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The St. Jude Cancer Education for Children Program Pilot Study: Determining the Knowledge Acquisition and Retention of 4th-Grade Students

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Abstract

In 2006, St. Jude Children's Research Hospital began developing a school-based outreach program known as the St. Jude Cancer Education for Children Program (SJCECP). The program aimed to teach children about cancer and healthy habits that can prevent the formation of cancers into adulthood. During the 2010-2011 academic year, we conducted a pilot evaluation of the SJCECP curriculum, with the primary objective of evaluating the impact of the intervention on knowledge acquisition and retention among 4th-grade students participating in the program. Seven local schools and 481 students from the Memphis area participated in the program evaluation. The results of this study show that 4th-grade students are able to acquire gains in knowledge related to cells, cancer, and healthy living after receiving the SJCECP intervention. We conclude that the program can be a useful tool for improving knowledge of cancer concepts at the 4th-grade level.

Background

According to the American Cancer Society (ACS), approximately 1,665,540 new cancer cases are expected to be diagnosed in 2014 in America, and approximately 585,720 Americans are expected to die of cancer, accounting for 1 in every 4 deaths in the United States [1]. More than half of all cancer deaths, however, can be prevented by making healthy lifestyle choices such as maintaining a healthy weight, eating a nutrient-rich diet, getting regular exercise, and avoiding smoking and tobacco use [1]. Yet, according to health statistics, many Americans do not make healthy lifestyle choices. For instance, more than a

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third of adults and 17% of children in the United States are obese [2]; more than 3,200 children younger than 18 years try their first cigarette each day [3]; and only 1 in 3 children in America are physically active every day [4]. In addition, the typical American diet exceeds the recommended intake of calories from sugars, sodium, and saturated fats and contains too few vegetables and fruits [5]. As a result, the cost of health care is on the rise, heightening the need for health education.

Health education is defined as teaching strategies and learning experiences that provide individuals with the opportunity to acquire the knowledge, attitudes, and skills needed to make healthy decisions, achieve health literacy, adopt healthy behaviors, and promote the health of others. Because lifestyle habits are often formed in childhood, education and positive reinforcement during early childhood development can help promote healthy lifestyle choices and reduce negative effects in later life [6]. Schools, daycares, and early childhood centers provide excellent avenues for targeting children for early health intervention because many children attend such institutions. According to a study conducted by the Center for Disease Control, 90% of states include health education in their health program and 74% of states have adopted health education standards based on the 2007 National Health Education Standards, which includes education in nutrition and dietary behavior, physical activity and fitness, and tobacco-use prevention [7].

In 2006, St. Jude Children's Research Hospital created a school-based outreach program that uses education and positive reinforcement to help promote healthy lifestyle choices and to reduce a child's lifetime risk of developing cancer. The program's educational objectives are to (a) educate elementary school children about cancer and dispel common misconceptions, (b) educate about and promote healthy lifestyle choices that can help children reduce their risk of cancer in adulthood, and (c) inspire an interest in science and scientific careers. It specifically addresses obesity, nutrition, smoking, and sun exposure, important issues in promoting childhood health and primary cancer prevention. Because health education curricula are administered by a variety of school staff members such as physical education teachers, school nurses, school counselors, or regular classroom teachers [8], the authors of the program decided to take a multi-disciplinary approach, focusing on combining concepts related to science education, health education, and cancer education.

During the 2010-2011 academic year, we conducted a pilot evaluation of the SJCECP curriculum, with the primary objective of evaluating the effect of the intervention on knowledge acquisition and retention among 4th-grade students participating in the SJCECP intervention. This paper addresses the results of this study and discusses the feasibility and usefulness of the SJCECP curriculum at the 4th-grade level.

Materials and Methods

Study Design and Materials

This pilot study had a single-group, pre-test/post-test design with a follow-up post-test given after 3 months to determine the effect of an education intervention on matched knowledge scores among participants. The St. Jude Cancer Education Program consists of three illustrated children's books, expert presentations, and hands-on activities. All of the

educational materials were developed and reviewed by a multidisciplinary team composed of St. Jude faculty and staff and local educators. There are three educational modules: Cells (presented as the basic unit of life), Cancer (presented as a disease of unhealthy cells), and Healthy Living (presented with practices for cancer prevention: proper nutrition, safe sun exposure, tobacco control, and appropriate physical activity). The reading level is for students in grades 3-5. Special care was taken to make the materials age-appropriate and sensitive to developmental levels of elementary school children. In addition, while developing the program, authors referenced relevant national and state education standards and performance indicators, including the National Science Education Standards, National Health Education Standards, and National Association for Sport and Physical Education [9-11].

Human and Animal Rights

This study was reviewed and approved by the St. Jude Children's Research Hospital Institutional Review Board for Human Subjects Research and has, therefore, been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. All classroom teachers and parents of students gave their informed consent prior to their inclusion in the study.

Study Sample

The study sample was one of convenience. For school recruitment, a variety of public and private schools were contacted by phone or by letters inviting schools in the area to participate in the study. Schools were chosen based not only on availability and willingness to participate, but also on demographics in an attempt to better reflect the overall Memphis demographics. During the 2010-2011 academic year, 7 local schools and 481 students, approximately 60% from public schools and 40% from private schools, participated in the SJCECP intervention evaluation. Participants in the study were 4th-grade boys and girls aged 8-11 years with the cognitive capacity to complete questionnaires (as determined by the teacher) and who attended a school in the Greater Memphis Area (Shelby and surrounding counties).

Intervention

As part of the intervention, each participating student received the illustrated children's books "*What are Cells?*", "*What is Cancer?*", and "*What is Healthy Living?*" as well as a laboratory manual for the exercise to accompany the presentation about cells. Each student attended three presentations given by St. Jude faculty and research staff on topics within their expertise: these were focused on cells, cancer, and healthy living. The students attended one presentation per day over a three-day period. Each presentation lasted approximately 15-20 minutes with approximately 10 minutes of question-and-answer time after the presentation. SJCECP program staff facilitated all additional activities. A laboratory exercise in which students used MicroSlide Viewers to compare healthy cells with cancerous cells followed the first presentation. An exercise in empathy toward patients with childhood cancer followed the second presentation. Small group activities occurred on the third day: students rotated through three stations and learned about the dangers of

tobacco and the benefits of sun protection, good nutrition, and antioxidants. A fourth station brought all the students back together to learn about the health benefits of regular exercise and participate in some physical activity. A more detailed description of the intervention has been described previously [12].

Instrument

SJCECP program staff developed a student questionnaire with three modules corresponding to the three educational modules in the curriculum: cells, cancer, and healthy living. Each “quiz” consisted of 10 multiple-choice and true-false content questions related to the material covered in the printed books, expert presentations, and hands-on activities. The instrument was evaluated by a group of subject matter and education experts for readability and content validity. The readability of all instrument items was evaluated before content relevance was. Readability was checked automatically by using the Flesch-Kincaid Formula in Microsoft Word, which resulted in a 3.9 grade level. The Spache Grade-Level Score resulted in a reading level of 3.84.

After evaluating the readability of the instrument, a panel of six experts evaluated the content validity of the pre/post-test. The panel was composed of St. Jude, National Cancer Institute, and other experts. Experts were chosen for expertise in the content areas of cellular biology, infectious diseases, cancer, wellness, childhood education, and health communication. They were mailed a cover letter about the St. Jude Cancer Education for Children Program's goals and the study's implementation and purpose; they were also given a complete set of the printed materials used to deliver the Program and design the instrument. Additionally, experts received the validity questionnaire and detailed instructions on how to complete the questionnaire. Upon receipt of the completed questionnaires, a Content Validity Index (CVI) was determined for each item on the test as well as for the test as a whole. The CVI for each item is the fraction of experts that rated the item a 3 or 4 on a 4-point scale. The CVI for the test as a whole is the proportion of content valid items, as rated by the experts. It is recommended that a new instrument have a CVI of at least 0.80 to be considered valid [13]. In the case of this pre/post-test, at least 5 of 6 (0.83) experts had to rate an item a 3 or 4 for the test to be considered valid. All 30 items received either a 3 or 4 from all six reviewers; thus, all individual items and the test as a whole were considered to be valid.

Data Collection and Analysis

Pre- and post-tests were administered by the school science teacher. All tests were de-identified. The teacher assigned a number to each student and used this number for pre- and post-testing. This method allowed analysis of both individual knowledge and collective knowledge of the entire cohort.

The pre-tests (O_1) took place 6 to 8 days before the scheduled program presentations and before students received copies of the printed material. We did not set a time limit on the test—the amount of time given was at the discretion of the science teacher who administered the test.

Two post-tests were given. The first post-test (O_2) was administered within 7 ± 1 days after the final scheduled program presentation and measured knowledge acquisition. The second post-test (O_3) took place approximately 3 months after the first post-test and measured knowledge retention.

The units of analysis were the total score on each module and the total score on the whole test. Each module score was based on a 10-point scale. We compared the paired difference between the pre-test and the first post-test scores ($O_2 - O_1$) with 0 to assess knowledge acquisition (H_0 : Paired difference = 0; H_1 : Paired difference > 0). We then compared the paired difference between the two post-test scores ($O_3 - O_2$) with 0 to determine whether knowledge was retained from O_2 to O_3 (H_0 : Paired difference = 0; H_1 : Paired difference < 0). A one-tailed paired t -test of the differences was used to explore the score differences between two time points.

Results

Each module quiz was scored on a 10-point scale. The mean score for the cells quiz increased from 6.4 (O_1) to 8.8 (O_2), and increases were retained at 8.5 three months later (O_3). The mean score for the cancer quiz increased from 6.5 (O_1) to 8.9 (O_2), and increases were retained at 8.7 three months later (O_3). The mean score for the healthy living quiz increased from 7.7 (O_1) to 8.7 (O_2), and increases were retained at 8.4 three months later (O_3). Test distributions are described in more detail elsewhere [12]. Figure 1 shows a comparison of the mean score of the O_1 , O_2 , and O_3 tests on all modules.

The mean scores on Test Modules A (Cells), B (Cancer), and C (Healthy Living) significantly improved between the pre-test (O_1) and the first post-test (O_2) ($P < 0.001$; Table 1).

Although there was a statistically significant reduction in scores between the first and second post-test, the reduction was small, indicating that most of the knowledge had been retained 3 months after the intervention (Table 2).

Discussion

The results of this study indicate that the SJCECP intervention implemented by St. Jude staff members improves student knowledge of cancer and healthy habits that can prevent the formation of cancers in adulthood, with much of the knowledge gained being retained 3 months after participation in the program. Therefore, the program can be considered to be a useful tool for improving knowledge of cancer concepts at the 4th-grade level.

This study has a number of limitations. First, although the sample size of students was not small, the number of participating schools was. Furthermore, the schools were a sample of convenience, and results may not be generalizable beyond the participating schools. The single-group design is also a limitation. Without a control or comparison group, it is not possible to definitively conclude that the SJCECP program caused the gains in knowledge. Additionally, a 3-month follow-up period was chosen primarily out of necessity to complete the study within the academic year. It is unclear how well knowledge gained from the

SJCECP intervention would be retained over a longer follow-up period. Finally, although knowledge can be a predictor of behavior changes in students, attitudes and health behavior as a result of receiving the SJCECP intervention were not measured. Further research is needed to measure any changes in students' beliefs, attitudes, perceptions of susceptibility to cancer, intentions, and self-reported health behaviors that may result from student participation in the program as well as its potential for broader dissemination.

Although the St. Jude–led delivery of the curriculum showed positive gains in student knowledge, it is clear that the delivery method is not scalable. The limitation of the current program is the time demand of running the program and the availability of St. Jude staff. To overcome this limitation, a teacher's manual to the SJCECP curriculum was created in 2011. The kit includes all the lesson plans needed to complete the program without the presence of St. Jude staff members. Further research is needed to determine the feasibility for teachers to use the kit to deliver the SJCECP intervention.

Conclusion

The St. Jude Cancer Education for Children Program intervention is a useful tool for improving knowledge of cancer concepts at the 4th-grade level. Further research is needed to determine changes in attitudes and behaviors from student participation in the program as well as its potential for broader dissemination.

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Fig. 1. Comparison of the pre- and post-test mean score for Cells, Cancer, and Healthy Living Modules

Table 1
Comparison of Pretest (O₁) and Posttest 1 (O₂) Scores

	<i>Test A (Cells)</i>	<i>Test B (Cancer)</i>	<i>Test C (Healthy Living)</i>
Mean of pretest (O ₁) scores	6.4	6.5	7.7
Mean of posttest (O ₂) scores	8.8	8.9	8.7
Paired difference (O ₂ –O ₁)	2.43 *	2.27 *	0.76 *
Standard deviation	1.89	1.78	1.43
Standard error	0.09	0.08	0.07
<i>P</i> value	< 0.001	< 0.001	< 0.001
N (pairs)	450	449	450
Range	–4.0 to 8.0	–4.0 to 8.0	–6.0 to 6.0

*
P < 0.05

Table 2
Comparison of Posttest 1 (O₂) and Posttest 2 (O₃) Scores

	Test A (Cells)	Test B (Cancer)	Test C (Healthy Living)
Mean of posttest (O ₂) scores	8.8	8.9	8.7
Mean of posttest (O ₃) scores	8.5	8.7	8.4
Paired difference (O ₃ –O ₂)	–0.23 *	–0.16 *	–0.25 *
Standard deviation	1.41	1.51	1.43
Standard error	0.07	0.07	0.07
<i>P</i> value	< 0.001	0.03	< 0.001
N (pairs)	435	442	438
Range	–8.0 to 6.0	–4.0 to 8.0	–7.0 to 5.0

*
P < 0.05