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Research Article

The Use of Photography for Determining Macronutrient Intakes of High School Students Participating in the National School Lunch Program

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Abbreviations BMI: Body Mass Index; NSLP: National School Lunch Program

Abstract

Background: The nutritional quality of the National School Lunch Program (NSLP) meals has been criticized as a major contributor to the obesity epidemic in U.S. children. There is need to determine the actual gram consumption and compare the energy and macronutrient contributions of these meals with foods eaten when not at school.

Objectives: To determine if photography is a reliable data collection tool for measuring food intakes of high school students who participate in the NSLP. Secondly, to compare the energy and macronutrient content of the NSLP meals with meals eaten when not at school and along with student's Body Mass Index (BMI).

Methods: Researchers measured the amounts of food consumed by the students in one high school in Illinois using photographs of before and after food trays and weighed food wastes for comparisons. Actual wastes were weighed and compared with the estimated gram wastes by blinded independent observers. Estimated percentage wastes were converted into gram amounts based on actual gram weight of the food items. Students completed a demographic and physical activity questionnaire and a 3- day food record to determine the contribution of calories and macronutrients consumed when not at school. Self-reported heights and weights were used to determine BMI. Thirty-six students from grades 9-12 participated in this pilot study, mean age was 16.41±1.30.

Results: Significantly high inter-rater reliability ($r= 0.966$, $p<0.001$) was found for photographic estimates and actual gram amounts of food consumed. Paired samples t-test for calories and macronutrients was significant ($p<0.05$) for meals eaten when not at school with those provided by the NSLP lunch meal. Overall, the NSLP meals provided fewer calories and macronutrients. Mean BMI was 23.09±3.74. High BMI was reported despite being physically active.

Conclusion: High inter-rater reliability was found for photographic estimates and actual food waste. Photography is a reliable tool for measuring food intakes of high school students. Energy and macronutrient intakes were higher for meals eaten when not at school compared to that provided by the NSLP. BMI was not related to calories provided by the NSLP meal nor physical activity.

Introduction

The nutritional quality of the National School Lunch Program (NSLP) meals has been criticized as a major contributor to the obesity epidemic in U.S. children [1-3]. Obesity is associated with the development of chronic nutrition-related diseases such as type 2 diabetes, cardiovascular diseases, and some types of cancers [4,5]. Type 2 diabetes, hypertension, hyperinsulinemia and hyperlipidemia are increasing in younger populations [6-8]. Approximately 17% of US children and adolescents ages 12-19 years are overweight (BMI > 95th percentile) [9]. Previous research reported higher consumption of dietary fat and calories and higher body weights among the participants of the NSLP compared with non-participants in this program [10-12]. However, past researchers have interviewed food service directors and relied on self-reported data from the students on food consumption and weights and heights. There is need for further evaluation of these meals and to compare them with out of school consumption to determine from where the majority of calories are derived. Further, instead of students' self-reports, actual weights and heights are needed. Other factors such as family history of obesity, and low physical activity which contribute to overweight among children and adolescents, need to be examined in future studies.

Previous studies on the diet quality of school lunches [13,14] and school food environment on Body Mass Index (BMI) of US public school children [2] have failed to examine the actual food consumption of the participants. Although relationships were determined between the diet quality of the NSLP meals and overweight among the participants, no other measurements were taken to determine if students were indeed overweight based on BMI standard in these studies [2,13,14]. BMI has been criticized as a means of estimating body fat since it does not take into account a person's lean muscle mass. Research using other measures of measuring body fat; skin fold thickness

measurements, percentage body fat, and family history, would shed light on results to better interpret findings.

Prior research relied on data collected from the planners of the meals instead of the consumers. O'Toole, et al. [15] used computer–assisted telephone interviews and mailed questionnaires to state education agency personnel, whereas Fox, et al. [2] interviewed food service personnel to determine children's consumption of the NSLP meals. However, analysis of verbal reports of available food choices, and typical portion sizes, and numbers of children eating these meals are not reliable to make conclusions about the actual food consumption of NSLP participants. In the current study actual food consumption is assessed by photography of what students ate, and also determined the sources of other macronutrients consumed when not at school via a 3-day food record.

In another study on food intakes of NSLP participants, Templeton, et al. [16] examined actual food consumption of sixth graders and compared this with consumption of "competitive foods" (other foods and beverages that compete with school meals). Trays were photographed at the end of the service line and again at the exit station after students had eaten their meals [16]. Results indicated that "competitive foods" increased energy intakes while decreasing other essential nutrients of students who participated in the NSLP. However, no relationship was determined between energy intakes and BMI of this study population or with foods eaten when not at school.

The purpose of the present study was to validate a method for determining food intakes by photographing the trays before and after students had eaten. Secondly, to determine the actual amounts of calories consumed from the school meals, and compare these with the macronutrient composition of meals eaten when not at school. Thirdly, to compare BMI with the macronutrient composition and consumption of the school meals with meals eaten when not at school. The following hypotheses were proposed: (1) Photographing students' lunch trays before and after eating is an accurate representation of the amounts of foods typically consumed. (2) There are no significant differences in energy and macronutrient intakes of the NSLP meals when compared to meals eaten when not at school as measured by plate wastes and 3-day food record. (3) BMI of NSLP participants will be positively correlated with the consumption of macronutrients and energy supplied by the NSLP lunch meal, and with physical activity.

Methods

Research design

This was a pilot survey on food intake of students in one high school in Kane County, Illinois. Sixty students were recruited via flyers and with the help of the school administrators. Approval for conducting the study was obtained from the Institutional Review Board, Northern Illinois University. Parental consent was obtained and students completed an assent form. Students were randomly selected from grades 9-12, and included males and females. Of the 60 students, 36 reported on data collection day, however, only 22 students completed the entire questionnaire and were included in the final analyses. Calculation of sample size and power using an expected r of 0.60, alpha = 0.05 and beta =0.10, 25 subjects would be needed for this correlation study. A sample size of 22 was deemed close enough to power of 0.10 or 90%.

Procedure

With the help of trained Research Assistants (RA) (graduate and undergraduate students), vice principal and food service workers, sixty students were randomly recruited; 15 from each grade level by choosing every nth name from a list. No student responded to the flyers by calling the researchers as originally intended to indicate their interest in the study; therefore, random selection was used to recruit study subjects. Selected students were given a package with two consent/assent forms to take home to their parents. Students were told that the purpose of the study was to make some suggestions for improving the kinds of foods they serve at lunch. They were informed that they can choose not to participate. Parents who consented were told to keep one of the forms and return the other in the envelope provided, to the secretary at the school. The secretary who was briefed on the study protocol, collected the informed consent presented in a sealed envelope, and matched the number on the envelope with the number on the questionnaire and gave the matching questionnaire to the student. Students were told to complete the validated demographic/physical activity questionnaire and 3-day food record prior to data collection day. After recruitment, students were informed of one day in the spring semester when the researchers would return to photograph their food trays. After recruiting and consenting were completed, the researchers returned within three weeks to photograph the food trays.

Data collection

With the help of the school administrators, students were randomly selected from the different lunch periods which allowed the researchers sufficient time to collect the food intake data as students were evenly spread out during the different lunch periods. Administrators also helped to guide consented students to the area of the cafeteria where the researchers were discretely located. On data collection day, consented students reported to the researchers as they entered the lunch room. Their names were verified against their consent/assent forms. Students were given an ID card with a Personal Identification Number (PIN) which matched the number of their consent form and questionnaire. This number was placed on a tray before the students collected their lunch meal. Students were allowed to choose their foods and were told to return to the researcher to have their trays photographed. Students were told not to exchange any food items and to return all food wastes on the trays to the researchers who again photographed the trays. One researcher also weighed and recorded the food wastes for later comparisons with estimated percentage food wastes.

Subjects' consumption of each food item was determined by estimating percentages of amount of each item eaten based on paired tray samples of before and after photographs. Estimated consumption of food items that could be counted, such as the number of "smiley fries" was determined by subtracting the amount left on the plate from the original amounts that was served. Milk was poured into a transparent cup from which the estimated percentage volume left was determined and then subtracted from the original amount served. Items such as pizza and sandwiches were estimated using the area left on the plates compared to the size of the item that was originally served. Numbers, area and volume were converted and recorded as percentages. Percentages were then converted to gram weights for statistical analyses.

To determine the gram weights, three samples of each food item served at lunch were weighed and averaged to arrive at a standard gram weight for that item by one RA not involved with the visual estimates. Amounts of food and beverages consumed were determined by converting the visual estimates of percentages of food wastes to the gram weights of the actual amounts served. For example, if an item weighed 60 grams and the estimated waste was 25%, then the amount of waste left on the plate was recorded as 15 grams. This indicated that 45 grams of this item was eaten. From the example given, this estimated 15 grams was then compared with the actual gram weight of the foods that were left on the plate. The 45 grams of estimated consumption were entered into the nutrient analysis program Diet Analysis Plus version 10.0, to determine the nutritional contribution of the food item consumed. Gram amounts were analyzed using Diet Analysis plus Version 10.0 and then re-entered into SPSS version 22.0.

To determine where the majority of calories came from, the students completed a 3-day food record of all food and drink consumed when not at school. Foods eaten when not at school were also analyzed using Diet Analysis Plus Version 10.0 to determine the nutrients consumed. The macronutrient composition and energy supplied by the meals eaten when not at school were compared with the NSLP meals and with students' BMI percentiles and physical activity.

Physical activity of participants was measured using the self-administered Physical Activity Questionnaire for Children (PAQ-C) [17]. This questionnaire assesses students' physical activity in and out of school for seven days. Self-reports of heights and weights were used to determine students' BMI. BMI was coded using the CDC's cut-off percentages [18] for at risk to overweight (> 85th percentile) and overweight (>95th percentile). Data were analyzed to determine the association between calories consumed from the NSLP meals with those eaten when not at school; calorie consumption and physical activity levels; BMI; and with demographic variables.

The researchers also collected the demographic questionnaires which were given to the students prior to data collection, when they returned their signed consent forms. Upon completion of all assessments: demographic/physical activity questionnaire, 3-day food record, and photographed trays, student's names were entered into a draw and three students were randomly selected and received cash incentives in the value of $25.00 each.

Statistical analyses

Data were analyzed using SPSS version 22.0 for Windows Statistical Software (SPSS Inc., Chicago, IL, USA). Pearson's correlations were used to determine inter-rater reliability for validating the use of photography. Paired samples t-tests were used to determine if there were significant differences in macronutrient and energy intakes of NSLP meals compared with meals eaten when not at school. Chi-square analysis were used to determine the proportion of subjects at risk for overweight and low physical activity. Descriptive statistics such as means, standard deviations, frequencies and percentages for demographic characteristics of the population were determined. A value of $p<0.05$ was considered significant.

Results

Of the 60 students who were recruited, thirty-six reported on data collection day, however, complete data sets were collected for only twenty-two which were used in the data analyses. Of the remaining fourteen students who had their food trays photographed, ten did not return the questionnaire and four returned the questionnaires without completing the demographic information. More females than males participated. The majority of the students were from grade twelve. Mean BMI was 23.09 ± 3.74 kg/m^2 and ranged from at risk to underweight to being overweight, with 50% of the sample reported being overweight or at risk for overweight based on the CDC's BMI percentiles for height, weight, age and gender. See table 1.

Table 1: Demographic characteristics of sample (N=22).

Variables	Categories	Frequency n (%)	Mean ± SD
Gender	Male	8 (36.4)	
	Female	14 (63.6)	
Age (Years)	14	2 (9.1)	16.41 ± 1.29
	15	3 (13.6)	
	16	7 (31.8)	
	17	4 (18.2)	
	18	6 (27.3)	
Grade	9	3 (13.6)	
	10	4 (18.2)	
	11	6 (27.3)	
	12	7 (31.8)	
	No Response	2 (9.1)	
Ethnicity	Caucasian	13 (59.1)	
	Mixed	4 (18.2)	
	Indian	3 (13.6)	
	No Response	2 (9.1)	
BMI (Overall)			23.09 ± 3.74
BMI (Percentiles)	Underweight (3-5)	2 (9.1)	3.00 ±0.00
	At risk for underweight (10-25)	2 (9.1)	17.50± 10.61
	Normal weight (50-75)	7 (31.8)	64.28 ± 13.36
	At risk for overweight (85-90)	6 (27.3)	87.50 ± 2.74
	Overweight (95-97)	5 (22.7)	91.20 ± 0.4.48
Physical Activity	Low PA (≤ 2 x per week)	3 (13.6)	
	High PA (≥ 3 x per week)	17 (77.6)	
	No Response	2 (9.1)	

Validation of photography

There was strong correlation ($r=0.966$, $p<0.001$) between estimated foods consumed using photography, when compared with the actual weights of foods consumed which indicates that photography is a valid method of estimating the amounts of foods the NSLP participants were in fact consuming. An average of three raters' scores was used to determine the inter-rater reliability of the visual estimates of the trays. See figure 1 for pictures of before and after food tray. Inter-rater reliability ($r = 0.966$, $p = 0.00$, 95 % C.I. 76.73-117.62) was determined by using all thirty-six food trays that

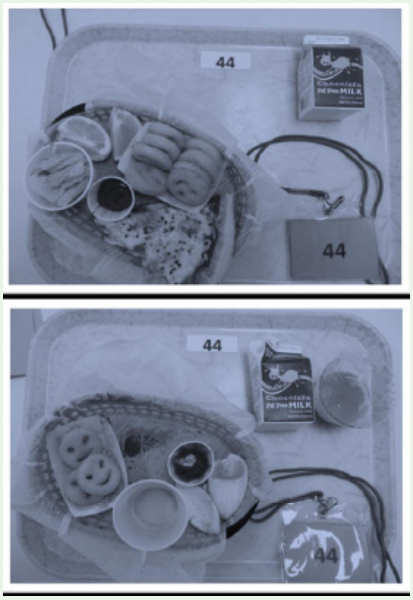

Figure 1: Pictures of before and after eating.

were photographed on data collection day. Having established the correlation and validity, the estimated amounts of foods consumed were analyzed for their energy and macronutrient contribution using the Diet Plus Version 10.0. Results are shown in tables 2 and 3. Despite using all thirty-six trays to determine the correlation between photographic estimates and actual intakes, only 22 subjects were used in all other analyses because complete data (3-day food recall, demographic questionnaire) were available for only 22 subjects.

Comparison of energy and macronutrients of NSLP lunch meal with meals eaten when not at school

Table 2 shows the energy and macronutrients consumed at the lunch meal as well as foods eaten when not at school. The overall mean and standard deviations do not include the calories and macronutrients from the lunch meals. The majority of calories were provided by the dinner meals (1314.86 ±800.48) and snacks (1223.56 ±1388.95). Lunch contributed the least amount of calories (491.42 ±270.63). Overall, mean caloric intake was 1205.34 ± 600.25, excluding the calories supplied by the lunch meals. The lunch calories were not included in order to compare these with calories supplied by meals consumed when not at school to determine from where the majority of calories are derived. When each meal is examined by itself, the mean energy and macronutrients of the lunches appear to be higher than that provided by the breakfast, dinner and snack, however, lunch contributes just a portion of the total calories and macronutrients consumed each day. The calories and macronutrients from lunch as indicated on the 3-days food record might or might not have included lunch items from the NSLP; hence they were not added to the total calories in the 3-day food record.

Table 2: Comparison of calories and macronutrients of 3-day food log (N=22).

Variables	Breakfast (Mean ±SD)	Lunch (Mean ±SD)	Dinner (Mean ±SD)	Snack (Mean ±SD)	Overall Mean ± SD
Calories	808.67 ±508.22	491.42 ±270.63	1314.86 ±800.48	1223.56 ±1388.95	1205.34 ± 600.25
Carbohydrates(g)	117.79 ±74.71	189.04 ±131.24	151.14 ±96.40	179.61 ± 281.93	159.39 ± 111.26
Fiber(g)	6.96 ±5.11	15.78 ±10.03	15.96 ±10.37	11.83 ± 11.16	12.63 ± 6.71
Protein (g)	47.45 ±97.33	88.04 ±174.70	62.85 ±33.76	28.59 ± 32.45	56.73 ± 49.85
Total fat (g)	28.08 ±28.76	62.15 ±30.21	52.71 ±38.13	43.20 ± 38.83	46.53 ± 17.78
Saturated fat (g)	9.43 ±9.79	18.21 ±10.82	19.40 ±16.94	12.54 ± 11.72	14.89 ± 6.68
Cholesterol (g)	102.85 ±207.69	104.67 ±96.55	184.06 ±212.98	27.76 ± 38.80	104.84 ± 67.48

Note: Overall mean and SD does not include calories and macronutrients from the NSLP lunch. Energy and macronutrients for the lunch meal might have included NSLP meals in this 3-day food record.

Table 3: Comparison of calories and macronutrients of NSLP lunch with average of 3-day food log (N=22).

Variables	NSLP Lunch (Mean ± SD)	3-days Meals Not at School (Mean ± SD)[a]	P value
Calories	496.96 ±174.24	1115.70 ± 656.02	0.000***
Carbohydrates(g)	65.32 ± 28.88	149.51 ± 113.91	0.003**
Fiber(g)	4.60 ± 2.01	11.59 ± 6.46	0.000***
Protein (g)	24.73 ± 7.57	46.29 ± 38.09	0.015*
Total fat (g)	16.78 ± 5.79	41.33 ± 24.07	0.000***
Saturated fat (g)	5.71 ± 2.75	13.79 + 8.87	0.001**
Transfat (g)	0.01 ± 0.01	NA	NA
Cholesterol (g)	41.33 ± 14.79	104.89 ± 91.27	0.004**

***p< 0.001, **p< 0.01, *p< 0.05

[a]Does not include the calories or macronutrients from the NSLP lunches.

Table 3 shows the mean energy and macronutrient composition of the breakfast, dinner and snacks from the 3-days food record which was used to represent one day of food intake away from school, compared with the macronutrient contribution of the NSLP test meal. Paired samples t-test revealed significant difference($p<0.05$) for the calories, gram amounts of carbohydrates, protein, total fat, fiber, saturated fat, and cholesterol supplied by the lunch meal compared with foods eaten when not at school.

Figure 2 further highlights the differences between energy and macronutrients of the NSLP test meal compared to meals eaten when not at school. In all cases, significantly more calories and macronutrients were supplied by the foods eaten when not at school. This is expected as averages for two meals (breakfast and dinner) plus snacks are used in these comparisons against a test meal for lunch. Lunch calories are expected to provide at least one third of total calories for the day.

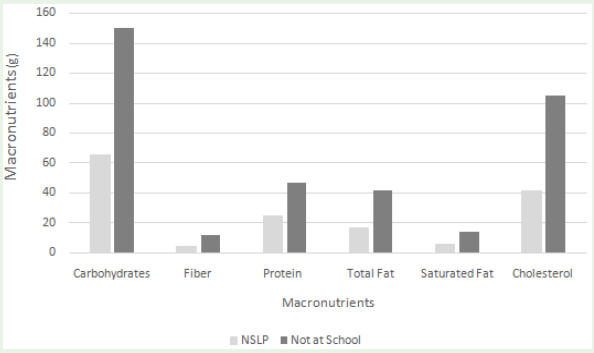

Figure 2: Comparison of macronutrients for the NSLP lunch with meals eaten when not at school.

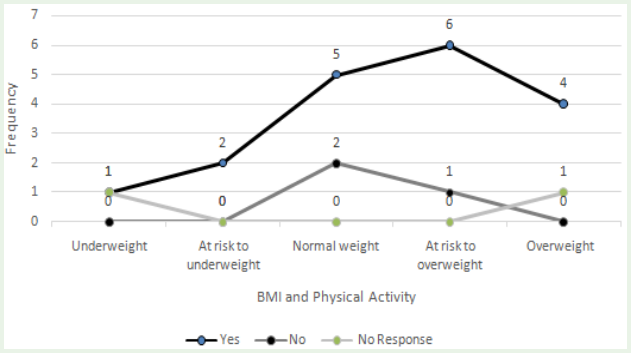

Figure 3: Comparison of physical activity with body mass index.

Comparison of physical activity and body mass index

The PAQ-C examined how many times per week students engaged in some form of physical activity. Table 4 shows the most frequently performed physical activities. It was expected that students would have preferences over one type of activity than others. As expected, jogging was the most cited physical activity followed by walking. The overall mean PA score was 1.20 ± 0.48 which indicated that on average students engaged in physical activities 1-2 times per week. The least performed activities were swimming, football, martial arts, hockey and volleyball. Other activities that were mentioned by only one participant included yoga 1-2 times/wk., soccer 3-4 times/wk., horseback riding 5-6 times/wk., bowling 1-2times/wk., and gymnastics 1-2times/wk. Students were also asked if they perceived themselves to be active, the majority

(n = 17, 77.3 %) perceived themselves as being physically active.

Table 4: Frequency of physical activities performed /week (N=22).

Types of Activities Performed	Students' Ratings Number of Times Per Week Frequency n (%)						Mean ± SD
	No response	0	1-2	3-4	5-6	≥7	
Skip rope	2 (9.1)	12 (54.5)	7 (31.8)	0	1 (4.5)	0	1.36 ± 0.85
Walk	2 (9.1)	6 (27.3)	9 (40.9)	3 (13.6)	2 (9.1)	0	1.86 ± 1.08
Active Games	5 (22.7)	11 (50.0)	4 (18.2)	1 (4.5)	1 (4.5)	0	1.18 ± 1.01
Bicycling	4 (18.2)	11 (50.0)	4 (18.2)	1 (4.5)	2 (9.1)	0	1.36 ± 1.14
Jogging	3 (13.6)	4 (18.2)	4 (18.2)	6 (27.3)	5 (22.7)	0	2.27 ± 1.39
Racquet sports	4 (18.2)	13 (59.1)	1 (4.5)	2 (9.1)	2 (9.1)	0	1.32 ± 1.17
Swimming	3 (13.6)	16 (72.7)	1 (4.5)	0	0	2 (9.1)	1.27 ± 1.28
Dance	4 (18.2)	14 (63.6)	2 (9.1)	2 (9.1)	0	0	1.09 ± 0.81
Football	4 (18.2)	17 (77.3)	1 (4.5)	0	0	0	1.05 ± 0.58
Basketball	3 (13.6)	15 (68.2)	4 (18.2)	0	0	0	1.05 ± 0.58
Hockey	4 (18.2)	16 (72.7)	1 (4.5)	0	1 (4.5)	0	1.00 ± 0.82
Martial Arts	4 (18.2)	17 (77.3)	1 (4.5)	0	0	0	0.86 ± 0.48
Volleyball	4 (18.2)	16 (72.7)	1 (4.5)	0	1 (4.5)	0	1.00 ± 0.82

After finding no relation between BMI and calories consumed, we compared physical activity with subjects' BMI. The mean BMI was 23.09 ± 3.74. Body Mass Index was categorized using the CDC's percentiles for children's age, weight, height, and gender to determine if children and adolescents are underweight, at risk to underweight, normal weight, at risk to overweight and overweight. Figure 3 compared students' physical activity with their BMI. Results indicate that six children were at risk to overweight, and four were overweight despite being physically active. Of the two subjects who did not respond to the physical activity questions, one was at risk to underweight and the other was overweight.

Subjects were questioned on their perceived weight whether they considered their weight to be below normal, normal or above normal. When compared with the reported BMI using CDC's classification, thirteen subjects perceived their weight as normal but only seven were actually classified as normal by CDC's standard. Similarly, eight subjects perceived their weight to be above normal however, six were at risk to overweight and five classified as overweight. Chi square analyses indicated significant difference (p=0.004) for perceived versus calculated BMI. In all cases, students underestimated their weight.

Discussion

This pilot study validated a method of estimating food consumption of students participating in the National School Lunch Program (NSLP) to determine if these lunch meals are the main contributor of calories and saturated fat as alleged in other studies [10-12]. Despite the fact that the NSLP food items may contain high amounts of saturated fat and calories, research is lacking on just how much of these foods are actually being consumed. Earlier studies [2,15] did not measure the amounts of foods consumed, but rather, analyzed the nutritional quality of the NSLP meals on the assumption that the students were actually eating all that was served to them on any particular day. The current study used photography to determine if this was a valid method for estimating just how much of the NSLP foods are consumed.

Three researchers who were not involved with the photographing and weighing of food wastes, estimated the percentages of each photographed food item left on the tray. Results supported hypothesis one that photography could be used to reliably estimate food consumption. High inter-rater reliability (r= 0.966, p<0.001) was observed using Pearson Correlations to determine the gram amounts of foods consumed. In addition to validating the use of photography

for estimating food wastes and conversely food consumption, we also analyzed the lunch meal for calories as well as macronutrients. These were compared with foods eaten when not at school, as reported on the 3-day food record.

For hypothesis two, we hypothesized that there would be no significant differences between energy, and gram amounts of macronutrients consumed from the NSLP lunch meal when compared with foods eaten when not at school. Overall mean caloric intakes from the 3-day food record appear to be less than what adolescents would require based on age, gender and level of Physical Activity (PA). However, it must be noted that the standard deviations were high indicating high variance among the students' intakes of calories. When each meal is examined for its caloric and macronutrients contribution, it would appear that an average of the three days' lunches exceeds those of breakfast, dinner and snacks based on the 3-days food record (Table 2). However, it must be noted that lunch provides one-quarter of the total daily calories when snacks are included. In our comparisons of calories and macronutrients consumed when not at school, we did not include the lunch meals as there might have been overlaps with the NSLP meals. We compared one test meal from the NSLP with the average of the 3-day food record. An average of three days was used to adjust for any discrepancies in eating on these three days. Our results refuted former claims that the school lunch meals are contributing higher calories, saturated fat and overall higher macronutrients which further exacerbate the obesity epidemic among children in the U.S.A [1-3]. It is likely that students might not have recorded all that they ate when not at school, however, the test meal was photographed and the researchers were able to capture all the items served at lunch which strengthens our findings on the foods eaten at school.

For our third hypothesis, we examined the relationship between caloric intake and BMI of the students. We hypothesized that a positive relationship existed between calories supplied by the NSLP meals and the students' BMI. Pearson Correlations revealed no significant correlations ($p > 0.05$). Scatter plots also showed no liner association between calories supplied by the NSLP lunch and students' increase in BMI. Since we did not find an association between calories consumed and student's BMI, we compared BMI with physical activity levels as determined by the Physical Activity Questionnaire for Children (PAQ-C). This was done to determine if the high BMI that was found was a result of insufficient physical activity and not necessarily due to imbalance between energy intake and energy expenditure.

Chi square analysis was performed to determine the proportion of students who were at risk to overweight or overweight based on physical activity. We found, as in previous studies [19-22], that adolescents who are physically active may also have high BMI. This may be due to the inability of BMI to adequately distinguish body fat from lean muscle mass. Secondly, the PAQ-C rated the students as being physically active as long as they performed any two of the activities listed on the questionnaire. Many of the activities are commonly performed such as walking, jogging or running

Similar to other studies on perceived BMI [22], we found that students underestimated their weights which can pose a problem when conducting an intervention to address high BMI among school children. Thirteen subjects perceived their weight as normal but only seven were actually classified as normal by CDC's standard. Eight subjects perceived their weight to be above normal whereas only six were at risk to overweight and five classified as overweight. In our study we found significant difference between perceived and reported BMI.

Strengths and limitations

Despite the small sample size, we were able to validate photography and found it to be a reliable tool for assessing food intakes of students who ate the NSLP meals. This method may also be used to determine food intakes of other institutionalized populations such as nursing homes. Strength in the study was the comparison with a 3-day food record which showed from where the majority of calories are derived. With two meals eaten when not at school, it is expected that more calories would be found in those meals when compared to the lunch meal. These findings further strengthened our arguments that the NSLP lunch meal is not the main contributor of the excess calories as indicated in earlier studies. Our study also examined the role of physical activity in relation to BMI and compared macronutrient consumption with BMI as well as with physical activity.

Limitations include the inability to separate snacks eaten at schools from snacks eaten when not at school. However, the aim of this pilot study was not to compare calories or macronutrients from other foods eaten at school but to determine if the NLSP meals were indeed the highest contributor of calories and macronutrients as alleged. Another limitation could be the comparison of one test meal to the average of 3-days of food consumed when not at school. However, an average of 3-days was considered prudent to account for any anomaly in recording food intakes.

The index used to determine physical activity was low considering that many of these activities are performed on a daily basis such as walking, dancing, running or jogging. Future studies should aim to determine intensity and duration of these activities. The instrument (PAQ-C) used estimated the performance frequency of each activity only. Other limitations included self-report of food intakes and weight and height. Foods eaten when not at school were based on self-reports and might not have been completely accurate. Additionally, the onetime only cross-sectional design was not able to capture seasonal variations of foods eaten when not at school. BMI was calculated based on self-reports. Actual weights and heights were not collected because the data were collected in the dining hall with the students having only twenty minutes to eat their lunches and there was not sufficient time to take these measures. Also, we were only allowed one day to collect the data. As can be seen in the comparison of reported versus perceived BMI, subjects reported significantly higher perceived BMI than what they reported for their weight and height which were used in calculating their BMI. It is likely that the reported weights and heights might have been underestimated if they perceived themselves as having a higher BMI.

Conclusion

The purpose of this pilot study was to validate the use of photography to determine how much of the foods the NSLP provides, is actually being consumed by the participants. We found high inter-rater reliability in using photographs to estimate food consumption and food waste among NLSP participants. Photographic estimates can be used to measure food consumption and waste to determine just how much of the NSLP meal is being eaten. The meals eaten when not at school provided significantly higher total calories,

saturated fat, total fat, cholesterol, carbohydrates, proteins and fiber when compared to the NSLP lunch meal. Unlike other studies, we found no positive relationship between BMI and caloric intake from the NSLP meals. High BMI was also associated with being physically active. Further evaluation of the nutritional quality of the NSLP meals need to be conducted using a larger sample size. Assessment of the micronutrients is also needed as the USDA has changed its recommendations on sodium and vitamins that need to be provided by these meals. Future studies may examine if the schools are adhering to the new Local Wellness Policies (LWP's) that are now part of the 2010 Healthy, Hunger-free Kids Act.

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