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An Analysis of a Calcium Nutrition Educational Intervention for Middle School Students in Las Vegas, Nevada Using SAS®

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ABSTRACT

Calcium is an essential mineral that is found and u in the human body. An estimated 1.5 million fractures occur each year in the United States due to osteoporosis. The aim of this study is to evaluate the effectiveness of a calcium nutrition intervention for middle school students in Las Vegas, Nevada. The overarching research question is whether the intervention was successful in improving the calcium nutrition knowledge of the students. Data have been collected from pretests and posttests completed by the students. To determine whether each student benefited from the intervention, the percentage improvement from pretest to the posttest was calculated. Paired t-tests (PROC TTEST), mixed linear models (PROC MIXED), and frequency distributions in SAS® 9.2 were used. The SAS code can be seen in the Appendix section at the end of the paper.

INTRODUCTION

Calcium is an essential mineral that is found and utilized in the human body. It plays a role in many physiologic functions including muscle contraction, blood vessel expansion and contraction, secretion of hormones and enzymes, and transmitting electrical impulses throughout the nervous system (1). Most of the calcium in the body is stored in the bones and teeth; calcium's function within these structures is to provide structural support (2). The calcium within bones is constantly being broken down to increase blood calcium and reincorporated back into the bone to decrease blood calcium. This process of calcium deposition and re-absorption within bones changes with age; bone absorption is greater than bone deposition during childhood in order to facilitate growth, during middle adulthood the two processes are equal, and in old age the deposition of calcium is greater than the absorption which can lead to weak bones (1).

The Food and Nutrition Board (FNB) at the Institute of Medicine of the National Academies have developed intake recommendations for calcium and other nutrients. The FNB recommends 1300 mg of dietary calcium a day for both males and females between the ages of 9-18. The recommended calcium intake is presented as "Adequate Intake," which is the level of calcium assumed to be enough to meet nutritional adequacy (1); a "healthy" person who meets the recommended daily intake of calcium will maintain adequate rates of calcium retention and bone health.

Table 1: Adequate Intakes (AIs) for Calcium (1)

Age	Male	Female	Pregnant	Lactating
Birth to 6 months	210 mg	210 mg		
7-12 months	270 mg	270 mg		
1-3 years	500 mg	500 mg		
4-8 years	800 mg	800 mg		
9-13 years	1,300 mg	1,300 mg		
14-18 years	1,300 mg	1,300 mg	1,300 mg	1,300 mg
19-50 years	1,000 mg	1,000 mg	1,000 mg	1,000 mg
50+ years	1,200 mg	1,200 mg		

The three foods that provide the most calcium in the American diet are cheese, yogurt and milk (3). There are non-dairy sources of calcium, such as vegetables like the Chinese cabbage, kale, and broccoli (1). Many foods that do not have calcium naturally are fortified with calcium; for example many fruit juices and drinks, tofu, and cereals are fortified with calcium. The U.S. Department of Agriculture recommends that persons aged 9 years and older eat 3 cups of foods from the milk group per day (7). A cup is equal to 1 cup (8 ounces) of milk, 1 cup of yogurt, 1.5 ounces of natural cheese (such as Cheddar), or 2 ounces of processed cheese (such as American).

Table 2: Selected Food Sources of Calcium (4-6)

Food	Milligrams (mg) per serving	Percent DV*
Yogurt, plain, low fat, 8 ounces	415	42
Sardines, canned in oil, with bones, 3 ounces	324	32
Cheddar cheese, 1.5 ounces	306	31
Milk, nonfat, 8 ounces	302	30
Milk, reduced-fat (2% milk fat), 8 ounces	297	30
Milk, lactose-reduced, 8 ounces**	285-302	29-30
Milk, whole (3.25% milk fat), 8 ounces	291	29
Milk, buttermilk, 8 ounces	285	29
Mozzarella, part skim, 1.5 ounces	275	28
Yogurt, fruit, low fat, 8 ounces	245-384	25-38
Orange juice, calcium-fortified, 6 ounces	200-260	20-26
Tofu, firm, made with calcium sulfate, ½ cup***	204	20
Salmon, pink, canned, solids with bone, 3 ounces	181	18
Pudding, chocolate, instant, made with 2% milk, ½ cup	153	15
Cottage cheese, 1% milk fat, 1 cup unpacked	138	14
Tofu, soft, made with calcium sulfate, ½ cup***	138	14
Spinach, cooked, ½ cup	120	12
Ready-to-eat cereal, calcium-fortified, 1 cup	100-1,000	10-100
Instant breakfast drink, various flavors and brands, powder prepared with water, 8 ounces	105-250	10-25
Frozen yogurt, vanilla, soft serve, ½ cup	103	10
Turnip greens, boiled, ½ cup	99	10
Kale, cooked, 1 cup	94	9
Kale, raw, 1 cup	90	9
Ice cream, vanilla, ½ cup	85	8.5
Soy beverage, calcium-fortified, 8 ounces	80-500	8-50
Chinese cabbage, raw, 1 cup	74	7
Tortilla, corn, ready-to-bake/fry, 1 medium	42	4
Tortilla, flour, ready-to-bake/fry, one 6" diameter	37	4
Sour cream, reduced fat, cultured, 2 tablespoons	32	3
Bread, white, 1 ounce	31	3
Broccoli, raw, ½ cup	21	2
Bread, whole-wheat, 1 slice	20	2
Cheese, cream, regular, 1 tablespoon	12	1

Even though there are many foods that contain calcium, many Americans do not consume the recommended amounts of calcium with food. According to the nationwide Continuing Survey of Food Intakes of Individuals, approximately 44% of boys and 58% of girls aged 6–11, 64% of boys and 87% of girls aged 12–19 years and 55% of men and 78% of women aged 20 years or older fell short of recommended calcium intake in 1994–1996 (8). The National Health and Nutrition Examination Survey 1999-2000 found that average calcium intakes were 1,081 and 793 mg/day for boys and girls ages 12-19 years, 1,025 and 797 mg/day for men and women 20-39 years and 797 and 660 mg/day for men and women ≥60 years, respectively. Overall, females are less likely than males to get recommended intakes of calcium from food (9).

There are many factors that affect calcium absorption in the gut, because not all calcium is absorbed in the gut. The amount of calcium consumed can affect absorption. For example, the efficiency of absorption decreases as the amount of calcium consumed at a meal increases (1). Age plays an important role in calcium absorption. Very young children can absorb as much as 60% of consumed calcium in order to provide sufficient minerals for bone growth (10). By adulthood, the amount of calcium that is absorbed decreases to 15-20% and continues to decrease as one ages; this is why people 50 years and older have higher recommended calcium intakes (11). Vitamin D intake improves calcium absorption. Vitamin D is a nutrient found in certain foods and is produced by the skin when exposed to intense sunlight (1). Some components of foods, such as oxalic acid, can inhibit the absorption of calcium. Oxalic acid is found at high levels in spinach, collard greens, sweet potatoes, rhubarb, and beans. Eating spinach and milk at the same time reduces absorption of the calcium in milk (12). All of these factors were taken into account when creating the recommended daily calcium intake guidelines.

Calcium deficiency, from inadequate consumption of foods containing calcium or supplements, has no obvious short term symptoms. This is because blood calcium levels are very carefully regulated by enzymes within the bone. Hypocalcemia, or low calcium levels, usually results from medical problems or treatments rather than inadequate dietary calcium. Symptoms of hypocalcemia include numbness and tingling in the fingers, muscle cramps, convulsions, lethargy, poor appetite, and abnormal heart rhythms (2). In the long run, calcium deficiency can lead to death.

Bone increases in size and mass until reaching peak mass around age 30. The greater the peak bone mass, the longer one will have strong bones. Thus, it is important for everyone to consume the recommended amounts of dietary calcium in childhood, adolescence and early adulthood.

Osteoporosis is a disorder which is characterized by porous and fragile bones. More than ten million U.S. adults suffer from osteoporosis, of which 80% are women. Preceding osteoporosis is osteopenia, or low bone mass, which is much more prevalent; 34 million U.S. adults suffer from osteopenia. Osteoporosis is associated with fractures of the hip, vertebrae, wrist, pelvis, ribs, and other bones (13). An estimated 1.5 million fractures occur each year in the United States due to osteoporosis (14). This is a serious public health problem.

The body uses its stored calcium to maintain normal biological functions, so bone breakdown can occur if calcium intake is low or ingested calcium is poorly absorbed. Bone loss is also a natural part of aging. There are many risk factors for developing osteoporosis including being female, thin, inactive, or of advanced age; smoking cigarettes; drinking excessive amounts of alcohol; and having a family history of osteoporosis (15). Women are at highest risk because their skeletons are smaller than those of men and because of the accelerated bone loss that accompanies menopause.

It is possible to maintain healthy bones into late age and prevent osteoporosis with adequate intakes of calcium and vitamin D as well as regular exercise. Weight-bearing exercise is recommended such as walking, running, and activities where one's feet leave and hit the ground and work against gravity, as well as resistance exercises such as calisthenics and that involve weights (16). In January 2010, the FDA expanded their health claim for the prevention of osteoporosis to include vitamin D; “adequate calcium and vitamin D as part of a healthful diet, along with physical activity, may reduce the risk of osteoporosis in later life." (17)

The aim of this study is to evaluate the effectiveness of calcium nutrition interventions for middle school students in the Las Vegas area. The overarching research question is whether the interventions were successful in improving the calcium nutrition knowledge of the students. It is important to study the effectiveness of this intervention, because the students should be receiving a great educational program. It is important to educate middle school students about proper nutrition, but is the calcium nutrition intervention used in Las Vegas producing satisfactory results? Are the students actually learning new information about calcium nutrition?

MATERIALS AND METHODS

The University of Nevada Reno Cooperative Extension has been administering calcium nutrition educational interventions for the past five years; data have been collected from pretests and post-tests (corresponding to pre and post intervention) completed by middle school students in Nevada (Las Vegas). “The Calcium, It's Not Just Milk” educational intervention promoted healthy eating and active lifestyles among the middle school health students. The program promoted the increased consumption of calcium-rich foods and weight-bearing exercise in the prevention of osteoporosis. The program promoted the key Dietary Guidelines for Americans message "Make smart choices from every food group. Get your calcium-rich foods." The intervention lasted an entire semester. The educational goal for post intervention was ≥ 50% of the students would answer each question correctly. This study provides a secondary data analysis of the existing database. This analysis will focus on the most recent data because the questionnaires from 2008 are the most representative of what will be used in the future.

Research Hypotheses

1) The mean difference between post- and pre-test score will be greater than zero, i.e. there will be an increase in test scores from pre- to post-test.

2) The mean post-test score will not be statistically different for girls and boys, i.e. the intervention will be gender neutral.

3) On question 11 (post-test) the four foods with the greatest selection frequency will be: 1 cup milk, 2 cups chocolate milk, 1 cup calcium fortified OJ, and 1 cup yogurt.

Analytic Methods

To determine whether each student benefited from the intervention, a score was calculated for each student's pre-test and post-test. The multiple choice questions were graded as follows; a correct answer received 1 point and an incorrect answer received 0 points. The questions that required multiple selections were graded as follows; each correct selection received 1 point. There was a total of 21 points possible on both pre- and post-test. The pre-test score was subtracted from the post-test score to give a difference. A Difference score was assigned to each student; these scores were summed and divided by the total number of students to give the mean difference. The mean difference was divided by the highest possible score and multiplied by 100; this gave the percentage improvement from pre-test to post-test. Paired t-test was used to determine whether the mean difference was significantly different from zero. The PROC TTEST procedure was used for this statistical analysis.

One of the questions on the questionnaire asks the students to pick the four food items that in combination would meet the daily calcium requirements; the distribution of the answer choices were found and the four top selected food items were reported. The top four food choices were compared from pre- to post-test. The PROC FREQ procedure was used for this analysis.

Traditional t-test models are not well suited for the analysis of clustered and non-independent data. In contrast, multilevel models (also known as hierarchical linear modeling or mixed modeling) are explicitly designed to analyze clustered data structures and can incorporate individual level predictors, group level predictors, and individual by group level interactions. Multilevel modeling allows for the analysis of non-independent (auto correlated) or "clustered" data that arise when studying topics such as students nested within classrooms or longitudinal repeated measures nested within individuals.

SAS PROC MIXED is a flexible program suitable for fitting multilevel models, hierarchical linear models, and individual growth models for normally distributed continuous data. PROC MIXED can fit many common types of multilevel models (a) school effects models, designed for data on individuals nested within naturally occurring hierarchies (e.g., students within classes, teachers within schools); and (b) individual growth models, designed for exploring longitudinal data (on individuals) over time. Therefore, we used SAS PROC MIXED to correct the non-independence and clustered effect of students nested within different schools (and grades) in mean score differences between pre and post scores.

RESULTS

The gender distribution was 305 males and 219 females for the post-test, while 9 records had missing values for gender and were not included in the analysis. The ethnicity distribution can be seen in the table below. The Mexican/Hispanic/Latino ethnicity had the greatest frequency, representing 59.21% of the students. Black/African American is the next largest ethnicity, representing 12.03% of the students.

ETHNICITY	Frequency	Percent
Native American/American Indian	9	1.69
Asian American/Pacific Islander	25	4.70
Black/African American	64	12.03
Mexican/Hispanic/Latino	315	59.21
White/Caucasian	57	10.71
Mixed Race	62	11.65

The paired t-test for pre-test mean, comparing gender, yielded a p-value of 0.4329 (PROC TTEST) which is not significant; the male pre-test mean score (9.96 out of 21) and the female mean score (9.74 out of 21) are not statistically different (Table 1). The graphs created with SAS ODS output show that the pre-test means scores are normally distributed.

Table 1: Paired t-test of pre-test mean by gender

GENDER	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
male		9.9577	9.5543	10.3610	3.5912	3.3278	3.9002
female		9.7364	9.3547	10.1180	2.8722	2.6266	3.1690
Diff (1-2)	Pooled	0.2213	-0.3532	0.7957	3.3103	3.1217	3.5235
Diff (1-2)	Satterthwaite	0.2213	-0.3327	0.7752			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	525	0.76	0.4495
Satterthwaite	Unequal	518.67	0.78	0.4329

The paired t-test for post-test mean, comparing gender, yielded a p-value of 0. 9817 (PROC TTEST) which is not significant; the male post-test mean score (15.29 out of 21) and the female mean score (15.30 out of 21) are not statistically different which confirms the hypothesis that the intervention was gender neutral. The graphs created with SAS ODS output show that the pre-test means scores are normally distributed, although the curves are slightly skewed to the left because of low scores of 5.

Table 2: Paired t-test of post-test mean by gender

GENDER	Method	Mean	95% CL Mean		Std Dev	95% CL Std Dev	
male		15.2984	14.8715	15.7253	3.7888	3.5101	4.1159
female		15.3059	14.8205	15.7914	3.6451	3.3327	4.0226
Diff (1-2)	Pooled	-0.00758	-0.6565	0.6413	3.7294	3.5163	3.9703
Diff (1-2)	Satterthwaite	-0.00758	-0.6525	0.6374			

Method	Variances	DF	t Value	Pr > |t|
Pooled	Equal	522	-0.02	0.9817
Satterthwaite	Unequal	480.19	-0.02	0.9816

The average increase in score for males and females from pre- to post-test is 5.42 points which is a 26.46% improvement. This increase in score is statistically significant, which was tested using a paired t-test (p-value < 0.0001, PROC TTEST, Table 3); this confirms the hypothesis that there will be an increase in test scores from pre- to post-test. The difference scores calculated from subtracting the pre-test scores from the post-test scores also had a normal distribution.

Table 3: Mean difference score paired t-test

Mean	95% CL Mean		Std Dev	95% CL Std Dev	
5.4203	5.1274	5.7131	3.4417	3.2468	3.6618

DF	t Value	Pr > |t|
532	36.36	<.0001

Seven different schools participated in the “It’s Not Just Milk” 2008 program, and within each school the students were split into different classes with different teachers. This type of clustering indicates the data for each student is not independent of each other so the PROC TTEST procedure is not appropriate for the analysis of this data. On the other hand, the PROC MIXED procedure is appropriate for clustered multi-level data and was used to correct the non-independence and clustered effect of students nested within the class (or teachers) in mean score differences between Pre and Post scores.

The mean scores for pre- and post-test remained significantly different (P-value <0.0001). The mean scores of summed pre- and post-test scores by gender were not significantly different (p-value = 0.9567). The mean scores for pre- and post-test by gender were not significantly different (p-value= 0.5773). For this study, the same conclusion can be drawn from both PROC TTEST and PROC MIXED results (Table 4). However, for clustered data the results generated by PROC TTEST are not valid. The PROC MIXED results confirm the results from the PROC TTEST procedure.

Table 4: PROC MIXED results

Type 3 Tests of Fixed Effects

Effect	Num DF	Den DF	F Value	Pr > F
Treatment	1	7	138.55	<.0001
GENDER	1	6	0.00	0.9567
GENDER*treatment	1	6	0.35	0.5773

Least Squares Means

Effect	Treatment	GENDER	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper
GENDER		1	12.4795	0.3407	6	36.63	<.0001	0.05	11.6459	13.3131
GENDER		2	12.5011	0.3649	6	34.25	<.0001	0.05	11.6081	13.3941
Treatment	Post		15.2833	0.3801	7	40.21	<.0001	0.05	14.3844	16.1821
Treatment	Pre		9.6973	0.3801	7	25.51	<.0001	0.05	8.7985	10.5962
GENDER*treatment	Post	1	15.3404	0.4267	6	35.95	<.0001	0.05	14.2964	16.3844
GENDER*treatment	Pre	1	9.6188	0.4267	6	22.54	<.0001	0.05	8.5748	10.6628
GENDER*treatment	Post	2	15.2260	0.4543	6	33.51	<.0001	0.05	14.1143	16.3378
GENDER*treatment	Pre	2	9.7757	0.4543	6	21.52	<.0001	0.05	8.6639	10.8874

The percentage of students who answered each question correctly is shown in table 4.1. The cells in table 4.1 that are shaded grey are questions which had ≥ 50% of the students answer correctly. On the pre-test, before the intervention, 8 out of 21 questions met the program educational goal where ≥ 50% of the students had to answer the question correctly. After the intervention, 20 out of 21 questions met the program educational goal.

Table 4.1: Percentage of Correct Answers by Question for Pre- and Post-test

Question #	Pre-test	Post-test	% improve.
1	20.45 %	50.47 %	30.02 %
2	35.65 %	84.43 %	48.78 %
3	61.91 %	76.92 %	15.01 %
4	60.60 %	66.98 %	6.38 %
5	80.68 %	82.18 %	1.5 %
6	6.57 %	58.54 %	51.97 %
7	29.08 %	61.16 %	32.08 %
8	19.70 %	54.41 %	34.71 %
9	75.23 %	88.56 %	13.33 %
10	19.14 %	49.72 %	30.58 %
11.milk	77.86 %	87.80 %	9.94 %
11.yogurt	69.79 %	92.50 %	22.71 %
11.OJ	47.65 %	76.55 %	28.9 %
11.Choc_Milk	36.96 %	69.61 %	32.65 %
12	75.61 %	86.87 %	11.26 %
14.a	40.71 %	71.67 %	30.96 %
14.b	43.71 %	84.80 %	41.09 %
14.c	48.41 %	70.92 %	22.51 %
14.d	41.46 %	66.23 %	24.77 %
14.e	52.91 %	69.42 %	16.51 %
14.f	44.09 %	80.49 %	36.40 %

On question 11, the top four foods chosen by the students for both pre- and post-test were Milk, Yogurt, Ca fortified OJ, and Chocolate milk (Table 5).

Table 5: Question 11 results

	Milk	Yogurt	OJ	Chocolate Milk
Pre-test	415	372	254	197
Post-test	468	493	408	371

Top four choices listed in descending order:
Pre-test: Milk>Yogurt>OJ>Chocolate milk
Post-test: Yogurt>Milk>OJ>Chocolate milk

These results confirm the hypothesis that for question 11 (post-test), the four answer choices with the greatest frequency selections would be milk, yogurt, OJ, and chocolate milk.

From the item analysis, four questions were selected to report about for the following reasons: the most confusing, the most difficult, the most improved, and the easiest question. The most confusing question was selected based on how many students answered the question correctly on the pre-test, but then answered the same question incorrectly on the post-test. The most difficult question was selected based on how many students answered the question incorrectly on both the pre- and post-test. The most improved question was selected based on how many students answered the question incorrectly on the pre-test, but then answered the same question correctly on the post-test. The easiest question was selected based on how many students answered the question correctly on both the pre- and post-test.

The most confusing question was question 4, "The amount of physical activity you do is related to the strength of your bones." The correct answer is true. See table 6.

Table 6: Most confusing question selection frequencies, Q4

Q4	Frequency	Percent	Cumulative Frequency	Cumulative Percent
wrong to wrong	103	19.32	103	19.32
right to wrong	73	13.70	176	33.02
wrong to right	107	20.08	283	53.10
right to right	250	46.90	533	100.00

The most difficult question was question 10, "If you ate three servings of food, how many milligrams of calcium would you consume (used food label to answer the question)?" The answer is 600mg. See table 7.

Table 7: Most difficult question selection frequencies, Q10

Q10	Frequency	Percent	Cumulative Frequency	Cumulative Percent
wrong to wrong	224	42.03	224	42.03
right to wrong	44	8.26	268	50.28
wrong to right	207	38.84	475	89.12
right to right	58	10.88	533	100.00

The most improved question was question 6, "How many milligrams of calcium do you need every day?" The correct answer is 1300 mg. See table 8.

Table 8: Most improved question selection frequencies, Q6

Q6	Frequency	Percent	Cumulative Frequency	Cumulative Percent
wrong to wrong	217	40.71	217	40.71
right to wrong	4	0.75	221	41.46
wrong to right	281	52.72	502	94.18
right to right	31	5.82	533	100.00

The easiest question was a tie between question 9 and 11, "What is the serving size of the item on this food label (used food label to answer the question)?" and "Which combination of four foods below would give you enough calcium to meet your daily requirements?" The correct answers are 1-once and milk (milk was selected the most out of the four top choices), respectively. See tables 9 and 10.

Table 9: Easiest question selection frequencies, Q9

Q9	Frequency	Percent	Cumulative Frequency	Cumulative Percent
wrong to wrong	42	7.88	42	7.88
right to wrong	19	3.56	61	11.44
wrong to right	90	16.89	151	28.33
right to right	382	71.67	533	100.00

Table 10: Easiest question selection frequencies, Q11_milk

Q11_Milk	Frequency	Percent	Cumulative Frequency	Cumulative Percent
wrong to wrong	32	6.00	32	6.00
right to wrong	33	6.19	65	12.20
wrong to right	86	16.14	151	28.33
right to right	382	71.67	533	100.00

There were three evaluation questions given on the post-test: "The food tasting events encouraged me to eat more calcium rich foods (Q15),"" The "Calcium, it's not just milk" lessons have increased my belief that it is important to have adequate calcium in my diet (Q16)," and "After learning about the importance of calcium in my science class, I try to include more calcium rich foods in my diet (Q17)." These questions were designed to evaluate the effectiveness of the program. The answer choices for these three questions were "agree," "disagree," and "I don't know." Fortunately, none of the students answered "I don't know."

On question 15, 81% of the student agreed. See table 11.

Table 11: Evaluation Q15 selection frequencies

Q15	Frequency	Percent	Cumulative Frequency	Cumulative Percent
disagree	101	18.95	101	18.95
agree	432	81.05	533	100.00

On question 16, 85.7% of the students agreed. See table 12.

Table 12: Evaluation Q16 selection frequencies

Q16	Frequency	Percent	Cumulative Frequency	Cumulative Percent
disagree	76	14.26	76	14.26
agree	457	85.74	533	100.00

On question 17, 82.9% of the students agreed. See table 13.

Table 13: Evaluation Q17 selection frequencies

Q17	Frequency	Percent	Cumulative Frequency	Cumulative Percent
disagree	91	17.07	91	17.07
agree	442	82.93	533	100.00

DISCUSSION

The results are encouraging because they indicate that the extension training was successful. We rejected the Ho: hypothesis, that the mean difference from pre- to post-test score would be equal to zero. The average score improvement was 5.42 points (95% CI: 5.1274-5.7131) from pre- to post-test, which is a 26.46% improvement. This improvement in calcium nutrition knowledge is likely related to the "Calcium, It's Not Just Milk" training intervention.

We could not reject the null hypothesis that the mean post-test score would be equal for girls and boys. The mean post-test score for girls and boys were not statistically different. These results show that both girls and boys benefitted equally from the training.

The hypothesis that the top four foods selected by the students for the combination of foods that would meet the daily calcium requirements would be: 1 cup milk, 2 cups chocolate milk, 1 cup calcium fortified OJ, and 1 cup yogurt, is true. This was true for both the pre- and post-test. The fact that the students selected the correct top four foods for calcium in the pre-test is surprising, because it shows that most of the students already knew what foods contained the most calcium. The major differences between pre- and post-test are the frequency of students whom selected these four foods increased on the post-test and yogurt had the highest selection frequency on the post-test. From these results, it seems like there was a large emphasis in promoting yogurt as a good source of calcium during the "It's Not Just Milk" program.

From the item analysis, four questions were selected to report in the results section based on their unique trends. Two of these questions should be improved on in future questionnaires. The most confusing question, "The amount of physical activity you do is related to the strength of your bones," had the highest frequency of students switch their answer from correct to incorrect from pre- to post-test. This question was not worded properly or this topic was not covered satisfactorily. The question could be reworded to, "being more physically active will strengthen your bones." The most difficult question, "If you ate three servings of food, how many milligrams of calcium would you consume (used food label to answer the question)," had the highest frequency of students who answered wrong on both the pre- and post-test. This question was most likely the most difficult because it required a computation to find the correct answer. The computation could have been too difficult for some of the students, or maybe some of the students guessed on the question rather than attempting to calculate the answer.

A study conducted in Iran on osteoporosis prevention education for middle school female students tested whether an educational program based on the health belief model (HBM), or a traditional didactic health education would be better at increasing the calcium nutrition knowledge of the students. Their results indicate that group of students who participated in the lessons that incorporated the HBM domains had the largest increase in post-test scores and self reported behavioral changes. One HBM domain in particular had a significant impact on behavioral changes, and this was perceived susceptibility. Knowledge and perceived susceptibility to disease are considered to be motivating factors for behavior change (18). In 2004, a study on 1065 women (aged 16-72) found that 50% of the study population believed that osteoporosis was a minor health problem and 53% thought it was a curable disease (19). These results were consistent with the perceptions of students in the Iran study at the time of the pre-test (20). This lack of perceived susceptibility could be a major reason why people do not engage in disease preventative behaviors. Based on these findings, it would be beneficial to consider adding questions to the "Calcium, It's Not Just Milk" questionnaire that address the HBM perceived susceptibility domain.

The results indicate that the evaluation questions were answered with positive opinions of the "It's Not Just Milk" program. Each question had more than 80% of the students answer positively and in favor of the program's effectiveness. Clearly, the students appreciated the program.

The Mexican/Hispanic/Latino ethnicity represented almost 60% of the students. Although we can not confirm this, English may have been a second language for many of these students. Taking this into consideration, there is a possibility that having an optional questionnaire written in Spanish would have lead to increased test scores among this subgroup of students.

The main limitation to this study is there is no longitudinal follow-up of nutritional behavioral changes and, or calcium intake. Another limitation is the possibility of confounding factors, because the observed increase in calcium nutrition knowledge could partly be due to outside factors unrelated to the "Calcium, It's Not Just Milk" educational intervention (ex. TV programs, parents, other reading materials, etc.). Although the results show that school based health education can be effective in producing increased knowledge and interest in calcium nutrition and osteoporosis prevention, further studies should be developed to assess whether or not this educational approach leads to sustained behavioral change.

CONCLUSION

School health education programs are critical opportunities for facilitating healthy lifestyles for youth. The results show that the "It's Not Just Milk" program was highly successful in improving the knowledge of calcium nutrition in middle school students in Las Vegas. The average score improvement was 5.42 points (95% CI: 5.1274-5.7131) from pre- to post-test, which is a 26.46% improvement. The mean pre- and post-test scores by gender were not significantly different, which shows that both boys and girls benefitted equally from the training. The top four foods chosen by the students for both pre- and post-test were Milk, Yogurt, Ca fortified OJ, and Chocolate milk, but there was a higher selection frequency of all four foods on the post-test. Two questions could be improved on the questionnaire, possibly by rewording question 4, and removing the need to calculate the answer to question 10. Each evaluation question had more than 80% of the students answer positively and in favor of the program's effectiveness.

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APPENDIX (SAS CODE)

Code Box 1: Data step code used to calculate difference scores

```
data calcium.difference;
       set calcium.caseid;
              dtf1=tf1c2-tf1c1;
              dtf2=tf2c2-tf2c1;
              dtf3=tf3c2-tf3c1;
              dtf4=tf4c2-tf4c1;
              dtf5=tf5c2-tf5c1;
              dcmg=cmgc2-cmgc1;
              dbonc=boncc2-boncc1;
              dnf1a=nf1ac2-nf1ac1;
              dnf2a=nf2ac2-nf2ac1;
              dnf3=nf3c2-nf3c1;
              dfcoma=fcomac2-fcomac1;
              dr8f1=r8f1c2-r8f1c1;
              dr8f2=r8f2c2-r8f2c1;
              dr8f3=r8f3c2-r8f3c1;
              dr8f4=r8f4c2-r8f4c1;
              dr8f5=r8f5c2-r8f5c1;
              dr8f6=r8f6c2-r8f6c1;
              dff3=ff32-ff31;
              dff6=ff62-ff61;
              dff11=ff112-ff111;
              dff13=ff132-ff131;
              dtotal=(dtf1+dtf2+dtf3+dtf4+dtf5+dcmg+dbonc+dnf1a+
              dnf2a+dnf3+dfcoma+dr8f1+dr8f2+dr8f3+dr8f4+dr8f5+dr8f6+dff3
              +dff6+dff11+dff13);
run;
```

Code Box 2: PROC TTEST code

```
proc ttest data=calcium.pretests2008c;
       class gender;
       var pretotal;
       title 'Gender Paired t-test: Comparing pre-test mean';
       format gender gender.;
run;
```

Code Box 3: PROC FREQ code for question 11

```
proc freq data=calcium.pretests2008;
      tables ff1-ff15;
      title 'Best Foods for Calcium Q11: Pre Selection Frequency';
      label ff1= '1 slice of bread'
            ff2='1 orange'
            ff3='1 cup milk'
            ff4='1 cup salad'
            ff5='1 piece chicken'
            ff6='1 cup yogurt'
            ff7='1 cup spinach'
            ff8='1 egg'
            ff9='1 baked potato'
            ff10='1/2 cup refried beans'
            ff11='1 cup Ca fortified OJ'
            ff12='1 candy bar'
            ff13='1 cup chocolate milk'
            ff14='1 cup vege soup'
            ff15='2 tbsp peanut butter';
      format ff1-ff15 food.;
run;
```

Code Box 4: PROC MIXED code

```
proc mixed data=calcium.mixdmdl2008;
      class school grade gender treatment;
      model total=treatment| gender;
      random grade(school) treatment(grade school) gender(grade school)
gender*treatment(grade school);
      lsmeans gender |treatment/cl diff;
run;
```