

# Building Better Bones

Arizona Department of Health Services  
Bureau of Nutrition and Physical Activity  
Research and Development

November 21, 2012



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## INTRODUCTION

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Building strong bones during adolescence and early adulthood is a key defense against the development of osteoporosis in later life. The overall goal of the Building Better Bones Program (BBB) is to increase awareness of osteoporosis as a disease which is preventable by practicing healthy lifestyles including consuming a healthy diet high in calcium and engaging in regular weight bearing physical activity.

The BBB Program includes three interactive classroom lessons:

Class 1: Identify appropriate dietary guidelines for maintenance of health.

Class 2: Identify adequate amounts and sources of calcium.

Class 3: Engage in daily weight bearing physical activity.

The set of three classes are designed to deliver osteoporosis prevention messages through interactive, age-appropriate methods. While some information is delivered through mini-lectures, other methods may include educational games, puzzles, word search, videos, and portable exhibits.

Upon completion of the curriculum the students will be able to:

1. Define osteoporosis.
2. Recognize 130% Daily Value as the goal for calcium intake.
3. Identify the Percent Daily Value for calcium on the Nutrition Facts Label.
4. Identify the number of daily servings to meet calcium needs.
5. Identify foods that contain calcium.
6. Identify the most important years for building denser, stronger bones.
7. Plan a meal that provides at least 40% Daily Value for calcium.
8. Recognize weight bearing and lifting activities as those that help build and preserve bone.
9. Participate in at least four activities that strengthen bone.
10. Prepare and keep a physical activity log for at least one week.
11. Identify the recommendation for physical activity: accumulate 60 minutes or more of physical activity at least five days per week, preferably every day of the week.
12. Evaluate the amount of calcium in a chosen meal.

## METHODOLOGY

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Each student who participated in the BBB Program was given a 14 question pre-survey prior to the first class and a 16 question post-survey after completion of the third class (see Appendix A – Building Better Bones Survey). Pre- and post-surveys were not matched and no identifying information regarding the student was collected on the survey. The survey contains two demographic, nine knowledge related and two behavioral questions. The post-survey contains two additional questions that were not asked on the pre-survey which asks for a retrospective self-report of whether certain behaviors changed after completion of the BBB Program.

The percent of correct or favorable responses were calculated for both pre- and post-surveys, and Z-scores for proportional differences were calculated to evaluate whether improvements between pre- and post-surveys were statistically significant at the 95% confidence level. In other words, for statistically significant results, the probability that the difference between the scores was due to chance is five percent or less.

## SUMMARY OF FINDINGS

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Overall, students showed statistically significant improvements on all questions between the pre- and post-surveys, indicating increased knowledge about appropriate calcium intake and levels of physical activity, identifying foods high in calcium, and understanding the connection between calcium, physical activity and healthy bones. The program was particularly effective in increasing knowledge about recommended daily values of calcium, activities that build better bones, and osteoporosis. Students also reported increased calcium intake and physical activity after participating in the program.

## CONCLUSIONS

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The Building Better Bones program is effective in improving knowledge about calcium and physical activity in students who attended the program. Students demonstrated greater understanding on every question between the pre- and post-surveys. In addition, a majority of students indicated increased calcium consumption (67.5%) and increased physical activity (78.0%) after participating in the Building Better Bones program.

## DESCRIPTIVE STATISTICS

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A total of 4,714 pre-surveys and 4,606 post-surveys were completed. Over 95% of students taking the survey were in fifth grade, and over 99% took the survey in English. Surveys were evenly distributed between boys and girls, and six different locations were represented. Table 1 below displays demographic information.

**Table 1 - Demographics**

	Pre Survey N = 4714		Post Survey N = 4606	
	N	%	N	%
<b>Grade Level</b>				
Blank	24	0.5	21	0.5
3rd	6	0.1	8	0.2
4th	142	3.0	131	2.8
5th	4493	95.3	4386	95.2
6th	49	1.0	60	1.3
<b>Gender</b>				
Blank	14	0.3	19	0.4
Boy	2402	51.0	2328	50.5
Girl	2298	48.7	2259	49.0
<b>Test Language</b>				
English	4677	99.2	4572	99.3
Spanish	37	0.8	33	0.7
<b>Location</b>				
Coconino	234	5.0	232	5.0
Maricopa	194	4.1	183	4.0
Mohave	328	7.0	321	7.0
Navajo	795	16.9	787	17.1
Washington Elementary District	1353	28.7	1338	29.0
Yuma	1810	38.4	1745	37.9

Results of the pre- and post-surveys are displayed in Table 2 below. Students demonstrated statistically significant improvements in all questions relating to their nutritional knowledge. Students made the greatest gain in demonstrating knowledge of the amount of calcium they need, a 64.5 percentage point improvement. In addition, students demonstrated improved knowledge about activities that promote strong bones (56.9 percentage point improvement), knowledge about osteoporosis (54.7 percentage point improvement), the number of servings of calcium needed (47.5 percentage point improvement), and bone density (47.0 percentage point improvement).

Students came into the program with relatively high levels of knowledge about three questions, demonstrating high scores on the pre-survey: selecting a fast food item high in calcium (70.3%), recommended daily levels of physical activity (71.0%), and recommended weekly levels of physical activity (73.7%). Because of high levels of previous knowledge, these questions did not have as large of an improvement between pre- and post-surveys, but still showed statistically significant gains.

One question concerning behavior change showed an unexpected result between the pre- and post-surveys. On the question asking how much time the students had spent being physically active on the previous day, students reported a statistically significant decrease (9.9 percentage points) in physical activity lasting two hours or more between the pre- and post-surveys. This could be an accurate portrayal of their physical activity, or may also be the result of learning that 60 minutes was the recommended amount of physical activity for building better bones, and thus reporting their activity to match the recommendation.

Finally, students reported greater consumption of high calcium foods (67.5%) and physical activity (78.0%) after participating in the program. Results are displayed in Table 3 below.

**Table 2 - Pre- and Post-Survey Comparison of Preferred Answer Percentages**

	Pre Survey N = 4714	Post Survey N = 4606	Percentage Point Change Between Pre and Post	Statistically Significant Difference Between Pre and Post?
What percent Daily Value for calcium do students your age need?	19.0	83.5	64.5	<b>Yes</b>
How many daily servings from the milk group should you have to meet your calcium needs?	36.1	83.6	47.5	<b>Yes</b>
How many servings from the milk group did you have yesterday?				
None	10.0	4.9	-5.1	<b>Yes</b>
1	23.1	11.7	-11.4	<b>Yes</b>
2	34.7	32.2	-2.5	<b>Yes</b>
3 or more	24.6	45.5	20.9	<b>Yes</b>
Don't Know	6.7	5.0	-1.7	<b>Yes</b>
Which of the following foods does not have calcium?	43.5	74.4	30.9	<b>Yes</b>

	Pre Survey N = 4714	Post Survey N = 4606	Percentage Point Change Between Pre and Post	Statistically Significant Difference Between Pre and Post?
Choose the fast food menu item with the most calcium and the least amount of fat.	70.3	75.5	5.2	<b>Yes</b>
What is osteoporosis?	21.2	75.9	54.7	<b>Yes</b>
Ninety percent (90%) of your bone density will be built by what age?	37.1	84.1	47.0	<b>Yes</b>
Which of the following activities does not build better bones?	17.9	74.8	56.9	<b>Yes</b>
How much time should you spend being physically active each day to build better bones?	71.0	88.0	17.0	<b>Yes</b>
How much time did you spend yesterday being physically active?				
None	5.2	2.4	-2.8	<b>Yes</b>
10 minutes	16.1	12.3	-3.8	<b>Yes</b>
60 minutes or more	39.5	57.1	17.6	<b>Yes</b>
2 hours or more	32.2	22.3	-9.9	<b>Yes</b>
Don't Know	6.3	4.7	-1.6	<b>Yes</b>
How many days each week should you be physically active to build better bones?	73.7	85.6	11.9	<b>Yes</b>
Did you attend a Building Better Bones Program last year?				
Yes	n/a	20.0	n/a	n/a
No		80.0		

**Table 3 - Post-Survey Behavior Change Percentages**

Since taking the Building Better Bones class:	
I eat or drink more calcium foods	67.5
I eat or drink the same amount of calcium foods	30.9
I am more physically active	78.0
My physical activity is the same	22.0



## COMPARISONS BY GENDER

There were some statistically significant differences between boys and girls on the pre-survey, with the greatest difference in reports of physical activity. Girls indicated they were physically active for 10 minutes the previous day at a higher level than boys (19.4% compared to 13.0%). In addition, girls reported being physically active for two hours or more at a lower rate than boys (28.0% compared to 36.2%).

Girls also showed slightly higher pre-survey knowledge on questions about the number of daily servings needed, identifying food that does not have calcium, and knowing recommended amounts of physical activity. However, girls demonstrated slightly lower pre-survey knowledge about bone density. While these differences were statistically significant, the difference between boys and girls was small. Results are displayed in Table 4 below.

**Table 4 - Pre-Survey Results by Gender**

	Boys N = 2402	Girls N = 2298	Statistically Significant Difference Between Boys and Girls?
What percent Daily Value for calcium do students your age need?	19.9	18.1	
How many daily servings from the milk group should you have to meet your calcium needs?	34.3	38.0	<b>Yes</b>
How many servings from the milk group did you have yesterday?			
None	10.2	9.8	
1	22.5	23.8	
2	35.2	34.2	
3 or more	24.6	24.6	
Don't Know	6.6	6.7	
Which of the following foods does not have calcium?	41.7	45.4	<b>Yes</b>
Choose the fast food menu item with the most calcium and the least amount of fat.	70.2	70.6	
What is osteoporosis?	21.4	20.9	
Ninety percent (90%) of your bone density will be built by what age?	39.5	34.7	<b>Yes</b>
Which of the following activities does not build better bones?	18.5	17.3	
How much time should you spend being physically active each day to build better bones?	69.7	72.6	<b>Yes</b>

	Boys N = 2402	Girls N = 2298	Statistically Significant Difference Between Boys and Girls?
How much time did you spend yesterday being physically active?			
None	5.6	4.8	<b>Yes</b>
10 minutes	13.0	19.4	
60 minutes or more	38.2	40.9	
2 hours or more	36.2	28.0	<b>Yes</b>
Don't Know	6.3	6.4	
How many days each week should you be physically active to build better bones?	71.4	76.3	<b>Yes</b>

Boys and girls demonstrated some statistically significant differences in their responses on the post-survey. Girls scored higher on questions about the recommended amount of calcium, identifying foods without calcium, and recommended amounts of physical activity. In addition, girls reported that their amount of physical activity increased after participating in the program at a statistically significantly higher rate than boys (82.0% compared to 74.5%). Girls scored lower than boys on one measure, with boys reporting they spent two or more hours being physically active on the previous day at a higher rate than girls (25.8% compared to 18.9%). This result was statistically significant. Results for all questions are displayed in Table 5 below.

Boys made the largest gains between the pre- and post-surveys on questions about the recommended daily values of calcium (62.7 percentage point improvement), activities that build better bones (56.0 percentage point improvement), knowledge about osteoporosis (54.2 percentage point improvement), and knowledge about bone building activities (56.0 percentage point improvement). Girls showed their largest gains on the same questions.

**Table 5 - Post-Survey Results by Gender**

	Boys N = 2328	Percentage Point Change Between Pre and Post for Boys	Girls N = 2257	Percentage Point Change Between Pre and Post for Girls	Statistically Significant Difference Between Boys and Girls on the Post-Survey?
What percent Daily Value for calcium do students your age need?	82.6	62.7*	84.8	66.7*	<b>Yes</b>
How many daily servings from the milk group should you have to meet your calcium needs?	81.7	47.4*	86.0	48.0*	<b>Yes</b>

	Boys N = 2328	Percentage Point Change Between Pre and Post for Boys	Girls N = 2257	Percentage Point Change Between Pre and Post for Girls	Statistically Significant Difference Between Boys and Girls on the Post-Survey?
How many servings from the milk group did you have yesterday?					
None	4.9	-5.3*	4.9	-4.9*	
1	11.7	-10.8*	11.8	-12.0*	
2	31.5	-3.7*	32.8	-1.4	
3 or more	46.2	21.6*	45.1	20.5*	
Don't Know	5.2	-1.4*	4.7	-2.0*	
Which of the following foods does not have calcium?	72.6	30.9*	76.6	31.2*	<b>Yes</b>
Choose the fast food menu item with the most calcium and the least amount of fat.	74.4	4.2*	76.9	6.3*	
Since the Building Better Bones Program, I eat or drink:		n/a		n/a	
More calcium foods	66.3		68.9		
Same amount of calcium foods	32.2		29.6		
What is osteoporosis?	75.6	54.2*	76.6	55.7*	
Ninety percent (90%) of your bone density will be built by what age?	84.5	45.0*	84.0	49.3*	
Which of the following activities does not build better bones?	74.5	56.0*	75.4	58.1*	
How much time should you spend being physically active each day to build better bones?	87.1	17.4*	89.7	16.5*	<b>Yes</b>
How much time did you spend yesterday being physically active?					
None	2.9	-2.7*	1.9	-2.9*	<b>Yes</b>
10 minutes	11.5	-1.5	13.2	-6.2*	
60 minutes or more	54.5	16.3*	60.0	19.1*	<b>Yes</b>
2 hours or more	25.8	-10.4*	18.9	-9.1*	<b>Yes</b>
Don't Know	4.5	-1.8*	4.9	-1.5*	
How many days each week should you be physically active to build better bones?	83.8	12.4*	87.9	11.6*	<b>Yes</b>
Has the Building Better Bones Program helped you become more physically active?		n/a		n/a	
My physical activity is the same	25.5		18.0		<b>Yes</b>
Yes, I am more active	74.5		82.0		<b>Yes</b>

\*Indicates a statistically significant difference between the pre- and post-surveys

## COMPARISON BY LOCATION

Locations scored similarly on the pre-survey with a couple of exceptions. Table 6 below displays all pre-survey results by location. Students in Navajo county scored more than ten percentage points higher than the other locations on the question, “*What percent Daily Value for calcium do students your age need?*” This difference was statistically significant. In addition, Yuma students scored statistically significantly lower on the same question, scoring almost five percentage points lower than the next lowest score.

Navajo students also scored statistically significantly higher on the question, “*How many daily servings from the milk group should you have to meet your calcium needs?*” This score was over nine percentage points higher than the next highest score.

Finally, Maricopa students scored statistically significantly higher than students in the other locations on the question, “*Choose the fast food menu item with the most calcium and the least amount of fat.*” Maricopa students’ score was over nine percentage points higher than the next highest score.

**Table 6 - Pre-Survey Results by Location – Percentage of Preferred Answers**

	Coconino N = 234	Maricopa N = 194	Mohave N = 328	Navajo N = 795	Washington Elementary N = 1353	Yuma N = 1810
What percent Daily Value for calcium do students your age need?	23.9	18.6	24.1	34.8	16.8	12.2
How many daily servings from the milk group should you have to meet your calcium needs?	37.2	36.1	35.7	46.3	33.9	33.2
How many servings from the milk group did you have yesterday?						
None	6.0	8.8	11.9	8.3	9.8	11.3
1	21.8	28.4	21.3	21.8	21.4	24.9
2	37.6	36.1	32.6	35.2	33.2	35.4
3 or more	29.9	19.1	25.9	26.9	27.6	20.9
Don't Know	3.8	7.2	7.3	7.0	7.0	6.4
Which of the following foods does not have calcium?	41.5	43.8	35.4	46.5	40.2	46.3
Choose the fast food menu item with the most calcium and the least amount of fat.	70.1	79.9	68.3	69.3	70.0	70.3
What is osteoporosis?	28.2	28.9	21.3	33.7	17.1	17.0

	Coconino N = 234	Maricopa N = 194	Mohave N = 328	Navajo N = 795	Washington Elementary N = 1353	Yuma N = 1810
Ninety percent (90%) of your bone density will be built by what age?	43.2	33.5	36.6	41.4	35.4	36.3
Which of the following activities does not build better bones?	16.7	16.0	14.3	22.4	21.4	14.4
How much time should you spend being physically active each day to build better bones?	79.9	82.5	64.0	69.7	69.0	72.0
How much time did you spend yesterday being physically active?						
None	3.4	9.3	4.9	4.0	5.5	5.4
10 minutes	15.8	17.0	14.6	10.6	17.8	17.5
60 minutes or more	45.3	41.8	32.9	43.3	36.1	40.5
2 hours or more	29.9	22.7	38.4	35.8	34.8	28.7
Don't Know						
How many days each week should you be physically active to build better bones?	75.6	79.4	71.0	78.9	73.8	71.0

Like the pre-survey, the locations had many similar results on the post-test with some exceptions. Table 7 below displays post-survey results by location. Mohave students correctly identified the food that didn't have calcium at a statistically significantly higher rate than all other locations – a difference of almost ten percentage points. For the question, *“Choose the fast food menu item with the most calcium and the least amount of fat”* students in Navajo county did statistically significantly worse than the other locations, scoring lower on that question by over seven percentage points than the next lowest location.

On the question, *“Which of the following activities does not build better bones?”* each location scored statistically significantly differently from all of the other locations; the only question where each location's result was unique from the others.

Washington Elementary students scored statistically significantly higher on the question, *“How many days each week should you be physically active to build better bones?”* outperforming the next highest scoring location by almost seven percentage points. Finally, Washington Elementary students scored statistically significantly higher on the questions, *“Has the Building Better Bones Program helped you become more physically active?”* than the other locations, indicating that students reported a higher rate of behavior change as a result of the program than any of the other locations.

**Table 7 - Post-Survey Results by Location**

	Coconino N = 232	Maricopa N = 183	Mohave N = 321	Navajo N = 787	Washington Elementary N = 1338	Yuma N = 1745
What percent Daily Value for calcium do students your age need?	79.3	95.1	95.0	70.8	86.2	84.3
How many daily servings from the milk group should you have to meet your calcium needs?	73.7	89.6	91.3	79.3	83.1	85.2
How many servings from the milk group did you have yesterday?						
None	5.2	5.5	5.3	5.0	3.3	5.8
1	12.1	13.7	12.1	14.0	10.3	11.5
2	34.9	33.9	29.9	32.5	29.3	34.1
3 or more	43.5	38.3	50.8	43.6	51.3	41.9
Don't Know	3.4	7.7	1.2	4.6	5.1	5.6
Which of the following foods does not have calcium?	80.6	76.5	90.3	69.8	69.7	76.2
Choose the fast food menu item with the most calcium and the least amount of fat.	77.2	80.9	89.1	67.2	77.1	74.7
Since the Building Better Bones Program, I eat or drink:						
More calcium foods	56.5	66.7	73.5	59.8	72.0	67.9
Same amount of calcium foods	40.9	32.8	25.9	39.0	26.5	29.9
What is osteoporosis?	71.6	78.1	83.8	69.9	75.0	78.3
Ninety percent (90%) of your bone density will be built by what age?	77.6	91.8	90.0	75.7	92.2	80.6
Which of the following activities does not build better bones?	42.7	78.1	93.1	75.2	84.6	67.7
How much time should you spend being physically active each day to build better bones?	89.2	90.7	87.5	84.9	91.0	86.6
How much time did you spend yesterday being physically active?						
None	1.7	4.9	3.1	1.9	1.4	3.0
10 minutes	9.9	16.4	10.9	9.1	12.3	13.8
60 minutes or more	57.3	57.9	57.0	55.4	59.3	56.1
2 hours or more	23.7	15.3	24.9	27.6	22.4	20.0
Don't Know	6.9	4.9	2.2	5.0	3.5	5.6
How many days each week should you be physically active to build better bones?	82.8	79.2	83.8	84.5	91.4	83.2

	Coconino N = 232	Maricopa N = 183	Mohave N = 321	Navajo N = 787	Washington Elementary N = 1338	Yuma N = 1745
Has the Building Better Bones Program helped you become more physically active?						
My physical activity is the same	29.3	33.3	23.7	24.5	17.7	21.7
Yes, I am more active	70.7	66.7	76.3	75.5	82.3	78.3

Each location showed statistically significant differences between the pre- and post-surveys on almost every question. Behavior change questions such as “*How many servings from the milk group did you have yesterday*” tended to have fewer statistically significant differences. Two knowledge questions showed no statistically significant improvement between the pre- and post-surveys. Students at three out of six locations did not show a statistically significant improvement in identifying a fast food item that was high in calcium. In addition, students in Coconino and Maricopa counties had slightly fewer statistically significant differences than the other locations. Results are displayed in Table 8 below.

**Table 8 - Percentage Point Difference Between Pre- and Post-Surveys**

	Coconino	Maricopa	Mohave	Navajo	Washington Elementary	Yuma
What percent Daily Value for calcium do students your age need?	55.4*	76.5*	70.9*	36.0*	69.4*	72.1*
How many daily servings from the milk group should you have to meet your calcium needs?	36.5*	53.5*	55.6*	33.0*	49.2*	52.0*
How many servings from the milk group did you have yesterday?						
None	-0.8	-3.3	-6.6*	-3.3*	-6.5*	-5.5*
1	-9.7*	-14.7*	-9.2*	-7.8*	-11.1*	-13.4*
2	-2.7	-2.2	-2.7	-2.7	-3.9*	-1.3
3 or more	13.6	19.2*	24.9*	16.7*	23.7*	21.0*
Don't Know	-0.4	0.5	-6.1*	-2.4*	-1.9*	-0.8
Which of the following foods does not have calcium?	39.1*	32.7*	54.9*	23.3*	29.5*	29.9*
Choose the fast food menu item with the most calcium and the least amount of fat.	7.1	1.0	20.8*	-2.1	7.1*	4.4*
What is osteoporosis?	43.4*	49.2*	62.5*	36.2*	57.9*	61.3*

	Coconino	Maricopa	Mohave	Navajo	Washington Elementary	Yuma
Ninety percent (90%) of your bone density will be built by what age?	34.4*	58.3*	53.4*	34.3*	56.8*	44.3*
Which of the following activities does not build better bones?	26.0*	62.1*	78.8*	52.8*	63.2*	53.3*
How much time should you spend being physically active each day to build better bones?	9.3*	8.2*	23.5*	15.2*	22.0*	14.6*
How much time did you spend yesterday being physically active?						
None	-1.7	-4.4	-1.8	-2.1*	-4.1*	-2.4*
10 minutes	-5.9	-0.6	-3.7	-1.5	-5.5*	-3.7*
60 minutes or more	12.0*	16.1*	24.1*	12.1*	23.2*	15.6*
2 hours or more	-6.2	-7.4	-13.5*	-8.2*	-12.4*	-8.7*
Don't Know	1.3	-2.3	-4.2*	-1.2	-1.7*	-1.6*
How many days each week should you be physically active to build better bones?	7.2	-0.2	12.8*	5.6*	17.6*	12.2*

\*Indicates a statistically significant difference between the pre- and post-surveys



## APPENDIX A – BUILDING BETTER BONES SURVEY

---

1. What grade are you in?

Fourth      Fifth      Sixth

2. Are you a boy or a girl?

Boy      Girl

3. What percent Daily Value for calcium do students your age need?

50%      100%      130%      150%

4. How many daily servings from the milk group should you have to meet your calcium needs?

None      Two      Four      Six      Eight

5. How many servings from the milk group did you have yesterday?

None      One      Two      Three      Four of more

6. Which of the following foods have calcium? (Mark all that apply.)

Chicken      Dark green leafy vegetables      Yogurt      Beans

7. Choose the fast food menu item with the most calcium and the least amount of fat?

Hamburger      Shake      French Fries      Chicken Nuggets

8. What is osteoporosis?

Clogged blood vessels      Porous bones      High blood pressure  
High blood sugar      Do not know

9. Ninety percent (90%) of your bone density will be built by what age?

10 years      18 years      25 years      40 years      55 years

10. Which push, pull, pound or pick-up activities help build better bones? (Mark all that apply.)

Jumping rope      Dancing      Swimming      Basketball

11. How much time should you spend being physically active each day to build better bones?

None      10 minutes      60 minutes or more      2 hours or more

12. How much time did you spend yesterday being physically active?

None      10 minutes      60 minutes or more      2 hours or more

13. How many days each week should you be physically active to build better bones?

1 day      2 days      3 days      4 days      5 days

14. Did you attend a Building Better Bones Program last year?

Yes      No