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Can Children's Museums Deliver Effective Health Outreach?: Evaluation Results of the HealthWorks! Be A Food Groupie Program for Elementary Students

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Abstract

Objectives: We evaluated the Be A Food Groupie (BAFG) program’s impact on health/nutrition knowledge among elementary students who received BAFG at HealthWorks! children’s museum.

Methods: In 2012-2013, we conducted a matched comparison evaluation using pre-/post-tests among 446 intervention and 524 comparison students (N = 970) in Grades 3-5 recruited from 11 Mississippi schools to determine whether BAFG improved health/nutrition knowledge across three domains: 1) comprehending food labels, 2) understanding serving sizes, 3) understanding food groups.

Results: After controlling for pre-test scores, ANCOVA results indicate that intervention students scored significantly higher on the post-test across all three domains and across all three grades as compared to comparison students. Third-grade intervention students had significantly higher post-test scores overall than their comparison counterparts, $F(1,288) = 52.02$, $p < .001$, $h^2 = .153$. Fourth-grade intervention students had significantly higher post-test scores overall than their comparison counterparts, $F(1,373) = 58.52$, $p < .001$, $h^2 = .136$. Fifth-grade intervention students had significantly higher post-test scores overall than their comparison counterparts, $F(1,300) = 151.71$, $p < .001$, $h^2 = .336$.

Conclusion: BAFG results support the argument that interactive health/nutrition education programs at children’s museums can positively impact children’s health knowledge and, therefore, can support learning beyond the school setting. When children’s museums and schools collaborate to develop long-term partnerships to enhance children’s learning experiences that—like BAFG—meet state-mandated requirements, programmatic impacts can be further augmented. Children’s museums can provide supplemental health-related education—including obesity prevention information—that can be reinforced at school, home, and in the community.

Keywords

Matched comparison evaluation; Children’s health/nutrition program; Children’s museum; Obesity prevention

Cover Page Footnote

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ABSTRACT

Objectives**:** We evaluated the Be A Food Groupie (BAFG) program's impact on health/nutrition knowledge among elementary students who received BAFG at HealthWorks! children's museum.

Methods**:** In 2012-2013, we conducted a matched comparison evaluation using pre-/post-tests among 446 intervention and 524 comparison students (N = 970) in Grades 3-5 recruited from 11 Mississippi schools to determine whether BAFG improved health/nutrition knowledge across three domains: 1) comprehending food labels, 2) understanding serving sizes, 3) understanding food groups.

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Conclusion**:** BAFG results support the argument that interactive health/nutrition education programs at children's museums can positively impact children's health knowledge and, therefore, can support learning beyond the school setting. When children's museums and schools collaborate to develop long-term partnerships to enhance children's learning experiences that—like BAFG—meet state-mandated requirements, programmatic impacts can be further augmented. Children's museums can provide supplemental health-related education—including obesity prevention information—that can be reinforced at school, home, and in the community.

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INTRODUCTION

In 2004, the U.S. Surgeon General Carmona helped place childhood obesity on the national agenda as a major public health issue with his testimony before a Senate Subcommittee about dramatic increases in childhood overweight and obesity in the U.S. As Carmona put it, "Because of the increasing rates of obesity, unhealthy eating habits, and physical inactivity, we may see the first generation that will be less healthy and have a shorter life expectancy than their parents" (Carmona, 2004, p. 1). Yet over a decade after Carmona's commentary, approximately one in three children in the U.S. is overweight/obese (CDC, 2014). Overweight children have about an 80% chance of staying overweight into adulthood, which is cause for concern because overweight/obesity in adulthood is linked to cardiovascular disease and death at earlier age (American Heart Association, 2011). Interestingly, 6- to 11-year-olds in the U.S. are at increased risk for obesity as compared to 12- to 19-year olds (Ogden & Carroll, 2010).

Obesity causes a range of health problems in U.S. children previously unseen until adulthood, including high blood pressure, elevated blood cholesterol levels, and Type 2 diabetes (American Heart Association, 2013). It is anticipated that obesity prevalence and associated health problems among children will continue to increase unless there are substantial changes to address childhood overweight/obesity across the U.S., and especially in the Southeast where high rates of childhood overweight/obesity are found in resource-limited states such as Arkansas, Alabama, Georgia, Louisiana, Tennessee, and Mississippi (National Conference of State Legislatures, 2014), which is the focus of this study.

For example, although Mississippi's efforts to address this health issue produced a 13% decline in childhood obesity from 2005 to 2011, the state's childhood overweight/obesity prevalence rate of 41.8% (Center for Mississippi Health Policy, 2014; Kolbo et al., 2012; Zhang et al., 2014) remains one of the highest in the nation. One of Mississippi's important health promotion efforts to address childhood overweight/obesity was passage of the *Mississippi Healthy Students Act of 2007*, whose policies seek to improve nutrition and promote physical activity and health education in public schools (Rodriguez, 2011; Rowe et al., 2011).

However, multiple individual, family, community, and environmental factors contribute to childhood overweight/obesity in resource-limited states beyond the school environment, such as concentration of food deserts in high poverty areas, low access to parks and recreational areas, and community- and family-level attitudes towards eating and exercise (Brennan, Castro, Brownson, Claus & Orleans, 2011; Buffington et al., 2014; Dutko, Ver Ploeg & Farrigan, 2012; Kuross & Folta, 2010; Phillips et al., 2010; Rodriguez, 2011; Schetzina et al., 2009; Southward et al., 2012; Thompson & Card-Higginson, 2009). Therefore, effective health/nutrition promotion among U.S. children must take a multilevel approach. One way to accomplish this is to engage children in health/nutrition education not only in the school environment but in non-school settings such as children's museums, which serve an estimated 31 million visitors each year (Maher, 2010).

Child-focused health/nutrition education programs that can be widely disseminated by children's museums via field trips and on-site school visits can play an important role in supplementing mandated school health/nutrition educational requirements that resource-limited schools may have a difficult time fulfilling (Amis, Wright, Dyson, Vardaman & Ferry, 2012). For example, although the Mississippi Healthy Students Act legislates that children in Grades K-8 receive 45 minutes per week of health education (Southward et al., 2012), only 67% of school principals surveyed in 2010 reported that 75% or more of their students received the required health education instruction (Molaison, Kolbo, Zhang & Harbaugh, 2011).

Although a key component of any health education program should be determining its effectiveness, few children's museums conduct systematic evaluations of their health/nutrition education programs. Indeed, a search to identify evaluations of health education programs offered at children's museums in the past five years indicates a dearth of current peer-reviewed articles, of which most include very small samples. For example, a qualitative evaluation of the *GoKids Project* was conducted among 23 children and 16 adults participating in a health promotion program provided by the Boston Children's Museum (Kuross & Folta, 2012) and the pre-/post-test evaluation of *Healthy Pizza Kitchen* was conducted among 151 children at the Hall of Health in Berkeley, California (Freedman, 2010).

Although a collection compiled by the Association of Children's Museums that highlighted best practices for health-oriented exhibits and programs at children's museums included seven in-house educational programs that "offer family-friendly strategies to combat the childhood obesity epidemic" (Maher, 2010, p. iv), the authors were unable to locate peer-reviewed evaluations of these programs.

In this paper, we present the quantitative results of a multimethods evaluation of the *Be A Food Groupie* (BAFG) health education program offered at HealthWorks!, a children's health museum in Mississippi. This evaluation helps fill an important gap in the literature on evidence-based health promotion to children through educational programs delivered in informal educational settings (e.g., children's museums). To our knowledge, our matched comparison pre-/post-test evaluation of HealthWorks!'s BAFG program (N = 970) is the largest and most systematic quantitative evaluation of its kind. Implications for research and praxis are discussed.

HealthWorks!: An Interactive Children's Museum

HealthWorks! North Mississippi is an interactive children's health museum in Tupelo, Mississippi, modeled on Memorial HealthWorks! Kids' Museum in Indiana. Opened in 2009, HealthWorks! reaches approximately 25 thousand students and teachers each year. One way HealthWorks! North Mississippi fulfills its mission to improve health/nutrition knowledge among children is through programs delivered to students in Grades Pre-K-8 during cost-free school field trips to the museum. HealthWorks!'s programs are aligned with the Mississippi Department of Education standards for grade-specific health education competencies.

In 2012, HealthWorks! received funding from the Appalachian Regional Commission to cover costs for 3,000 3rd- through 5th-grade students and teachers to participate in the *Be A Food Groupie* health education program during school field trips in 2012-2013. With additional support from the Appalachian Regional Commission, the Health Care Foundation of North Mississippi commissioned researchers at the Social Science Research Center of Mississippi State University to conduct a systematic evaluation to determine the BAFG's effectiveness in improving the acquisition of health/nutrition knowledge among 3rd- through 5th-grade students. This evaluation study was approved by the institutional review boards of Mississippi State University and the North Mississippi Health Services.

Be A Food Groupie (BAFG) Program

BAFG is an intensively interactive 60-minute group program for Grades 3-5 delivered during a two-hour school field trip to HealthWorks!. BAFG is designed to improve health/nutrition knowledge acquisition across three domains: 1) comprehending food labels, 2) understanding serving sizes, and 3) understanding food groups. The curricula was originally developed by Memorial HealthWorks! Kids' Museum of South Bend, Indiana, and was positively evaluated by Mid-continent Research for Education and Learning (McREL) in the year prior to HealthWorks!'s opening in Mississippi in 2009 (Moore, Linder-VanBerschot & Phillips, 2008). During their cost-free/grant-funded field trip to HealthWorks!, elementary students engage with dynamic multi-sensory health exhibits on the "Funtastic Floor" (e.g., the Supersize Challenge), explore brain processes inside the "Brain Theater," and participate in the BAFG program in a "Learning Lab" classroom. Designed to be age-appropriate for Grades 3-5 and to meet the Mississippi Department of Education requirements for grade-specific health education competencies, BAFG is delivered by trained HealthWorks! staff whose goal is to equip students with "smart food know how" through multiple interactive games and hands-on demonstrations. See Appendix 1 for an outline of the BAFG curricula.

METHODS

In order to determine whether BAFG was meeting its health/nutrition knowledge acquisition goal, we conducted a matched comparison pre-/post-test evaluation among 970 3rd- through 5th-graders from 11 schools who participated in BAFG field trips in 2012-2013. Regardless of whether they were in the intervention or comparison group, all students received the same pre-/post-tests. Intervention students also received two additional post-test questions related to behavior change, which are not included in the present analysis.

Students from the five intervention schools (i.e., intervention students) 1) completed the pre-test, 2) participated in the BAFG program, and then 3) completed the post-test approximately two weeks later. Students from the six comparison schools (i.e., comparison students) 1) completed the pre-test, 2) completed the post-test approximately two weeks later, and then 3) participated in the BAFG program. Therefore, both treatment groups received exactly the same BAFG curriculum, but at two different time-points. The intervention group participated in the BAFG program *before* taking the post-test and the comparison group participated in the BAFG program *after* taking the post-test. Per the study design, the amount of time between pre- and post-test was just under two weeks for both treatment groups.

School Recruitment

Principals of the 23 schools located in the Appalachian Regional Commission's catchment area for North Mississippi were invited to have their school participate in the BAFG evaluation via personalized letters and follow-up emails. Principals were assured that their schools were eligible for the cost-free BAFG field trip regardless of whether they participated in the evaluation. The 12 schools whose principals agreed to participate were matched into pairs that contained one intervention and one comparison group school. Using 2012 student assessment data from the Mississippi Department of Education (2012), schools were paired based on the percentage of students at each school who were at or below the poverty level, the percentage who were minority status (primarily African American), and the number of students who scored as proficient on the language portion of the Mississippi Curriculum Test.

This last criterion was included because language proficiency is an important factor when it comes to doing well on tests, such as those used in the evaluation. School personnel were not informed as to whether their school was in the intervention or comparison group. One school decided not to go on the cost-free field trip and, as a consequence, dropped out of the evaluation. The school's administrators communicated that they decided to not send students on the field trip due to school-related scheduling logistics. As a result, five intervention schools and six comparison group schools participated in the BAFG evaluation.

Pre-/Post-Test Administration Procedures

Each child's parent/guardian was required to return a signed/dated parental consent form to the child's teacher. The parental consent form included information that the data collected from participants would not include personal identifiers and the results would be available only in aggregate form. The student assent document was read aloud to students by their teacher before students took the pre- and post-tests. The assent document explained that 1) the test would not count as part of the child's final class grade, 2) the child could skip any question(s) on the test, and 3) the child could stop taking the test at any time s/he desired.

The teachers at each participating school were asked to administer the pre-/post-test to students in their classrooms. Teachers received pre- and post-test packets on a strict schedule. The packets included the tests as well as easy-to-follow instructions on the administration dates. Teachers were provided two options for administration dates for each test and were asked to indicate which date the tests were administered. In order to mitigate against variations in children's reading comprehension since all grade levels received the same tests, the pre-/post-tests were read aloud to students by their teacher.

Analytic Procedures

Data for 46 students were excluded from the final analyses because the student 1) did not finish or skipped an entire page of the pre-test, 2) did not finish or skipped an entire page of the post-test, 3) was in the intervention group and indicated on the post-test that s/he did not go on the BAFG field trip, 4) was in the comparison group and the teacher administered the post-test after the BAFG field trip, or 5) was in a classroom where the numeric codes that linked individual students' pre- and post-tests were not used appropriately. The analyses were conducted using SPSS version 21.0 and the pre- and post-tests assessed students' health/nutrition knowledge using 22 multiple-choice or multiple-response items (see Appendix 2).

Sample items included "A calorie is a measurement of how much ______ is in food" and "Put an X beside ALL of the foods that are in the Protein group (You may put more than one X)." For each of the 22 items, each correct answer received a score of one (1) point, each incorrect answer received a score of zero (0), and each item left blank received a score of zero (0). Next, the total points per student were divided by the number of test items (22) to calculate a correctness percentage (hereafter referred to as pre- and post-test scores). Finally, the pre-test score was subtracted from the post-test score to yield a difference in test scores (gain score).

Students could not be randomly assigned to a treatment group because BAFG was delivered during a field trip. Instead, students were assigned to the intervention or comparison group based on their enrollment in a particular school. Therefore, an analysis of covariance (ANCOVA) provides the best estimate of how the two groups would score on post-tests if their scores were statistically equivalent at pre-test. To examine BAFG's impact on health/nutrition knowledge, we conducted an ANCOVA where the treatment group was the independent variable, the post-test score was the dependent variable, and the pre-test score was the covariate. We also conducted a separate series of ANCOVAs for the questions that correlated with each of BAFG's three primary domains in order to explore the intervention's impact on each domain (i.e., comprehending food labels, understanding serving sizes, understanding food groups). Finally, the ANCOVAs were repeated by grade in order to explore the impact of the intervention among students at each grade level.

RESULTS

Results Among all Students

The final sample (N = 970) included 446 intervention students and 524 comparison group students of whom 51.0% were girls and 30.0% were 3rd-graders, 38.8% were 4th-graders, and 31.2% were 5th-graders. In Table 1, intervention and comparison schools are ranked in order of percentage of students at or below the poverty level. Information on percentage of minority students per school and number of students in each grade who scored as proficient on the language portion of the Mississippi Curriculum Test per school is also included in Table 1. Figure 1 includes the overall scores and domain-specific scores on pre- and post-tests for the intervention and comparison groups.

Results by Grade

Third-graders in the intervention group had an average gain score of 13.5 percentage points while those in comparison group had an average gain score of 3.1 points. Fourth-graders in the intervention group had an average gain score of 16.6 percentage points while those in the comparison group had an average gain score of 5.0 points. Fifth-graders in the intervention group had an average gain score of 17.5 percentage points while those in comparison group had an average gain score of -1.6 points.

Figures 2-3 include unadjusted means and standard errors for overall and domain-specific pre- and post-test scores by grade and treatment group. After controlling for pre-test scores, 3rd-graders in the intervention group had significantly higher post-test scores overall than those in the comparison group, F (1,288) = 52.02, $p < .001$, $\eta^2 = .153$. They also had significantly higher post-test scores than the comparison group across the food label domain, F (1,288) = 6.04, $p < .05$, $\eta^2 = .021$, serving size domain, F (1,288) = 64.19, $p < .001$, $\eta^2 = .182$, and food group domain, F (1,288) = 14.28, $p < .001$, $\eta^2 = .047$.

After controlling for pre-test scores, 4th-graders in the intervention group had significantly higher post-test scores overall than those in the comparison group, F (1,373) = 58.52, $p < .001$, $\eta^2 = .136$. They also had significantly higher post-test scores than comparison group students across the food label domain, F (1,373) = 5.61, $p < .05$, $\eta^2 = .015$, serving size domain, F (1,373) = 84.29, $p < .001$, $\eta^2 = .184$, and food group domain, F (1,373) = 30.35, $p < .001$, $\eta^2 = .075$. Likewise, after controlling for pre-test scores, 5th-graders in the intervention group had significantly higher post-test scores overall than those in the comparison group, F (1,300) = 151.71, $p < .001$, $\eta^2 = .336$. They also had significantly higher post-test scores than comparison group students across the food label domain, F (1,300) = 39.01, $p < .001$, $\eta^2 = .115$, serving size domain, F (1,300) = 140.98, $p < .001$, $\eta^2 = .320$, and food group domain, F (1,300) = 74.81, $p < .001$, $\eta^2 = .200$.

Table 1. Intervention and Comparison Schools Ranked in Order of Percentage of Students At or Below the Poverty Level (N = 970).

	At/Below Poverty Level (%)	Minority* (%)	Proficient in Language* (%)	Subtotal by Grade (n)
Intervention				
School 1 (n = 165)	70	13	30.4 (Grade 3)	48 (Grade 3)
			28.6 (Grade 4)	67 (Grade 4)
			42.4 (Grade 5)	50 (Grade 5)
School 2 (n = 144)	69	33	—	—
			35.0 (Grade 4)	80 (Grade 4)
			28.8 (Grade 5)	64 (Grade 5)
School 3 (n = 147)	62	1	33.3 (Grade 3)	45 (Grade 3)
			54.8 (Grade 4)	55 (Grade 4)
			44.0 (Grade 5)	47 (Grade 5)
School 4 (n = 132)	42	6	40.9 (Grade 3)	44 (Grade 3)
			43.2 (Grade 4)	38 (Grade 4)
			22.9 (Grade 5)	50 (Grade 5)
School 5 (n = 115)	0	9	46.3 (Grade 3)	44 (Grade 3)
			38.5 (Grade 4)	32 (Grade 4)
			46.3 (Grade 5)	39 (Grade 5)
Comparison				
School 1 (n = 125)	75	43	42.5 (Grade 3)	65 (Grade 3)
			40.8 (Grade 4)	60 (Grade 4)
			—	—
School 2 (n = 164)	63	0	28.6 (Grade 3)	47 (Grade 3)
			40.0 (Grade 4)	59 (Grade 4)
			40.3 (Grade 5)	58 (Grade 5)
School 3 (n = 113)	55	8	35.0 (Grade 3)	37 (Grade 3)
			37.1 (Grade 4)	34 (Grade 4)
			51.4 (Grade 5)	42 (Grade 5)
School 4 (n = 173)	51	5	39.7 (Grade 3)	89 (Grade 3)
			55.3 (Grade 4)	84 (Grade 4)
			—	—
School 5 (n = 145)	44	14	42.2 (Grade 3)	45 (Grade 3)
			49.1 (Grade 4)	51 (Grade 4)
			57.8 (Grade 5)	49 (Grade 5)
School 6 (n = 108)	44	0	50.0 (Grade 3)	34 (Grade 3)
			40.5 (Grade 4)	36 (Grade 4)
			58.1 (Grade 5)	38 (Grade 5)

*Percentages may not equal 100 due to rounding.

Figure 1. Overall and Domain-Specific Pre- and Post-Test Scores by Treatment Group.

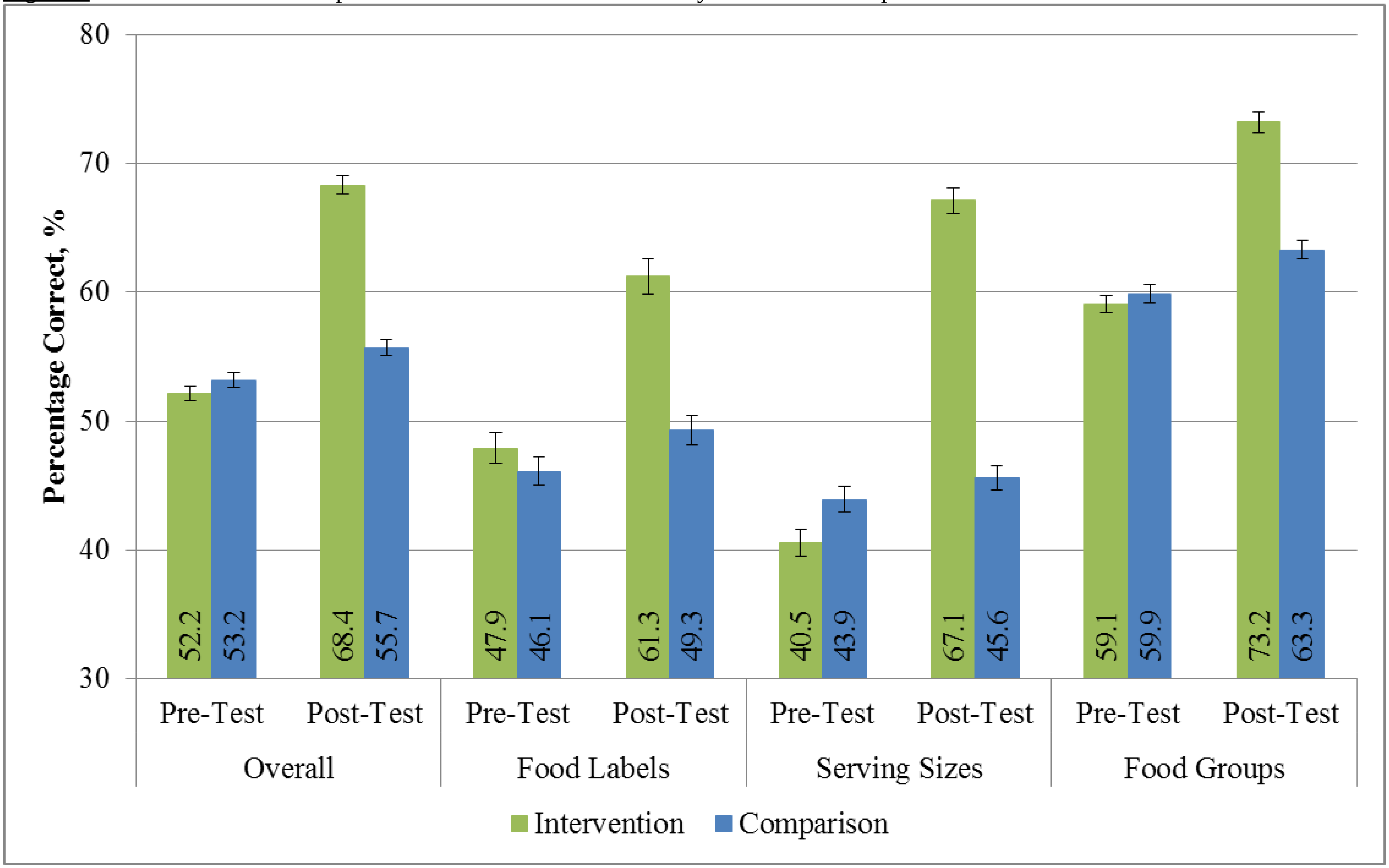


Figure 2. Overall and Food Labels Domain Pre- and Post-Test Scores by Grade and Treatment Group.

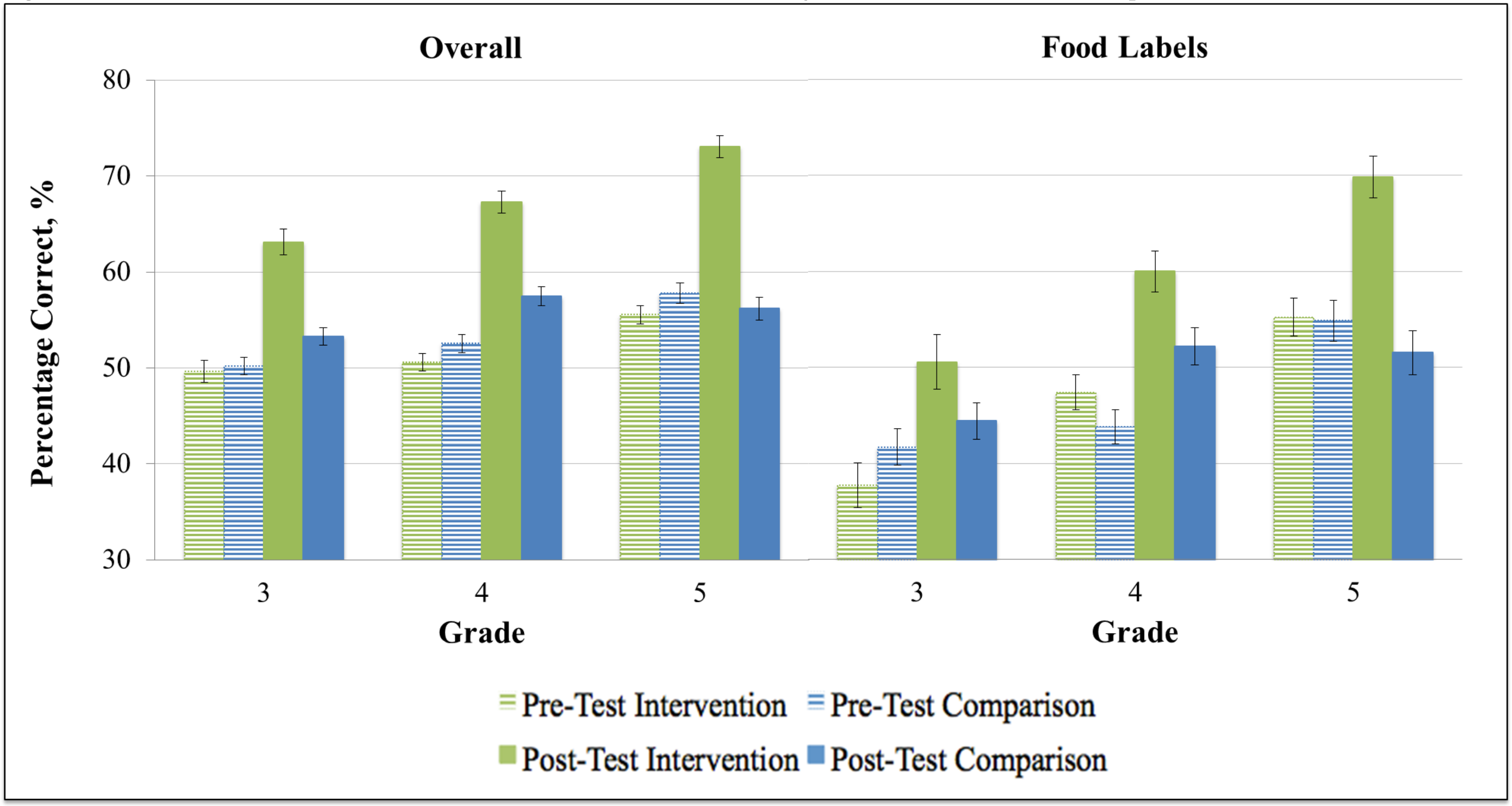
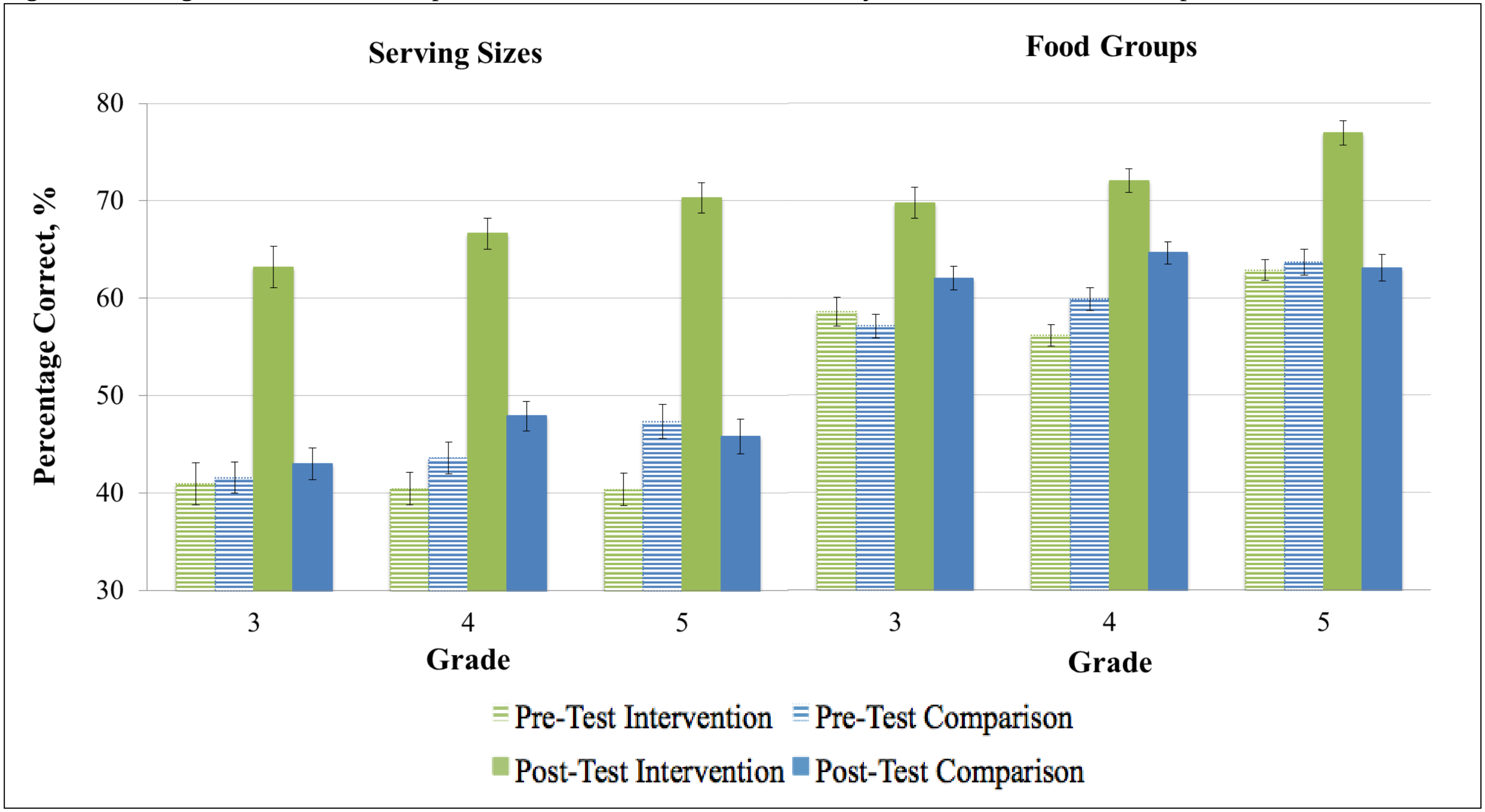


Figure 3. Serving Sizes and Food Groups Domain Pre- and Post-Test Scores by Grade and Treatment Group.



DISCUSSION

This paper presents results of a matched comparison evaluation conducted among 970 3rd- through 5th-grade students to determine whether HealthWorks!’s BAFG program improved health/nutrition knowledge related to comprehending food labels, understanding serving sizes, and understanding food groups. All students received the BAFG curriculum during their field trip and were administered pre- and post-tests in the classroom by their teachers. Results indicate that intervention students (who participated in the BAFG program *before* taking the post-test) scored significantly higher on the post-test than did comparison group students (who participated in the BAFG program *after* taking the post-test) even after controlling for pre-test scores.

Further, the significant differences in post-test scores between the two groups was apparent across all three domains. Interestingly, although BAFG positively impacted health/nutrition knowledge among intervention students across all grade levels, the score gap between the treatment groups increased as grade level increased and was highest for 5th-graders. Additionally, as Figures 2-3 indicate, the post-test scores of 3rd-graders in the intervention group were comparable to or even higher than the pre-test scores of 4th- and 5th-graders in the comparison group.

These results suggest that BAFG improved health/nutrition knowledge, as measured by 1) differences in gain scores across the two treatment groups from pre- to post-test and 2) differences in post-test scores between the two treatment groups, even after controlling for pre-test scores. The finding that younger students scored higher on the test after participating in BAFG than did older students who hadn’t yet participated in BAFG provides further evidence that the program measurably improved health/nutrition knowledge among its targeted age-range of students. This is important because age-appropriateness is a key to successful health/nutrition programing for children.

This study adds to the scant body of quantitative research to evaluate health education programs in informal educational settings of children’s museums. Although the long-term effects of the BAFG program on children’s health knowledge acquisition remains unclear, the observed gains in children’s health literacy demonstrated at two weeks is encouraging, particularly in a state with extremely high levels of childhood overweight and obesity. The results suggest that children’s museums can be an effective outreach option by providing important health education to children outside of their school and home environments, where there may be constraints of time, work, and other school- and family-related demands that limit opportunities for exposure to health education. In terms of generalizability, the BAFG program and this evaluation serve as a model for other children’s museums that offer – or are considering offering – curriculum-driven learning opportunities for children in non-school settings.

Strengths and Limitations

The findings must be considered in light of the study’s limitations. For example, because students are exposed to health/nutrition information through multiple venues, we cannot conclude that BAFG alone caused the measurable improvement in intervention students’ scores from pre- to post-test. Other factors may have contributed to their change in test scores—such as health/nutrition information the intervention students may have been exposed to at school, home, or through the media. However, we have no reason to believe that intervention students had a different exposure to outside information than did comparison group students during the study’s timeframe. Another potential limitation of the study is that some teachers did not provide the requested administration dates on their returned pre- and post-tests packets. Therefore, the time lapse between pre- and post-test administration could not be determined in all cases.

We attempted to mitigate this possibility by 1) separately delivering pre- and post-test packets to teachers on a strict schedule, 2) providing them with easy-to-follow instructions on when to administer each test, 3) providing them with a choice of two dates on which to administer the pre-test and another two dates on which to administer the post-test, 4) providing them with a feedback form in each test packet that included a place to write-in the date that test was administered, and 5) including a label on each test packet that contained both alternative test dates and instructed teachers to circle the date that test was administered. For those packets that did not include administration dates, we made the assumption that the most commonly reported date by other teachers at that school was the administration date for missing cases. However, one school did not have enough data to make inferences about administration dates, so they were not included in the computation of time lapse between pre- and post-tests (i.e., approximately two weeks for both groups).

Given that schools volunteered to participate in the study, the possibility of selection bias exists. To mitigate this possibility, all 23 schools within the Appalachian Regional Commission's catchment area for North Mississippi were eligible to participate in the evaluation. All Principals were informed of the study during the same time frame and through multiple communication channels that included personalized letters and follow-up emails. In these communications, Principals were assured that their schools were eligible for the no-cost/grant-funded BAFG field trip regardless of whether they participated in the evaluation.

And finally, this evaluation focused on knowledge acquisition (versus knowledge retention or behavior change) as a 'first step' in determining whether a children's museum program would be able to deliver health information that elementary-aged children could learn in a 60-minute 'one-dose' program. We did not have the funds to test how long intervention students retained the BAFG health information after post-test. Although budgetary constraints precluded addition of a retention-test to the evaluation, studies of science museum field trips indicate longer-term impacts that have ranged from a month to several years (DeWitt & Storksdieck, 2008; Falk & Dierking, 1997; Nadelson & Jordan, 2012; Sturm & Bogner, 2010). Similarly to knowledge retention, behavior change was not the focus this evaluation. We collected data on 1) whether intervention students reported that they learned something new while on the BAFG field trip and 2) whether intervention students reported that they shared the information they learned on the BAFG field trip with their families. As these two questions were only asked to the intervention students, a forthcoming manuscript compares these responses across multiple years.

A strength of the study was its relatively large sample size (N = 970) given that there is considerable lack of evaluation research on health education programs provided by children's museums—and most of these studies have small sample sizes (Amis, Wright, Dyson, Vardaman & Ferry, 2012; Freedman, 2010; Kuross & Folta, 2010; Maher, 2010; Molaison, Kolbo, Zhang & Harbaugh, 2011). Another strength of the study is its matched comparison design where intervention and comparison group schools were matched on percentage of students who were at or below the poverty level, percentage of students who were of minority status, and number of students who scored as proficient on the language portion of the Mississippi Curriculum Test.

Therefore, the results of the evaluation fill an important gap in evidence-based research on effective health/nutrition programs provided by children's museums. The evaluation's matched comparison design also helped to mitigate against a practice effect, which is a potential limitation of studies that use a pre-/post-test design. In this evaluation, there was a significant difference in post-test scores between the intervention and comparison group students even though both treatment groups completed the test twice and the amount of time between pre- and post-test was approximately two weeks for both groups. Since both groups should have experienced a practice effect, the significant differences in post-test scores between the intervention and the comparison groups cannot be attributed to repeated exposure to the test alone.

CONCLUSION

Although children's museums are increasingly engaged in providing health education programs, systematic evaluations to examine "whether provision of health education in these venues increases knowledge" are uncommon (Freedman, 2010, p. 353). Our results help fill this critical gap by providing evidence from a matched comparison evaluation that the BAFG program at HealthWorks! improved health/nutrition knowledge among intervention students. The study design can serve as a model for conducting systematic evaluations of health-related programs provided by children's museums.

The findings support the argument that interactive health/nutrition education programs at children's museums can positively impact children's health knowledge and, therefore, can support learning within and beyond the school setting. Due to funding restrictions, we were unable to examine the impact that changes in children's knowledge had on parental food-purchasing decisions in the present study. However, future research might include surveys of parents to determine if their children shared what they learned during a health education programs provided by a children's museums and/or asked their parents for different foods after participating in such a program.

When children's museums and schools collaborate to develop synergistic long-term partnerships to enhance children's learning experiences (Gupta, Adams, Kisiel & Dewitt, 2010; Kratz S, Merritt, 2011; Wishart & Triggs, 2010) that—like the BAFG program—also meet state-mandated curriculum requirements, the impact of such programs can be further augmented. With increasingly limited time for health education in the classroom environment, children's museums can provide vital supplemental health education to children and can provide children with health information—including obesity prevention information—that can be reinforced at school, at home, and in the community.

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Appendix 1**:** Be A Food Groupie (BAFG) Curriculum Outline

1.	Identify that food's purpose is to provide the body with energy.
2.	Explain the correlation between the body's activity level and its energy requirements.
3.	Describe USDA's MyPlate.
4.	Identify each of the major food groups and describe how each provides specific benefits for the body.
5.	Identify water as a healthy beverage choice.
6.	Describe and explain the purpose of a food label.
7.	Identify serving sizes for foods in the major food groups.
8.	Describe the importance of having a balanced diet and making choices from all of the food groups.