

The Effects of Visible Cheese on the Selection and Consumption of Food Groups to Encourage in Middle School Students

Joseph E. Donnelly, EdD; Debra K. Sullivan, PhD, RD, LD; Bryan K. Smith, PhD; Cheryl A. Gibson, PhD; Matt Mayo, PhD.; Robert Lee, PhD., Anthony Lynch, RD Tara Sallee, RD, Galen Cook-Weins, MS, and Richard A. Washburn, PhD

Please note that this study was published before the implementation of Healthy, Hunger-Free Kids Act of 2010, which went into effect during the 2012-13 school year, and its provision for Smart Snacks Nutrition Standards for Competitive Food in Schools, implemented during the 2014-15 school year. As such, certain research may not be relevant today.

ABSTRACT

Purpose/Objectives

The purpose of the investigation was to determine the effects of visible cheese on selection and consumption of food groups to encourage (FGTE) in middle school students.

Methods

Study 1 was conducted in three middle schools with 145 students (Boys=67, Girls=78, 30% minorities). The regular monthly menus were altered to provide items presented as normally served or with additional visible cheese. Study 2 was conducted in a research kitchen and utilized 72 middle school students (Boys=30, Girls=42, 78% minorities). For both studies FGTE were presented side-by-side as normally served with no visible cheese (NC) or with additional visible cheese (VC) across a 3 week period. Selection and consumption was documented using digital photography before and after the meal. Both studies assessed energy and macronutrient content using Nutrition Data System for Research software. Both studies assessed satiety and consumer satisfaction. Cost analysis was completed for Study 1.

Results

For Study 1, the composite score for FGTE indicated 16% greater consumption for VC compared to NC ($p<0.08$). Energy consumed for VC compared to NC was 35 kcal less (ns). VC increased the cost of an item ~\$0.20. For Study 2, the proportion of students who selected VC items compared to NC items was 0.74 ($p<0.0001$). The composite score for FGTE indicated greater consumption for VC compared to NC (54% to 46%; $p<0.002$). Energy consumed for VC compared to NC was 187 kcal greater. Both studies indicated greater consumer satisfaction for FGTE with VC and similar satiety compared to NC.

Applications to Child Nutrition Professionals

FGTE were not consumed in recommended amounts. Strategies are available to offset any increase in cost due to added VC. VC may be a strategy to increase consumption of FGTE in middle school children.

Key Words: Food Groups to Encourage, Whole grains, Fruits, Vegetables, Dairy

INTRODUCTION

The 2005 USDA Dietary Guidelines define food groups to encourage (FGTE) as fruits, vegetables, whole grains, and fat-free or low-fat milk products. These food groups have been associated with reduced risk from several chronic diseases including hypertension, type 2 diabetes, and some cancers, among others (U.S. Department of Health and Human Services, 2005). Most Americans,

including children, do not consume recommended amounts of FTGE (Guenther, Dodd, Reedy, & Krebs-Smith, 2006; Knol, Haughton, & Fitzhugh, 2006; Sebastian, Wilkinson Enns, & Goldman, 2009). Strategies are needed to encourage consumption of FGTE. The addition of visible cheese (VC) to foods may increase the appeal when compared to foods without additional visible cheese (NC) and in turn may increase selection and consumption of FGTE (Neumark-Sztainer, Story, Perry, & Casey, 1999). If VC is a viable strategy to increase selection and consumption of FGTE, this strategy may be most successfully applied to children as habits for diet intake are developed young and generally track into adulthood (Larson et al., 2008; Savage, Fisher, & Birch, 2007; Williams, Paul, Pizzo, & Riegel, 2008).

Although the addition of VC with FGTE may increase selection and consumption of these foods, there are a variety of questions regarding the appearance and acceptance of VC on the items in FGTE. For example, the addition of VC to fruits and vegetables may not increase consumption due to lack of familiarity of children and adolescents with these types of foods. The Third School Nutrition Dietary Assessment Study (Condon, Crepinsek, & Fox, 2009) revealed that schools are offering fruits and vegetables, but large percentages of children are still not consuming them, especially dark green or orange vegetables. Thus, it is not a forgone conclusion that the addition of VC may result in increased selection and consumption.

To determine the effects of VC on selection and consumption of FGTE in middle school children, we designed two studies. Study 1 was conducted in three cafeterias and used identical monthly menu cycles to provide FGTE either with VC or NC. Study 2 was conducted in a laboratory setting and provided side-by-side comparisons of FGTE with VC or NC.

VC has the potential to increase energy and fat consumption and this may be an issue considering the increase in child and adolescent obesity. It was not the intent of this study to alter the menus for energy or nutrient value; however, we did measure the energy and nutrient value of foods with and without additional VC to determine the level of overall energy consumed under the two conditions.

It is also important to recognize the potential financial impact of additional VC. School food services typically have budgets independent of the overall school budget and in effect run as separate businesses. Any alteration of menus and food items that impact student participation and pricing must be carefully considered. Therefore, we provided a cost analysis for preparation and production of meals as well as a comparison of the number of meals purchased during periods of VC and NC.

METHODOLOGY

Study 1

Participants. One hundred forty five students (Boys=46%, Girls=54%; 30% minorities) from three middle schools in Lawrence, KS, participated in this study after providing parental informed consent and student assent. Exclusion criteria were restrained eating habits, food allergies, eating disorders, or consumption of school lunch less than 3 days/week.

Design. A two week wash-in period familiarized participants with the study procedures. Subsequently, schools were randomized to a one month menu cycle with VC or NC. A two week wash out period followed and then participants were crossed over to the opposite condition for one month. Approximately 12 participants each day were randomly selected for nutritional analysis; however, students were not notified of selection until all food and beverage items were chosen for that day.

Modification of school menus for VC. The school foodservice director (PM) and investigators (DKS) altered existing menus by providing VC to selected FGTE. Altered menus provided approximately 0.75 oz of sliced cheese for whole grains (i.e., sandwiches, tortillas), one ounce of shredded cheese on whole grains (i.e., pastas, rice) and vegetables, and two ounces of cheese cubes with fruits.

Measurement of diet intake. Diet selection along with food intake were analyzed by digital photographs taken before and after meal consumption. The energy and nutrient content of food

consumed was determined using Nutrition Data System for Research ([NDS-R]; Nutrition Coordinating Center Minneapolis, MN, version 2008).

Cost analysis. We estimated the average cost per meal of providing VC using costs for the purchase of cheese and costs associated with meal preparation from work records. Total costs were divided by the number of meals served (cost/meal).

Student taste preference and satisfaction. Preference and satisfaction of foods are variables that may affect participation in the school lunch program and are thus linked to the potential for adoption of recipes with VC by school cafeterias. Surveys were administered to assess these variables for VC and NC.

Study 2

Participants. Seventy-two middle school students (Boys=42%, Girls= 58%; 78% minorities) in Kansas City, KS, participated in this study after providing parental informed consent and student assent. Exclusion criteria were identical as Study 1.

Design. Study 2 was a side-by-side comparison of choice and consumption of FGTE with or without VC. Participants consumed their lunch in a room separate from the cafeteria and selected items isolated from their peers. For each lunch, one or two FGTE were offered with VC. The type and amount of VC was the same as described in Study 1. A one week run-in period was used to familiarize participants with the study routine. Each participant was then assessed once each week for 3 weeks.

Methodology. Item choice (VC or NC), energy and macronutrient intake, and student taste preference and satisfaction were assessed using procedures described in Study 1.

Statistical analysis. For Study 1, a cross-over design was used in which three schools were randomized to two conditions and subsequently crossed over to the opposite condition. Frequencies and percentages were used to summarize categorical variables. NDS-R calculated servings from the specific FGTE in each meal were summed by individual and menu cycle into groups of fruits, vegetables, and whole grains. Due to the non-normal distributions of the data, differences in sums of serving amounts between conditions (VC–NC) were analyzed using signed-rank tests. Energy and macronutrient variables were analyzed with linear mixed models that adjusted for group and menu cycle. Carry-over effects due to the cross-over design were not significant.

For Study 2, the percentage of participants who chose a cheese item versus those who did not was modeled using a generalized logistic regression that adjusted for the week of the study. An exact binomial test was used to determine if the percentage of participants who chose cheese each week were increased over the random chance of 50%. NDS-R calculated servings were analyzed in a similar manner as Study 1. Due to the non-normal distributions of the data, differences in sums of serving amounts between conditions (VC – NC) were analyzed using signed-rank tests. All analyses were conducted using SAS version 9.1 (Cary, NC).

RESULTS AND DISCUSSION

Study 1

Consumption of FGTE from meals with VC and NC. Primary analysis was completed for participants who had measurements in both VC and NC cycles (N=108). Scores were computed for consumption of fruits, vegetables, whole grains, and a composite score for all FGTE. Compared to NC, participants consumed less fruit with VC (-30%), more vegetables with VC (+25%), and more whole grains with VC (+23%). The composite score indicated greater levels for FGTE (+16%) for VC compared to NC. None of these comparisons for VC and NC reached the level of statistical difference (Table 1). Lack of statistical difference may be the results of large standard deviations for selection of FGTE and selection of alternative lunch items that were not FGTE.

Table 1. Food group servings consumed: Between group comparisons				
	Study 1		Study 2	
	VC	NC	VC	NC
Fruits	0.14 ± 0.39	0.20 ± 0.54	0.42 ± 0.58	0.14 ± 0.29*
Vegetables	0.33 ± 0.53	0.25 ± 0.51	0.33 ± 0.57	0.23 ± 0.51
Whole grains	0.72 ± 0.92	0.56 ± 0.95	2.84 ± 2.99	1.31 ± 1.95*
FGTE	1.19 ± 1.28	1.0 ± 1.36	3.59 ± 3.28	1.68 ± 2.13*

Note. Values are mean ± standard deviations. VC = visible cheese. NC = no cheese. FGTE = food groups to encourage.

*Significant between group difference (p<0.05).

Energy and macronutrient intake. Energy (kcal) and macronutrient intake (fat, protein, carbohydrate) are presented in Table 2. For the VC menu cycle compared to the NC menu cycle, participants consumed less energy (-5%), similar amounts (g) of fat and protein, and less carbohydrate (- 11%); however, these differences were not statistically significant. When expressed as a percent of total kcal intake, participants consumed a higher percent fat (VC = 33.2, NC = 31.1; p<0.01) and protein (VC = 17.1, NC = 16.2; p<0.02) and lower amounts of carbohydrate (VC = 51.3, NC = 54.3; p<0.003). These differences were not great, and the clinical importance is uncertain.

Table 2. Macronutrients: Between group comparisons				
	Study 1		Study 2	
	VC	NC	VC	NC
Energy (kcal)	676 ± 226	711 ± 237	663 ± 198	476 ± 162
Fat (g)	27 ± 12	26 ± 13	25 ± 8	15 ± 5.3
Carbohydrate (g)	82 ± 28	92 ± 30	76 ± 25	62 ± 23
Protein (g)	29 ± 11	29 ± 12	36 ± 11	26 ± 10
% Fat	33.2 ± 8.7	31.1 ± 8.6*	33.3 ± 6.1	27.8 ± 6.5
% Carbohydrate	51.3 ± 10.6	54.3 ± 9.8*	44.5 ± 6.5	50.5 ± 7.2
% Protein	17.1 ± 3.3	16.2 ± 3.6*	22.4 ± 2.0	21.9 ± 3.4

Note. Values are means ± standard deviations. VC = visible cheese. NC = no cheese. *Significant between group difference (p<0.05).

Cost analysis. During the study period, the three cafeterias served 20,463 lunches, and spent \$4,060 on cheese used. The analysis indicated that adding cheese increased cost of a FGTE item by \$0.20-\$0.25 compared to the same meal without cheese.

We also analyzed the hours of cafeteria employees for VC and NC menu cycles. A regression controlling for school, day of the week, and condition (VC, NC) was applied to the hours data. There was no indication that adding cheese had any effect on hours. To determine if VC compared to NC affected the number of lunches sold, we developed an equation with the number of lunches sold as the dependent variable and days of the week, school, and VC or NC as the independent variables. There was no evidence that adding cheese increased or decreased the number of lunches sold.

Student taste preference and satisfaction. The results of the surveys revealed that the majority of participants felt that the taste of the cheese was more than satisfactory. Vegetables and whole-grain foods with VC were rated as satisfactory to very good. Taste of fruits with VC were less favorable with almost half of participants surveyed indicated that these items need improvement. Seventy-six percent of participants reported satisfactory to very good for the appearance of VC and a majority of participants reported that portion sizes of the cheese was just right.

Study 2

Choice of meals with VC and NC. The actual number of meals chosen by participants with at least one serving of VC is shown in Table 3 for each study day. For example, for study day one, eight participants chose at least one item with VC compared to four participants who did not chose any items with VC. The observed percentage of participants choosing items with VC compared to NC was 0.69, 0.79, and 0.73 for week one, two, and three, respectively. All these proportions are significantly different ($p < 0.001$) compared to 0.5 (i.e., random probability of selecting cheese or no cheese). Overall, the probability of selecting an item with VC compared to NC was 0.74 ($p < 0.0001$). There was no effect for gender; thus, both boys and girls selected items with VC more frequently than the same NC item. Thus, when the same item is presented side-by-side, VC is selected more frequently. In turn, this increases the potential for enhanced consumption of FGTE.

Study day	Meal choice	
	VC	NC
1	8 (66.6)	4 (33.3)
2	12 (85.7)	2 (14.2)
3	9 (64.2)	5 (35.7)
4	8 (72.7)	3 (27.2)
5	8 (57.1)	6 (42.8)
6	13 (92.8)	1 (7.1)
7	10 (76.9)	3 (23.0)
8	11 (68.7)	4 (25.0)*
9	6 (66.6)	3 (33.3)

10	6 (66.6)	1 (8.3)*
11	9 (75.0)	3 (25.0)
12	11 (91.6)	1 (8.3)
13	10 (66.6)	5 (33.3)
14	10 (76.9)	3 (23.0)
15	6 (54.5)	2 (18.1)*
<p><i>Note.</i> Values are number of meals chosen (%). VC = visible cheese. NC = no cheese.</p>		

Consumption of FGTE. Table 1 shows a summary of the number of servings of fruits, vegetables, and whole grains consumed over three weeks for VC or NC. Consumption exceeding one serving for a given meal (whole grains) was due to the portion size exceeding one serving. Significantly, more FGTE were consumed on average for fruits (66% to 33%) and whole grains (54% to 46%) for VC items compared to NC items. More vegetables were consumed on average for VC items (70%) compared to NC items (30%); however, this difference was not statistically significant. It appears that participants who select VC have greater intake of FGTE compared to participants who select NC.

Energy and macronutrient intake. Table 2 shows the estimated energy and macronutrient intake for meals. Boys consumed more energy compared to girls. When meals are consumed with VC added to FGTE, energy and percentage of energy from fat increases. Energy for meals with VC was 663 ± 198 kcal compared to 476 ± 162 for meals with NC. Macronutrients (g) were greater for fat (25 vs. 15) protein (36 vs. 26) and carbohydrate (76 vs. 62) for meals where items were chosen with VC compared to NC respectively. Given that FGTE were prepared identically either with or without VC, and that more FGTE were consumed with VC compared to NC, it is not surprising that meals with VC items had greater energy. If greater energy is not desirable, menus and portion sizes may be easily altered to reduce the energy value to be similar to meals with NC. Similar with increased energy, if added cheese increases the fat content of the meal, the menus can be altered to reduce fat in order to stay within the federal guidelines.

Student taste preference and satisfaction. The majority of participants felt that the overall taste of the cheese was more than satisfactory with little need for improvement. Vegetables, fruit, and whole grains were rated similarly with a majority of participants rating the taste or flavor of these items with VC as satisfactory to very good. The appearance of the cheese was rated highly with more than 90% of participants indicating a satisfactory to very good appraisal. Similarly, a majority of participants reported that size of portions of the cheese was just right.

CONCLUSIONS AND APPLICATION

Children do not consume recommended amounts of FGTE, especially fruits and vegetables. This is apparent in Study 2 where the number of selections of FGTE was considerably below what was available. Table 4 shows the number of selections for a particular FGTE. Each day approximately 12 children were measured for FGTE; thus, the number of potential selections can be approximated by multiplying the number of days offered by 12. For example, if all participants chose cooked broccoli, the count would equal 12. Table 4 shows that only 5 children chose cooked broccoli, only 2 children chose raw broccoli, only 2 children chose mixed greens, and so forth. The results are somewhat better for selection of whole wheat items, especially those that are most familiar such as whole wheat buns.

Table 4. Study 2: Choice analysis of individual FGTE items

Food Name	Days offered	Yes		No	
		Yes	No	Yes	No
apple	4	19	13	59.4	40.6
broccoli, cooked	1	4	1	80	20
brown rice	1	4	4	50	50
dinner roll	3	19	11	63.3	36.6
fresh broccoli	1	1	1	50	50
fresh carrots	3	10	6	62.5	37.5
fruit salad	1	10	3	76.9	23.1
green beans	1	2	4	66.7	33.3
mixed greens	1	1	1	50	50
orange	1	5	3	62.5	37.5
pear	5	17	8	68	32
skillet potatoes	1	7	4	63.6	36.3
tossed salad	5	34	14	70.8	29.2
whole kernel corn	1	3	5	37.5	62.5
whole wheat bun	6	53	27	66.3	33.7
whole wheat noodles	1	6	5	45.5	54.5
whole wheat tortilla	1	6	3	66.7	33.3

Note. FGTE = food groups to encourage.

Study 1 used a real world cafeteria design where participants had many choices from the existing cafeteria menu. Since children do not select and consume FGTE in recommended amounts, it is not surprising that alternate items were frequently selected that were not FGTE. Although the addition of VC improved the overall selection of FGTE compared to NC, it is apparent that when there is a wide variety of choices for food items, as is found in school cafeteria settings, FGTE are not a priority of middle school children.

If children are not exposed to a variety of fruits and vegetables at an early age, they will lack familiarity and likely will be hesitant to select and consume these items (Aldridge, Dovey, & Halford,

2009). This may be especially true for children of ethnicity or children who are economically disadvantaged. Our sample in Study 2 had 78% minority participants and 85% of participants received free or reduced lunch. In this group of children, we observed individuals who could not identify a pear. Exposure theory indicates that children must be presented food items multiple times to establish familiarity and acceptance of the items (Birch & Marlin, 1982; Sullivan & Birch, 1990). Thus, frequent and continuous presentation of FGTE at an early age may improve selection and consumption in young and adolescent children.

Enhancement of FGTE with familiar and desirable food items may increase their selection and consumption. Anecdotally, VC has been suggested by many foodservice directors as a means of enhancing the desirability of FGTE. Children generally indicate they like cheese and cheese is found in many of their favorite foods such as pizza, macaroni, cheeseburgers, and so forth. Cheese is versatile and comes in many types and in many forms (i.e., blocks, cubes, shredded, etc.). Cheese can be served cold or can be added to hot items and recipes and melted. Moreover, participants in both studies indicated satisfaction with taste, appearance, and portion size of FGTE with VC. This indicates that altering FGTE with VC is a strategy that is quickly accepted by middle school students.

In Study 2, cheese enhanced the selection of FGTE. FGTE with VC were chosen more frequently than the same item without VC with the exception of green beans, brown rice and mixed greens that were selected equally served as VC or NC. Both Study 1 and Study 2 indicated increased consumption of overall measures for FGTE for VC items compared to NC items. Thus, it appears that VC increases choice and consumption of FGTE.

Although VC may increase choice and consumption of FGTE, there may be concerns regarding the potential for additional energy intake from VC items. Interestingly, although Study 2 showed an increase in energy intake for VC compared to NC meals, Study 1 did not show an increase in energy consumption for those who chose VC compared to NC meals. Thus, in the normal cafeteria setting, exposure to FGTE with greater energy values did not appear to result in greater overall energy consumption at lunch. This could be due to the satiating effect of the additional protein from the VC in the meals (Poppitt, McCormack, & Buffenstein, 1998; Smeets, Soenen, Luscombe-Marsh, Ueland, & Westerterp-Plantenga, 2008), but this is speculative.

Cost of FGTE items with VC were increased by approximately \$0.20-\$0.25 per serving and it is recognized that school cafeterias are very sensitive to costs. Most school cafeterias are self-sustaining and have separate budgets from the general funds of the school. In Study 1, we did not alter menu items with the exception of additional VC on selected FGTE items; thus the resulting increase in costs. There was no effect of VC on production time or employee hours and there was no effect on the number of lunches sold. Should a cafeteria wish to reduce the cost of VC items and meals, several strategies may be employed including alteration of portion size, ingredients, and condiments. In this fashion, it would be feasible to provide FGTE with VC at a similar price to FGTE with NC.

In summary, consumption of FGTE in middle school students do not meet recommended levels. The addition of VC to FGTE was well received by middle school students and increased the selection and consumption of FGTE. Increased energy and cost associated with VC may be reduced with simple alterations to commonly selected foods other than FGTE.

ACKNOWLEDGEMENTS

This work was supported by grants from Dairy Management Inc., Rosemont, IL, Midwest Dairy Council, St. Paul, MN, Leprino Foods, Denver, CO, Land O'Lakes Inc., Arden Hills, MN.

We would like to thank Land O'Lakes and Leprino Foods for donating the cheese products for this project. We also would like to thank the staff and children at Rosedale Middle School USD 500, Kansas City, KS and at the middle schools of USD 497, Lawrence, KS for their assistance and participation.

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BIOGRAPHY

Donnelly, Smith, and **Washburn** are, respectively, Professor, Assistant Research Professor, and Associate Research Professor at The Center for Physical Activity and Weight Management at The Schiefelbusch Institute for Lifespan Studies located at the University of Kansas in Lawrence, KS. **Lynch** and **Sallee** are Research Assistants at The Center for Physical Activity and Weight Management. **Sullivan** is Associate Professor for the Department of Dietetics and Nutrition at the University of Kansas School of Allied Health in Kansas City, KS. **Gibson** is Associate Professor for the Department of Internal Medicine at the University of Kansas School of Medicine in Kansas City,

KS. **Mayo** and **Cook-Weins** are, respectively, Professor and Senior Research Analyst for the Center for Biostatistics and Advanced Informatics at the University of Kansas School of Medicine in Kansas City, KS. Lee is Professor for the Department of Health Policy and Management at the University of Kansas School of Medicine in Kansas City, KS.