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A School-Based Intervention's Impact on Children's Knowledge and Self-Efficacy Related to Physical Activity and Nutrition: A Pilot Study

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A School-Based Intervention's Impact on Children's Knowledge and Self-Efficacy

Related to Physical Activity and Nutrition: A Pilot Study

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A thesis submitted to the faculty of
Brigham Young University
in partial fulfillment of the requirements for the degree of

Master of Science

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ABSTRACT

A School-Based Intervention's Impact on Children's Knowledge and Self-Efficacy Related to Physical Activity and Nutrition: A Pilot Study

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Childhood obesity has become epidemic in the United States. One of the best places to combat this problem is within the school system. The purpose of this study was to examine changes in exercise self-efficacy, science interest, and science knowledge of children who participated in a school-based anatomy and healthy lifestyle intervention called Anatomy Academy. In this pilot study, 212 study participants were recruited from 5th and 6th grade children enrolled in one of three charter schools who participated in our 7-week intervention, Anatomy Academy.

Children completed four questionnaires pre and post intervention: (1) a science knowledge questionnaire, (2) a science interest questionnaire, (3) an exercise self-efficacy questionnaire, and (4) a demographic questionnaire. A statistically significant difference was found in participants' pre and post test scores on the science knowledge questionnaire. Anatomy Academy was well received by children, parents, and faculty and provides helpful curriculum for science and physical education classes.

Keywords: childhood obesity, overweight, school-based intervention, healthy lifestyle

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Introduction

Childhood obesity is epidemic in the United States (U.S.). Approximately 17% of children and adolescents (or 12.5 million) nationwide aged 2 to 19 years are obese (Centers for Disease Control and Prevention, 2012). Being overweight or obese means these children have increased body fat that can lead to health impairment (World Health Organization [WHO], 2012). Upon entering kindergarten, 14.9% of children in the U.S. are overweight, and another 12.4% are already obese. The rate of obesity continues to rise from kindergarten through the eighth grade, particularly in children who were overweight as kindergarteners (Cunningham, Kramer, & Narayan, 2014).

Children who are obese and remain obese throughout childhood and adolescence are at risk for developing chronic diseases as children and into adulthood. These chronic diseases include asthma, type 2 diabetes mellitus, hypertension, coronary artery disease, fatty liver, stroke, and sleep apnea (Sharma, 2011). Studies also show that childhood obesity leads to continued obesity in adulthood. For people over age 30 there is a higher rate of obesity in those who were obese in the later teenage years compared to people who were not obese as teens (Gonzalez-Suarez, Worley, Grimmer-Somers & Dones, 2009). Decreasing obesity in children allows for a decline in prevalence of these weight related diseases and mortality risk factors.

Comorbidities that Develop from Childhood Obesity

Children spend the majority of their weekdays in school; therefore, it seems appropriate for nutrition and physical activity interventions to occur in the school setting. Private and community programs are joining forces to improve the quality of food marketed to children,

support health and fitness programs in school systems, and engage children in healthy lifestyle behaviors (Rutkow, Vernick, Hodge, & Teret, 2008).

The purpose of this study was to examine changes in exercise self-efficacy, science interest, and science knowledge of children who participated in a school-based anatomy and healthy lifestyle intervention called Anatomy Academy. Upon completion of Anatomy Academy we expected to see improvement in the children's exercise self-efficacy, science interest, and science knowledge.

School Based Interventions for Obesity

Several studies have been conducted previously to determine the effectiveness of school-based interventions to prevent obesity. The Christchurch Obesity Prevention Programme in Schools (CHOPPS), also known as the “ditch the fizz” program, aimed to improve the nutrition choices of school aged children (James, Thomas, & Kerr, 2007). In the CHOPPS study, 644 children ages 7 to 11 years participated in a year-long intervention that included four different educational sessions aimed at decreasing the consumption of carbonated beverages and encouraging healthy food choices. Height, weight, and waist circumference were measured, and BMI was calculated. Results showed significant positive BMI differences between the control group and intervention group after 12 months ($p = 0.01$). Two years following completion of the study, BMI was measured again. Results showed that there was no longer a significant difference ($p = 0.28$), and both groups had an increase in the number of overweight children. However, the control group had a higher prevalence of overweight children than did the intervention group (James, Thomas & Kerr, 2007).

In Ontario, Canada 18 schools adopted the short term program “Nutrition Tools for Schools.” This program was designed to promote healthy eating among school-age children by

providing school employees, parents, and children with the necessary tools to make school a healthier place. These tools created by a registered dietician include posters, curriculum resources, fact sheets, newsletter inserts, and announcements. These toolkits were free to parents or school staff who were interested in implementing the program in their school. While pilot studies in several schools have been conducted, research evaluations have not yet been published (Mendelson, 2007).

In El Paso, Texas researchers studied a school-based intervention, based on Healthy People 2010 objectives, called Coordinated Approach to Child Health (CATCH). This study involved 896 low income elementary school children, mainly of Hispanic background. The purposes of CATCH were to decrease the fat content in school lunches, improve children's lifestyle behaviors, and increase the amount of aerobic exercise during physical education classes (CATCH, 2012). Results indicated obesity rates of Hispanic children in low-income schools participating in CATCH decreased. The obesity rate among girls in the CATCH schools increased by 2% compared to 13% among girls in the non-CATCH schools. The obesity rate for boys in CATCH schools increased by 1% compared to 9% among boys in non-CATCH schools (Coleman et al., 2005).

In 2010 a pilot study in rural Appalachia in the U.S. involved 13 teen mentors who promoted healthy diet and physical activity changes among 72 elementary school children in an eight-week, after-school program. Prior to the start of the intervention, the teen mentors were trained in a 12-hour mentoring program (Smith, 2010). Participants were randomly assigned into two groups, the attention-control or intervention group. Teens taught both groups, but the curriculum differed between groups. Children in the intervention group received 50 minutes of curricular content on the importance of daily physical activity and proper nutrition to promote

health and were encouraged to set attainable healthy lifestyle goals. This content was followed by 10 minutes of physical activity. Children in the attention-control group were taught content that included tobacco cessation, appropriate personal hygiene, and bicycle safety and participated in arts and crafts activities (Smith, 2010).

Smith (2010) found no statistically significant change in pre-test BMI between the two groups. Post test results indicate there was a significant decrease in BMI in the intervention group, but there was no significant change in the control group. The intervention group also had a significant increase in healthy eating behavior intention and nutritional knowledge from pretest to posttest but no significant change in physical activity behavior intention from pre to post intervention (Smith, 2010).

Method

Design

A pretest, posttest intervention design was used to evaluate the effectiveness of Anatomy Academy, on exercise self-efficacy, science interest, and science knowledge of children at three charter schools in Utah. We compared total scores on each of the pre and post instruments to assess effectiveness of the intervention. Additionally, qualitative data in the form of researcher observations were analyzed to help assess the effectiveness of Anatomy Academy.

Sample

A total sample of 212 children from two counties in Utah were enrolled in the study with 151 children completing the study. Both males and females participated and ranged in age from 9 to 14 years old ($M = 11.4$ years). The children had an average of four people in their households and had lived in their current homes for an average of 7.44 years. The percentage of children receiving free or reduced cost meals is an indication of the socioeconomic status of the

families at the schools. The first school does not participate in a free or reduced lunch or breakfast program, and is not a Title I school. The second school is not a Title I school and has 13% of children receiving reduced lunch and 30% receiving free lunch; breakfast is not served. The third is a Title I school with 36% minority, 13% with English as a second language, and 9% special education students. At this school 11% of children receive reduced lunch, and 28% receive free lunch; this school also offers free breakfast to children who receive free or reduced lunch.

Children participated in Anatomy Academy as part of their regular physical education curriculum at one of these three charter schools. Children who chose not to participate in the research study still took part in the Anatomy Academy but were excluded from data collection.

Program Development

Anatomy Academy was developed as part of physical education curriculum for charter schools. The program started in California in 5th and 6th grade classes at a charter middle school, predominantly attended by low-income Latino children. The goals were to help children understand basic anatomy and physiology of different body systems, and the importance of physical activity, health, and nutrition. Originally Anatomy Academy was held five consecutive days during summer 2012. Although anecdotal evidence from the original intervention is promising, further studies on Anatomy Academy are needed to determine its effectiveness.

Mentor Training

We modified Anatomy Academy from its original one week intensive summer program into a seven-week program that became integrated into the schools' physical education curriculum. Undergraduate and graduate students from two universities studying medicine, nursing, biology, elementary education, or dance volunteered to be Anatomy Academy mentors

and teach the curriculum to the 5th and 6th grade children. Prior to the start of Anatomy Academy, each mentor attended a training session where they were introduced to the teaching techniques and principles of classroom management and reviewed and discussed each unit in the Anatomy Academy curriculum. Body systems included in the curriculum were musculoskeletal, heart, lungs, oral cavity, gastrointestinal (GI), brain, and senses. The training session was taught by two Anatomy Academy Program Coordinators, one of whom is the first author of this study. These coordinators were available throughout the intervention to support the mentors, assist in teaching where needed, and monitor data collection.

Curriculum

Children spent 60 minutes once a week for seven weeks with mentors who taught them about the human body and healthy lifestyle behaviors. Each week mentors spent 30 minutes introducing children to a body system through an organized lesson and then participated with them in a 30 minute activity, in which mentors and children applied the concepts learned in an activity. For example, when studying the GI system, mentors first taught the path food follows through the GI tract, how to plan a day of healthy, balanced meals and snacks, and why body weight is maintained when calorie intake is equal to the calories expended. After learning this content, mentors and children then participated in a hands-on activity demonstrating the passage of food through the GI tract. Each child acted as a part of digestion, while using a plastic bag, graham crackers, and water to simulate food consumption, digestion, and elimination.

Procedure

Consent and assent. Children and their parents were contacted in writing about voluntary participation in the Anatomy Academy pilot study. Several days prior to the beginning of Anatomy Academy a cover letter, explaining the study and providing contact information for

the research team; two copies of "Parental Permission for a Minor," and two copies of "Child Assent" were sent home with the children. Participation was conditional on the completion and return of one copy of the consent and assent forms, which were securely stored thereafter.

Data collection. Each child was assigned a code using a random number generator. Children were given their number on the first day of Anatomy Academy and along with the help of their mentors, appropriately coded each pre- and post-test instruments. On the first and last day of Anatomy Academy, children completed the pre- and post-tests respectively by responding to prompts on four different questionnaires. Completion of the instruments took about 15 minutes each time.

Researcher observations. Throughout the intervention program coordinators observed interactions between children and mentors and listened carefully to comments regarding the program by children, mentors, school faculty, and parents. These observations provided information about the acceptability, quality, and benefits of the program.

Instruments. Children completed four questionnaires pre- and post-intervention. These instruments were developed by the second author for use at the site of the original weeklong Anatomy Academy and were based on review of the literature and educational standards. Instruments included an exercise self-efficacy questionnaire, a science interest questionnaire, a 5th grade physical education standards-based science knowledge questionnaire, and a demographic questionnaire.

The exercise self-efficacy instrument is an 8 item questionnaire designed to assess a child's confidence of exercise. This questionnaire was developed based on literature review; however, no reliability statistics are available. As an example, question four reads: "I can

exercise by myself, without friends or family.” Response options used a Likert-type scale with descriptors of “YES!, Sort of, Not really, NO!, I Don’t Know.”

The science interest instrument is an 8-item questionnaire to assess a child’s interest in science. This questionnaire was also developed based on literature review; however, no reliability statistics are available. As an example, question three reads: “I like reading science magazines and books.” Response options were the same as those in the exercise self-efficacy instrument.

The science knowledge instrument is a 10-item multiple choice questionnaire based on 5th grade physical education standards. It is designed to measure a child’s knowledge of the musculoskeletal, cardiac, pulmonary, and gastrointestinal systems. As an example, question one reads: “It is important to stretch your muscles because:” Children are then able to select the appropriate response from multiple choice answers: (a) stretching helps you prevent muscles from tearing during exercise, (b) stretching is the main way that muscles grow, (c) your muscles will break down if you do not stretch, (d) stretching makes you run faster.

In addition, we collected demographic data including age, household members, length at current residence, and ethnic identification. We also asked about their perceived health and physical strength, nutrition, and daily physical activity so we could determine any changes post-intervention.

Finally, researcher observations were discussed with the program team both during and after the intervention was complete. These discussions occurred at the end of each weekly Anatomy Academy session and allowed open discussion of how the intervention was going, as well as prep work for the following week. The program team included the program director, coordinators, mentors, and school faculty.

Data Analysis

After data collection was completed, data were entered and cleaned in SPSS version 21. We ran paired sample *t*-tests comparing pre and post total scores of each of the instruments used.

The variability in sample size of each questionnaire is due to incomplete collection of data from some of the children. Time constraints prevented some children from completing the questionnaires. Only questionnaires that were fully complete were included in data analysis.

Members of the research team met to discuss their observations each week during the intervention, and upon its completion. Faculty and parents also gave verbal feedback to the coordinators and mentors about the intervention and its impact on the children.

Results

Results on a sample of 174 children showed a significant increase in the total mean science knowledge (SSK) score from pre-test ($M = 7.87$) to post-test ($M = 8.18$, $p = .015$), indicating the intervention made a positive impact on the children's knowledge of science. The student science interest (SSI) questionnaire had a sample of 178 children and showed a slight increase in the total mean score from pre ($M = 32.13$) to post intervention ($M = 32.47$); however, this increase was not significant ($p = .307$). Similarly, the student exercise self-efficacy (SESE) questionnaire had a sample of 151 children with a slight increase in the total mean score from pre ($M = 34.13$) to post intervention ($M = 34.85$), which was not significant ($p = .111$).

Researcher observation indicated children were excited each to week to participate in Anatomy Academy and frequently expressed their enjoyment to program coordinators, mentors, school faculty, and parents. Some children's excitement was visible as they listened intently to learn about a new concept, interacted with their mentors and other children, and asked questions to clarify meaning. Several became especially animated during the activities, such as when they

acted as part of the digestive process. Parents and teachers also expressed their interest and satisfaction with the program and what the children learned. Since this pilot study, parents, faculty, and administrators at other elementary schools have heard positive reports from their peers at the original Anatomy Academy sites and have requested Anatomy Academy at their schools. Currently Anatomy Academy is in 30 classrooms in 12 schools between Utah and California, and requests for expansion to other schools continue.

Discussion

Results from analysis of our quantitative data indicate Anatomy Academy had minimal impact on the participants. We think the lack of significant differences from pre- to post-intervention in the student exercise self-efficacy and student science interest scores might be due to the instruments' inadequate sensitivity and the ability to appropriately discriminate changes; however, anecdotal evidence was overwhelmingly positive and suggests that there is promise with the intervention, despite difficulty finding statistically significant differences with our instruments.

The self-efficacy tool needs to be refined to improve sensitivity. According to researcher observations the children responded positively to the intervention. Also, the decrease in total self-efficacy scores might be partially due to children overestimating their knowledge prior to the intervention but understanding better afterward how much more there is to know and do.

Compared to other school-based studies, our intervention had a shorter duration. Several other school based interventions were eight weeks to one year in length, but our study was seven weeks long. Our study duration was similar to the Appalachia program, and though ours was one week shorter, the weekly session time was 60 minutes in both studies (Smith, 2010). These 60 minute weekly sessions allowed for much to be accomplished, but it is possible there would

be greater improvement and significant changes if Anatomy Academy was longer than 60 minutes per session and more than 8 weeks in duration. Mentors and coordinators in Anatomy Academy reported feeling rushed through both the educational content and physical activity every week. They expressed a desire for longer weekly sessions to cover content in greater depth and allow the children more time to learn and ask questions.

Similar to our study, other school based interventions showed effectiveness in some outcomes but were less effective in other outcomes. The Appalachia study showed positive improvement in participants' intentions to eat healthier meals. Participants in the teen mentored group had increased nutrition knowledge and efficacy, as well as lower BMI percentiles post intervention (Smith, 2010). Similarly, Anatomy Academy showed an increase in participants' science knowledge post intervention. The use of trained teen and college age mentors holds promise as an effective intervention in making changes in school aged children's knowledge of nutrition and physical activity.

Our study showed improvement in student science knowledge, but longitudinal studies would need to be completed to see if this improvement remains. Likewise, the CATCH study showed significant decrease in obesity rates among low-income Hispanic children who attend CATCH schools; however, no longitudinal studies have been completed to determine whether this decrease in obesity rates continued over time (Coleman et al., 2005). The CHOPPS study showed BMI differences between the control and intervention groups after 12 months. Two years after CHOPPS, participants' BMI was calculated again, and there was no longer a significant difference between groups, but the intervention group had a lower prevalence of increased BMI (James, Thomas & Kerr, 2007). This shows the importance of longitudinal studies to determine whether positive changes due to the intervention are effective long term.

Limitations and Recommendations

One limitation in our study was the research instruments lacked sensitivity in determining intervention effectiveness. The instrument's reliability and validity had not been established. We believe our results would have shown a more positive effect after the intervention if more reliable instruments to measure self-efficacy and science interest had been available. Our team is currently developing and testing a new self-efficacy tool that we anticipate will demonstrate more accurately the impact of Anatomy Academy. Further studies should be conducted using instruments that have established reliability and validity and can more accurately determine changes in the children's science knowledge and interest, and exercise self-efficacy after completion of Anatomy Academy.

Another limitation was our small sample size. With a sample size of 151 children, our study had the fewest participants of studies discussed herein, with the exception of the Appalachia pilot program whose sample size was 72 (Smith, 2010). It is recommended that further studies of Anatomy Academy be conducted with larger sample sizes than our pilot study. Enlarging sample size leads to improved reliability and validity, and also increases the chance of finding significant differences in study results. Larger sample sizes in further research studies would be helpful in determining the effectiveness of Anatomy Academy.

Several participants were unable to finish the study questionnaires due to time constraints, and incomplete instruments were not included in data analysis. Making the questionnaires available electronically so children can complete them at home or during a computer class in school might improve the number/percentage of children who complete them. Another option would be extending session time on the first and last days to provide sufficient opportunity for all participants to complete the questionnaires.

Recommendations for improving Anatomy Academy include lengthening the overall duration of the intervention and the weekly sessions so both mentors and children will have adequate time to teach and learn material. Each body system unit already included in the curriculum could be expanded and taught over two or three weeks, rather than trying to teach a new body system each week. It is also recommended that the curriculum be changed so a greater emphasis is placed on lifestyle changes to be made after understanding the anatomy and physiology of a body system.

An additional limitation would be the intervention did not include education and support for children's lifestyle changes outside the school setting. We recommend the intervention reach beyond the children and include parents and siblings, such as family involvement in homework assignments. This involvement can promote positive change not just with the child but within the family as a whole. Providing classes for parents and/or other siblings can help them become involved and reinforce the knowledge gained in Anatomy Academy and promote healthy changes within the family.

Finally, we did not follow the children longitudinally to assess changes in their science knowledge and interest and exercise self-efficacy over time. It is possible the children's self-efficacy might improve over time as they more fully integrate what they learned into their everyday life. We anticipated more evidence of positive impacts as a result of participation in Anatomy Academy, and had this been the case, it would have been important to determine whether those changes continued overtime. It is recommended that longitudinal studies be conducted to determine whether intervention changes are effective long term.

Implications

Implications for school nurses

School nurses play a vital role in promoting, educating, and supporting children's healthy lifestyle changes due in part to the nature of their interactions with children. It is recommended that school nurses coordinate programs like Anatomy Academy and collaborate with teachers within the schools, as well as faculty and students from local universities to sustain and improve programs like Anatomy Academy. University students can act as mentors within the program and work with school nurses to customize the program according to the schools demographics.

Policy Implications

On February 9, 2010, First Lady, Michelle Obama, started the “Let’s Move” initiative to combat childhood obesity and encourage children to engage in healthy lifestyle behaviors, including daily physical activity and nutritious eating (Let’s Move, n.d.). Programs like Anatomy Academy are aligned with the First Lady’s initiative to raise a healthier generation of Americans. Implementing school based interventions like Anatomy Academy in elementary and middle schools across America would help to advance the groundwork the First Lady has laid towards combating obesity.

Conclusion

Childhood obesity is a problem nationwide and affects children of all ages and races. Given the prevalence of childhood obesity, there is a great need for healthy lifestyle interventions, particularly those within the school system, that are aimed at educating and encouraging diet and physical activity changes. These interventions can help children establish patterns of healthy eating, nutrition, and vigorous daily physical activity. School based interventions are vital in establishing these patterns and pushing forward the national Let’s Move

initiative. Continued research on the impact of Anatomy Academy as well as the use of more sensitive tools will help to determine its effectiveness in a school setting.

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