was no test used to assess the motivation of the participant to accurately measure the serving sizes on the Nutrition Facts label.

In the future, it would be beneficial to evaluate the educational tools in other population groups. Different age groups learn in different ways with different motivations, so nutrition education may impact them differently. Determining the most appropriate educational tool for each population will help healthcare professionals share nutrition and health information with a given group in the most effective manner. Through successful nutrition education, there is an opportunity to minimize potential health risks from over- or underconsumption of nutrients.

### **Conclusion**

Female college-aged students are generally accurate at determining serving size measurements for a variety of foods when given tools to do so. In line with previous studies, this accuracy is influenced by the clarity of the nutrition label, the type of measurement unit that the serving size recommends, and the interest of the individual to use serving sizes. Future research

should look at populations that have limited knowledge of serving sizes to best determine nutrition education interventions.

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