School-Based Nutrition and Physical Activity Program for Rural Elementary School Students: A Pilot Study

Shaakira A. Jones, MPH, CPH
Gillian Danze, MPH
Anna E. Price, PhD, MCHES, FAAHB
Ashley L. Merianos, PhD, CHES, FAAHB
Matthew Lee Smith, PhD, MPH, CHES, FAAHB*

Abstract

Children who eat unhealthy diets and engage in limited physical activity are susceptible to adverse health effects, such as obesity. This pilot intervention study examined the immediate impact of a health education program, Get Charmed, which used a short-run incentive program as a strategy for motivating rural elementary school students to learn about physical activity and healthy eating behaviors. We assessed kindergarten through fifth grade students' knowledge of physical activity, healthy eating, and water consumption, at baseline and immediately following the intervention. Get Charmed is a six-week program geared toward elementary-aged children, with aims to increase participants' knowledge and awareness around healthier lifestyle behaviors. A pre-post evaluation assessed knowledge about healthy eating, physical activity, and hydration among elementary school-aged children (n = 22) enrolled in grades k-5. Frequencies were calculated for the number of correct responses for each item. A series of Wilcoxon signed rank tests were performed to assess changes in knowledge from baseline to post-test. Average knowledge scores for the 3rd-5th grade students increased from 15.56 (± 1.88) to 16.78 (± 1.20), which was statistically significant (z = -2.41, p = 0.016). Average baseline knowledge for the kindergarten to 2nd grade students increased from 9.54 (± 1.66) to 10.46 (± 0.66). For the these students, a statistically significant proportion of participants (six out of 13 participants) increased knowledge (z = -1.98, p = 0.048). Implementing Get Charmed with short-run incentives in rural school-based settings is a practical and economical approach to introducing new foods while increasing rural elementary students' knowledge in the areas of physical activity, nutrition, and hydration.

*Corresponding author can be reached at: matthew.smith@tamu.edu

Introduction

The prevalence of childhood obesity has increased significantly over the past 40 years, creating one of the nation's greatest public health challenges (Anderson et al., 2019; Sanyaolu et al., 2019; Stierman et al., 2021; U.S. Department of Health and Human Services, 2010). Effects of obesity among children include negative impacts to physical, psychological, and social well-being (Pulgarón, 2013; Sahoo et al., 2015). The incremental lifetime direct cost of a child who is obese relative to a child who maintains a normal weight is $19,000 (Finkelstein et al., 2014); this estimate does not consider the indirect costs that could be accrued.

Regular physical activity coupled with proper nutrition is essential to achieving and maintaining a healthy weight status. However, national data indicate that 42.5% of children age 6-11 years do not engage in the recommended 60 minutes of daily physical activity (U.S. Department of Health and Human Services, 2018). Elementary school-aged children also have indicators of

poor nutrition, such as inadequate fruit and vegetable consumption (Kim et al., 2014). The obesity prevalence among elementary school-aged children ages 6-11 years is higher (18.4%) than pre-school children ages 2-5 years (13.9%) (Hales et al., 2017). Thus, elementary school-based interventions are necessary to prevent childhood obesity and its associated negative health consequences, including but not limited to, metabolic syndrome, diabetes mellitus, hypertension, and obstructive sleep apnea (Daniels et al., 2005). While obesity prevention interventions are critically needed in multiple venues, the U.S. Surgeon General's vision indicates that creating healthy school environments is pivotal for promoting healthy nutrition and physical activity habits among students (U.S. Department of Health and Human Services, 2010). Creating such environments includes offering health education curriculum for obesity prevention that empowers elementary students to make individual healthy choices and meet the recommended dietary and physical activity guidelines. School-based interventions increase youth physical activity levels and are cost-effective with the potential to prevent up to about 73,600 cases of child obesity over time (Cradock et al., 2017). Additionally, school-based interventions for elementary school children show a moderate improvement in fruit intake, but only a minimal improvement in vegetable intake (Evans et al., 2012). Concerning environmental factors, prior research documents disparities among children residing in U.S. rural counties and states in the southern region (e.g., Georgia), which influence obesity-related health behaviors including poor nutrition and physical inactivity (Kaczynski et al., 2020).

The Childhood Obesity Challenge in Rural Communities

The Rural Healthy People 2020 campaign, complimenting Healthy People 2020, indicates that nutrition, weight status, physical activity, and health are within the top 10 identified rural health priorities (Bolin et al., 2015). A systematic review revealed that children living in rural areas are 26% more likely to be obese, in comparison with children residing in urban locations (Johnson & Johnson, 2015). A number of reasons contribute to this disparity. For example, specific gaps in the built environment within rural areas impact the promotion of physical activity among children and can be seen in the form of long distances to destinations, narrow winding roads, and limited sidewalks, trails, exercise facilities, and bicycle paths or lanes (Yousefian et al, 2009). In focus groups conducted in rural communities, parents and children identified limited access to physical activity resources (e.g., parks and gyms) as a barrier to physical activity; parents also noted poor safety-related infrastructure as limiting opportunities for activity (McWhinney et al., 2011). Further, persons living in rural communities also experience unique barriers to healthy eating, including higher food costs overall, with increased cost disparities observed among foods of with higher nutritional value (e.g., fresh fruits and vegetables), when compared to food prices in urban communities (Hardin-Fanning & Rayens, 2015). Specific to school-aged children, those who attend rural schools have significantly lower exposure to healthy eating practices and policies that support obesity prevention compared to children attending suburban and urban schools (Nanney et al., 2013). Not surprisingly, a review of physical activity and diet behaviors between rural and urban children concluded that future research

should focus on concurrently assessing physical activity and diet behaviors to combat the rural residency disparity of obesity (McCormack & Meendering, 2016). Thus, the present study was piloted to work toward addressing this health equity gap among rural students, especially during the elementary school years.

Rural School-based Obesity Prevention Interventions and Incentives

With obesity prevalence rates dis-proportionately affecting rural communities (Johnson & Johnson, 2015), there is a critical need for interventions aimed at increasing physical activity and healthy eating behaviors among rural elementary students. We acknowledge that an ecological approach is recommended when promoting health behaviors like physical activity and healthy eating (Sallis, et al., 2006). However, there are no obesity prevention tools or methods used within school environments that specifically address rural populations (Institute of Medicine, 2013). Irrespective of geographical area, there is opportunity to improve healthy eating behaviors among children, especially their vegetable intake (Evans et al., 2012).

Prior research indicates that offering children short-run incentives (i.e., incentives that are temporary and almost immediate) may influence their healthy eating behaviors (Jensen et al., 2011; List & Samek, 2017; Loewenstein et al., 2016). More specifically, Loewenstein and colleagues (2016) found that short-run incentives doubled the proportion of elementary school children consuming at least one serving of fruits and vegetables during lunch. The positive impact of short-run incentives was even maintained after the incentives were no longer given. List and Samek (2017) examined the impact of immediate non-monetary incentives on milk consumption in k-8 students in Chicago. The distribution of smiley face incentives led to a 2.5 times increase in the proportion of students choosing white milk over chocolate milk. Additional research indicates programs that incorporate short-run incentives are likely to be more successful than programs that provide incentives only at the program's completion (Bettinger, 2012). However, limited research has assessed short-run incentives specific to rural school children's comprehensive healthy eating and physical activity behaviors. Moreover, limited research has documented the benefits of specific incentive types (e.g., charms for bracelets, stickers, badges), or the frequency of their distribution, when engaging rural school children.

Study Aim

This pilot intervention study examined the immediate impact of a health education program, Get Charmed, which used a short-run incentive program as a strategy for motivating rural students to learn about physical activity and healthy eating behaviors. Specifically, we examined k-5 students' knowledge about physical activity, healthy eating, and water consumption at baseline and immediately following the six-week Get Charmed intervention.

Rural schools provide a unique venue because of their ability to reach this particular vulnerable population that spends a great portion of their time in school. This evaluation of an intervention specifically for rural elementary students is an important first step, especially since nearly 20% of U.S. children attend a rural school (Showalter et al., 2019). Of the children attending rural schools, approximately half reside in one of 10 states, and Georgia (i.e., which is where this study occurred) ranks 3rd for the most students attending rural schools.

Methods

Get Charmed Program

In this pilot study, we conducted an impact and outcome evaluation of Get Charmed, an intervention using short-run incentives to motivate program participation for knowledge gains. Get Charmed is a six-week health and wellness program geared toward elementary-aged children, with program implementation occurring in the school setting. The program aims to increase participants' knowledge and awareness around healthier lifestyle behaviors, including eating healthy, physical activity, and hydration. These target behaviors were chosen because they are modifiable behaviors that play a direct role in the prevention of childhood obesity. In addition, Walton Wellness personnel who developed the Get Charmed program recognized school children's limited motivation for, and negative perceptions of, trying different foods, drinking water, and being physically active.

Get Charmed followed the Centers for Disease Control and Prevention's ([CDC], 2011) physical activity and healthy eating school-based guidelines and was grounded in the positive youth development (PYD) framework approach to child programming, which includes three underpinning and fundamental characteristics (Lerner et al., 2011): 1) positive teacher-student relations; 2) skill-building activities related to physical activity and diet; and 3) providing an opportunity for student participation in health education activities at the school level.

Get Charmed classroom lessons. Get Charmed lessons were implemented once a week for six-weeks, and were conducted separately for each group (i.e., k-2nd and 3rd-5th) for one hour each week. Two program facilitators with public health training, one for each classroom, delivered the classroom lessons. The curriculum for both grade level groups was designed to be age appropriate. During each one-hour session, both groups were presented with nutritional information, followed by food taste testing, and a journaling session about their attitudes toward the sampling. The session always ended with a supplemental activity to reinforce the topic covered. For the k-2nd grade group, the nutritional information was covered via the reading of a nutrition-related book and a subsequent discussion. For the 3rd-5th grade group, the nutrition information was covered via an interactive lecture and visual aids in lectures, such as pictures of serving sizes, infographics of different foods, plastic food sets, and fact sheets. The food tasting selection is included in Table 1.

To maintain program fidelity, both program facilitators and teachers were provided with the full curriculum that included a weekly class outline with talking points, questions to stimulate discussion, and a checklist to follow to ensure all activities were conducted.

Get Charmed passport. The planned lessons and activities are supplemental to the Get Charmed passport that each program participant received at the start of the first week's session. The passport is a 42-page book all participants were asked to use during the six-week intervention. The Get Charmed passport is broken down into three different sections: 1) get nutritious; 2) get active; and 3) get hydrated. The 'Get Nutritious' portion of the passport is organized based on the five food groups (vegetables, fruits, grains, protein, and dairy). Each food group has a separate section, with one page dedicated for participants to write their thoughts about the foods they tasted each week. Within the 'Get Active' portion of the passport, participants log their physical activity each week and document activities such as walking, biking, and other cardiovascular exercises. The 'Get Hydrated' portion of the passport includes a

page for participants to track their water intake every week.

The use of charms as incentives. Given the evidence that short-run incentives can impact a child's willingness to perform positive healthy eating behaviors (Jensen et al., 2011; List & Samek, 2017; Loewenstein et al., 2016), Get Charmed participants earned "charms" to incentivize sustained engagement and the completion of intervention activities. The charms were small pieces of plastic that varied in color and shape, each specific to the program lessons (e.g., broccoli, apple, fish). The weekly goal for program participants was to sample all five foods during the lesson, document water uptake, and log physical activity hours. If all activities were completed, participants could earn up to three charms each week, totaling 15 charms. There was an opportunity for students to earn one bonus charm during Week 5, for a total of 16 charms over the course of the program. Table 2 includes an outline of the charms used throughout the intervention.

Table 1

Foods Sampled During Program Taste-testings

Week	Food Group	Foods Tasted
1	Vegetables	Snap pea crisps, sweet potatoes, yellow bell peppers, cherry tomatoes, and grilled eggplant
2	Fruits	Bananas, strawberries, blueberries, clementines, and grapes
3	Grains	Whole wheat bagels, black grain rice/quinoa, spinach tortillas, Ezekiel whole wheat bread, and raisin bran cereal
4	Proteins	Smoked salmon, lean beef jerky, scrambled eggs, almond butter, hummus
5	Dairy	Almond milk, low-fat gouda and mozzarella cheese, goat cheese, low-fat frozen yogurt, and various flavors of Naked© smoothies

Recruitment

An elementary school was chosen for this pilot because schools have the capacity to serve as encouraging and safe environments to promote healthy behaviors. The target population for Get Charmed was elementary-aged children in grades k-5 because childhood is a critical period to plant the seeds for developing knowledge, skills, and awareness to make lifelong healthy habits (CDC, 2011). This pilot study included one private school located in Monroe, Georgia. At the time of the pilot, the school had 66 kindergarten through 9th grade students enrolled, of whom 95.3% were non-Hispanic white. The private school had six classrooms with a student/teacher ratio of 11:1. There were 20 students enrolled in k-2nd grade and 17 students enrolled in 3rd-5th grade.

To recruit students for participation in the study, letters were sent home with every student in the target age groups. The letter included an overview of the program and served as a means to ask parents if their child had any dietary restrictions or food allergies that would affect their ability to participate in food sampling during the program. At the end

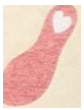
Table 2

Summary of Get Charmed Activities and Charms

Week #	Passport Topic	Passport Activities	Types of Charms Earned	Charm Illustration	Max # of Charms Earned
Week 1	Get Nutritious Get Active Get Hydrated	• Try 5 different vegetables *- One of the five vegetable must be green, red, yellow, purple, and orange.* • Get Outside (for ≥ 1 hour/day) *-Go outside and do a variety of activities such as playing sports, planting a garden, climbing a tree, or washing the car.* • Drink ≥ 1 glass of water/day	Broccoli = Vegetable Week Tree = Outdoor Movement Week Water Drop = Get Hydrated Weeks	  	**3**
Week 2	Get Nutritious Get Active Get Hydrated	• Try 5 different fruits *- One of the five fruits must be red, orange, yellow, purple, AND blue or green.* • Pedal Power (for ≥ 1 hour/day) *-Get active by riding a bike. Note: If there is no bicycle available, this activity can be substituted.* • Drink ≥ 1 glass of water/day	Apple = Fruit Week Biker = Bike Riding Week Water Drop = Get Hydrated Weeks	  	**3**
Week 3	Get Nutritious Get Active Get Hydrated	• Try 5 different grains *-These options are rice, a brown bread, a colorful tortilla, a brown muffin or bagel, and trail mix.* • Take a Hike (for ≥ 1 hour/day) *-Take a hike by walking or running either indoors or outdoors.* • Drink ≥ 1 glass of water/day	Bread Slice = Grain Week Walker = Walking/Running Week Water Drop = Get Hydrated Weeks	  	**3**

Table 2 (cont.)

Summary of Get Charmed Activities and Charms

Week 4	Get Nutritious Get Active Get Hydrated	• Try 5 different protein foods *- Choose any 5 from the 7 options which include nut butter, hummus, fish or shellfish, 90% lean beef, game meat, an omelet, and tofu or soy.* • Get Pumping Activity 1 (for ≥ 1 hour/day) *- Do a heart pumping activity that will increase your breathing and heart rate. Examples are fast walking, dancing, or swimming.* • Drink ≥ 1 glass of water/day)	Fish = Protein Week Big Foot = Get Pumping Week 1 Water drop = Get Hydrated Weeks	  	**3**
Week 5	Get Nutritious Get Active Get Hydrated	• Try 5 different dairy foods -These options are a soft cheese, white cheese, skim milk, alternative milk, and a frozen or Greek yogurt. *Note: *can earn a bonus charm for drinking a smoothie* • Get Pumping Activity 2 (for ≥ 1 hour/day) *-Do a heart pumping activity that will increase your breathing and heart rate. Examples are jogging, playing sports, or climbing.* • Drink ≥1 glass of water/day	Cheese = Dairy Week Small Foot = Get Pumping Week 2 Water Drop = Get Hydrated Weeks Milk Bottle = Dairy Week Bonus**	   	**4**
Total Weeks = 5					**Total Charms = 16**

of the letter, parents were invited to sign the letter to provide consent for their child to participate in the program. All students had parental consent to participate in the study.

Teachers also received a letter prior to program implementation, which detailed expectations around their roles, including monitoring and verifying that students recorded physical activity and water intake in their logs. In addition, preparation for Get Charmed involved holding an introductory session at the school a week prior to the first educational class. During that introductory session, facilitators presented a program overview to all student participants and teachers. During the presentation, facilitators showed an instructional video and addressed all questions and/or concerns participants had regarding Get Charmed.

Participants

Twenty-six elementary school-aged children received parental consent to participate in the pilot study. By grade level, 15 participants were in the k-2nd grade group (40.0% female), and 11 participants were in the 3rd-5th grade group (54.5% female). The program was administered in the afternoon following the students' lunch in a designated classroom where afterschool activities were held. Students who did not participate in Get Charmed attended other regularly scheduled school activities.

Thirteen of the 15 participants in the k-2nd grade group and nine of the 11 participants in the 3rd-5th grade group completed both baseline and post-test survey instruments. Those students ($n = 4$) who participated in the full intervention but did not complete both pre- and post-test instruments were excluded from the analysis, yielding an analytic sample of 22 participants. The reason for incomplete data collection was student absences on the day of post-test data collection. We conducted an analysis of those who did and did not complete both the pre-test and post-test questionnaires. We did not find any significant differences by grade level ($p > 0.05$) or pre-test knowledge score ($p > 0.05$).

Process Evaluation

The participants' classroom teachers participated in an orientation given by the program facilitators to familiarize them with the program goals and curriculum. This was to prepare the teachers for direct observations throughout the project period. Teachers were told they would be asked to provide feedback about program fidelity based on their observations.

Impact Evaluation

Pre-post questionnaires were used to examine program impact. Two separate questionnaires were administered to the two different grade groups prior to implementation of the first educational class and at the six-week mark of the completed program. The questionnaire sections are described below.

Instrumentation

The questionnaires used to examine immediate program outcomes included demographic questions as well as questions designed to examine knowledge about physical activity, nutrition, and hydration. These questionnaire sections are described below.

Demographic characteristics. Participants reported their first name on both surveys for matching purposes between baseline and post-test surveys, as well as their age. No other demographic information was collected from participants.

Questions assessing knowledge gains. The evaluators developed the knowledge assessments for each grade group after thoroughly reviewing the Get Charmed curriculum and its weekly activities. The questionnaires for both grade groups included dichotomous knowledge-based questions. The knowledge-related pre-test and post-test administered to the k-2nd grade group included 11 items, while the 3rd-5th grade group included 18 items. Response choices for items were visual analogues that depicted a 'thumbs up' or 'thumbs down' to indicate whether the participant perceived the statements to be true or false, respectively. Table 3 includes items included in the questionnaire for k-2nd grade students and Table 4 includes the items included in the questionnaires for the 3rd-5th grade group. Total knowledge scores were calculated by summing the number of correct responses to generate continuous variables, which were scored from 0 to 11 for the k-2nd grade group and 0 to 18 for the 3rd-5th grade group. At pre-test, the 11-item knowledge assessment for the k-2nd grade had a Cronbach's reliability coefficient of 0.501, and the 18-item knowledge assessment for the 3rd-5th grade had a Cronbach's reliability coefficient of 0.720.

Statistical Analysis

Statistical analyses were performed using SPSS version 25.0. Frequencies were calculated for correct responses for each item at baseline. To create a knowledge score, all correct answers were given one point and then summed. Means and standard deviations were calculated for knowledge scores at baseline and post-test. A series of Wilcoxon signed rank tests were performed to assess changes in knowledge from baseline to post-test. For Wilcoxon signed rank tests, ties indicate the number of participants who did not change from baseline to post-test; positive ranks indicate the number of participants who increased in knowledge from baseline to post-test; and negative ranks indicate the number of participants who decreased in knowledge from baseline to post-test. Analyses were performed for each individual item as well as the summed knowledge scale score. Analyses were performed separately for the k-2nd grade group and 3rd-5th grade group. *Z*-scores and *p*-values are reported for all Wilcoxon signed rank tests. Statistical significance was set a $p < 0.05$ for all tests.

Results

Process Evaluation

Direct observations indicated some challenges with program implementation for the younger grade group. Specifically, the younger group had trouble writing complete sentences about food perceptions when asked to journal. The time allotted for this portion of the weekly lesson did not seem to be adequate for the younger grade group. No other challenges were observed.

Impact Evaluation

Table 3 reports knowledge scores for participants in the k-2nd grade group. As shown, the percent of participants who responded correctly to knowledge items ranged from 69.2% to 100% depending on the questionnaire item. There were no significant differences in any individual item scores from baseline to post-test. The average knowledge scale score at baseline was 9.54 (± 1.66) and increased to 10.46 (± 0.66) at post-test. This scale score change was statistically significant ($z = -1.98$, $p = 0.048$).

Table 4 reports knowledge scores for participants in the 3rd-5th grade group. As shown in Table 4, the percent of participants who responded correctly to knowledge items

Table 3

Knowledge Change from Baseline to Follow-up, Kindergarten-2nd Grade (n = 13)

		Wilcoxon Signed Rank Test (change over time)				
Items	**% Correct Baseline**	**Negative**	**Positive**	**Tie**	***z*-score**	***p*-value**
I should exercise for 60 minutes (1 hour) or more every day.	92.3%	0	1	12	-1.00	0.317
Sitting on the couch and watching TV is exercise.	76.9%	0	2	11	-1.41	0.157
I should drink water before, during, and after I exercise.	100.0%	0	0	13	0.00	1.000
It is good to eat fruits and veggies because they have vitamins and minerals that are good for my health.	92.3%	0	1	12	-1.00	0.317
Eating lean protein is healthy for the muscles in my body.	92.3%	0	1	12	-1.00	0.317
Eating dairy products is healthy for my bones and teeth.	69.2%	2	3	8	-0.45	0.655
Eating wheat is healthy for giving me energy so I can exercise.	84.6%	1	2	10	-0.58	0.564
There are five different food groups.	69.2%	0	2	11	-1.41	0.157
I can exercise inside and outside.	92.3%	0	1	12	-1.00	0.317
I should always tell an adult before I go outside to exercise or play.	92.3%	0	1	12	-1.00	0.317
Walking and playing tag are examples of exercise.	92.3%	0	1	12	-1.00	0.317
Scale	**M(SD)**	**Negative**	**Positive**	**Tie**	**z-score**	**p-value**
Baseline: Abbreviated Charmed Knowledge Scale (possible range 0 to 11)	9.54 (±1.66)	1	6	6	-1.98	0.048
Follow-up: Abbreviated Charmed Knowledge Scale (possible range 0 to 11)	10.46 (±0.66)					

Table 4

Knowledge Change from Baseline to Follow-up, 3rd-5th Grade (n = 9)

		Wilcoxon Signed Rank Test (change over time)				
Items	**% Correct Baseline**	**Negative**	**Positive**	**Tie**	***z*-score**	***p*-value**
I should exercise for 60 minutes (1 hour) or more every day.	100.0%	0	0	9	0.00	1.000
Sitting on the couch and watching TV is exercise.	78.8%	0	2	7	-1.41	0.157
I should drink 6-8 cups of water every day.	88.9%	0	0	9	0.00	1.000
I should drink water before, during, and after I exercise.	100.0%	0	0	9	0.00	1.000
It is good to eat fruits and veggies because they have vitamins and minerals that are good for my health.	100.0%	0	0	9	0.00	1.000
Eating lean protein is healthy for the muscles in my body.	66.7%	0	3	6	-1.73	0.083
Eating dairy products is healthy for my bones and teeth.	100.0%	0	0	9	0.00	1.000
Eating wheat is healthy for giving me energy so I can exercise.	66.7%	1	1	7	0.00	1.000
It is healthier to eat white grains instead of whole wheat foods.	55.6%	1	0	8	-1.00	0.317
There are five different food groups.	66.7%	0	3	6	-1.73	0.083
I should be aware of the serving size of the foods I eat.	100.0%	0	0	9	0.00	1.000
One serving size of fruit equals the size of a tennis ball.	88.9%	0	1	8	-1.00	0.317
If I eat dairy, I should try and choose low-fat or fat-free foods from the group	100.0%	0	0	9	0.00	1.000
Vitamin C helps boost my immune system.	77.8%	0	1	8	-1.00	0.317
I should eat at least 2-3 servings of whole grains every day.	77.8%	0	1	8	-1.00	0.317
I can exercise inside and outside.	100.0%	0	0	9	0.00	1.000
I should always tell an adult before I go outside to exercise or play.	88.9%	0	1	8	-1.00	0.317
I should limit eating snack foods that have sugar in them.	100.0%	0	0	9	0.00	1.000
Scale	**M(SD)**	**Negative**	**Positive**	**Tie**	**z-score**	**p-value**
Baseline: Charmed Knowledge Scale (possible range 0 to 18)	15.56 (±1.88)	0	7	2	-2.41	0.016
Follow-up: Charmed Knowledge Scale (possible range 0 to 18)	16.78 (±1.20)					

ranged from 55.6% to 100% depending on the questionnaire item. There were no significant differences in any individual item scores from baseline to post-test. The average knowledge scale score at baseline was 15.56 (± 1.88) and increased to 16.78 (± 1.20) at post-test. This change was statistically significant (z = -2.41, p = 0.016).

Discussion

This pilot study examined the efficacy of a rural school-based intervention to improving knowledge in the areas of physical activity, nutrition, and hydration. The intervention was unique in that it used immediate incentives to motivate engagement in the program and subsequent learning. In addition, the study aimed to increase health equity by focusing on evaluating the immediate impact of a program tailored specifically for elementary students attending a school located in a rural community, a highly understudied setting (Institute of Medicine, 2013).

Despite relatively high knowledge scores at baseline, both grade level groups showed significant increases in knowledge scores from baseline to post-test. The high baseline knowledge scores could indicate that the program focused too much on rudimentary information already learned, or that the evaluation tool may have been too simplistic. However, the significant increases in knowledge suggest that the incentive-based intervention was effective in reinforcing and building upon rural children's existing knowledge. Thus, this pilot study adds to the body of literature showing short-run incentives (i.e., incentives that are temporary and almost immediate) can be effective motivators for change within health education programs focused on students (Jensen et al., 2011; List & Samek, 2017; Loewenstein et al., 2016).

For future steps, we plan to expand the intervention's reach beyond the teacher-student relationship by incorporating stronger engagement with parents/guardians at the interpersonal level and assessing school environmental and policy levels. Student participation in valued school, family, and community activities is one of the three previously mentioned important characteristics of PYD (Lerner et al., 2011). As an initial step, we assessed the immediate impact at the school level and will receive teacher and student buy-in before scaling the intervention's reach beyond the school setting. Thus, our encouraging results of increased comprehensive knowledge scores about physical activity and nutrition across grade levels indicate the potential to expand our rural school-based intervention and test the engagement of parents and other caregivers. Evidence indicates that interventions that combine physical activity with diet behaviors appear to be effective for preventing obesity among elementary school-aged children (Brown et al., 2019), and that incorporating parents into school-based programming may be vital for success (Dobbins et al., 2013). Additionally, since we observed an increase in students' knowledge, the intervention should focus on skill-building to further promote positive youth outcomes related to the "Five C's" of PYD – competence, confidence, connection, character, and caring (Lerner et al., 2005). Based on preliminary results and initial lessons learned, future research should consider placing increased attention on expanding *connection* to include parents and families and building students' *competence* (i.e., skills) and *confidence* (i.e., positive self-efficacy). While we focused on the comprehensive health education components of the CDC's (2011) recommended school guidelines, involving families would move toward the CDC's (2011) coordinated school

health approach and align with the CDC's Whole School, Whole Community, Whole Child (WSCC) model (ASCD & CDC, 2014). Other considerations when aligning future intervention research with these coordinated frameworks would be to also assess school nutrition services, physical education, health services, the social and emotional climate, and the physical environment that influence elementary students' health and well-being. Further, to align with the WSCC model, future interventions should include complementary and supportive aspects that occur outside of the school setting, incorporate home-based lessons and activities, and encourage other forms of family and community involvement.

Those interested in replicating Get Charmed should consider adding a robust process evaluation plan. While direct observation was used to identify potential challenges to program implementation, we recommend future studies also use a satisfaction questionnaire to determine acceptability of the program (Saunders et al., 2005). The collection of such process data would enable future researchers to determine which aspects of the intervention were most effective in influencing student knowledge gains. The process evaluation that was conducted identified several issues with program implementation for the younger grade group. Those implementing the intervention in the future might consider additional program facilitators to provide personal, direct attention to younger participants while journaling. Alternatively, the journal system could be revised for the younger grade levels to use visual analogues, such as a smile/frown face or even drawings or stickers. Prior research shows that art journaling can reinforce positive learning experiences among youth (King & LaRocco, 2006; McCann, 2015). While we did not have the opportunity to collect in-depth interview data, future research should conduct qualitative interviews with teachers who observed the lessons as well as the students' feedback about the lessons. This would be highly beneficial for process evaluation and further refining the intervention.

There were several limitations associated with this school-based intervention. First, external validity is limited due to small sample sizes for both grade level groups. Further, the study took place in a private school in a rural county. The findings might not generalize to dissimilar settings. The absence of a control group is also a major limitation. Without a control group, it is unclear whether the increase in knowledge gains were due to the intervention itself or confounding factors, such as media influences or other school events. An additional study limitation was the lack of control for demographic factors such as race, ethnicity, and socioeconomic status, as only grade level and gender were identified. Another potential shortcoming of the pilot was the focus on knowledge change among the participants. While knowledge improvement may be a strong indicator of the effectiveness of a curriculum because it is a precursor to skill development, increased knowledge does not necessarily equate to knowledge retention or behavior change. Beyond knowledge attainment, future evaluations should examine other skill- and behavior-related outcomes, as well as the influence of school- and home-based reinforcement techniques. Further, despite using an age-appropriate visual analogue scale for data collection, the younger grade group may not have fully understood the questions being asked (or may have inconsistently interpreted the items), which may have contributed to a lower reliability coefficient for this group.

Implication for Health Behavior Theory

The findings of this pilot study suggest that Get Charmed, a rural school-based, health education intervention using short-run incentives, was successful in increasing elementary students' knowledge in the areas of physical activity, nutrition, and hydration. Future studies should expand the program to larger samples, use a control group, simplify the journaling process for younger grade group, and include a more robust process evaluation plan. The findings of this study indicate Get Charmed is potentially worth replicating as a strategy for addressing individual-level factors that could influence healthy weight management among elementary children. Findings suggest this practical and economical approach to introducing new foods while encouraging physical activity and water consumption among children could be appropriate for other settings such as after-school programs, Scouts, faith-based organizations, and day camps.

Those working in rural school health settings might consider the use of short-run incentives like the charms used in this study, which motivated continued participation in the intervention among both lower and upper grade student groups. We recommend those collecting assessment data to plan for make-up days for pre-test and post-test assessments to ensure all students have an opportunity to participate in assessment activities. Further, rural school health professionals might benefit from building on this successful health education program by addressing additional levels of influence for healthy eating and exercise behaviors (e.g., social support, changes to the school environment).

Discussion Question

This pilot found that a rural school-based, health education intervention using short-run incentives successfully increased elementary students' knowledge about physical activity, nutrition, and hydration. What are the best approaches to increasing the effectiveness of this intervention?

Acknowledgements

The authors would like to thank and acknowledge Walton Wellness for providing access to the data used for the analysis provided in this study. The authors have no conflicts of interest to declare, financial or otherwise.

References

ASCD, & Centers for Disease Control and Prevention ([CDC], 2014). Whole school, whole community, whole child: A collaborative approach to learning and health. ASCD. Retrieved November 1, 2021, from http://www.ascd.org/ASCD/pdf/siteASCD/publications/wholechild/wscc-a-collaborative-approach.pdf

Anderson, P. M., Butcher, K. F., & Schanzenbach, D. W. (2019). Understanding recent trends in childhood obesity in the United States. *Economics & Human Biology, 34,* 16-25. https://doi.org/10.1016/j.ehb.2019.02.002

Bettinger, E. P. (2012). Paying to learn: The effect of financial incentives on elementary school test scores. *The Review of Economics and Statistics*, *94*(3), 686-698.

Bolin, J. N., Bellamy, G. R., Ferdinand, A. O., Vuong, A. M., Kash, B. A., Schulze, A., & Helduser, J. W. (2015). Rural Healthy People 2020: New decade, same

challenges. *The Journal of Rural Health*, *31*(3), 326-333. https://doi.org/10.1111/jrh.12116

Brown, T., Moore, T. H. M., Hooper, L., Gao, Y., Zayegh, A., Ijaz, S., Elwenspoek, M., Foxen, S. C., Magee, L., O'Malley, C., Waters, E., & Summerbell, C. D. (2019). Interventions for preventing obesity in children. *The Cochrane Database of Systematic Reviews*, *7*(7), Article CD001871. https://doi.org/10.1002/14651858.CD001871.pub4

CDC (Centers for Disease Control and Prevention). (2011). School health guidelines to promote healthy eating and physical activity. *Morbidity and Mortality Weekly Report Recommendations and Reports*, *60*(RR-5), 1-76.

Cradock, A. L., Barrett, J. L., Kenney, E. L., Giles, C. M., Ward, Z. J., Long, M. W., Resch, S. C., Pipito, A. A., Wei, E. R., & Gortmaker, S. L. (2017). Using cost-effectiveness analysis to prioritize policy and programmatic approaches to physical activity promotion and obesity prevention in childhood. *Preventive Medicine*, 95 (Suppl), S17-S27. https://doi.org/10.1016/j.ypmed.2016.10.017

Daniels, S. R., Arnett, D. K., Eckel, R. H., Gidding, S. S., Hayman, L. L., Kumanyika, S., Robinson, T. N., Scott, B. J., St. Jeor, S., & Williams, C. L. (2005). Overweight in children and adolescents: Pathophysiology, consequences, prevention, and treatment. *Circulation*, *111*(15), 1999-2012. https://doi.org/10.1161/01.CIR.0000161369.71722.10

Dobbins, M., Husson, H., DeCorby, K., & LaRocca, R. L. (2013). School-based physical activity programs for promoting physical activity and fitness in children and adolescents aged 6 to 18. *The Cochrane Database of Systematic Reviews*, *2013*(2), Article CD007651. https://doi.org/10.1002/14651858.CD007651.pub2

Evans, C. E. L., Christian, M. S., Cleghorn, C. L., Greenwood, D. C., & Cade, J. E. (2012). Systematic review and meta-analysis of school-based interventions to improve daily fruit and vegetable intake in children aged 5 to 12 y. *The American Journal of Clinical Nutrition*, *96*(4), 889-901. https://doi.org/10.3945/ajcn.111.030270

Finkelstein, E. A., Graham, W. C. K., & Malhotra, R. (2014). Lifetime direct medical costs of childhood obesity. *Pediatrics*, *133*(5), 854-862. https://doi.org/10.1542/peds.2014-0063

Hales, C. M., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2017). Prevalence of obesity among adults and youth: United States, 2015-2016. *NCHS Data Brief*, (288), 1-8.

Hardin-Fanning, F., & Rayens, M. K. (2015). Food cost disparities in rural communities. *Health Promotion Practice, 16*(3), 383-391. https://doi.org/10.1177/1524839914554454

Institute of Medicine. 2013. *Evaluating obesity prevention efforts: A plan for measuring progress*. The National Academies Press. https://doi.org/10.17226/18334

Jensen, J. D., Hartmann, H., de Mul, A., Schuit, A., & Brug, J. (The ENERGY Consortium). (2011). Economic incentives and nutritional behavior of children in the school setting: A systematic review. *Nutrition Reviews*, *69*(11), 660-674. https://doi.org/10.1111/j.1753-4887.2011.00422.x

Johnson, J. A., III, & Johnson, A. M. (2015). Urban-rural differences in childhood and adolescent obesity in the United States: A systematic review and meta-analysis. *Childhood Obesity*, *11*(3), 233-241. https://doi.org/10.1089/chi.2014.0085

Kaczynski, A. T., Eberth, J. M., Stowe, E. W., Wende, M. E., Liese, A. D., McLain, A. C., Breneman, C. B., & Josey, M. J. (2020). Development of a national childhood obesogenic environment index in the United States: Differences by region and rurality. *The International Journal of Behavioral Nutrition and Physical Activity*, *17*(1), Article 83. https://doi.org/10.1186/s12966-020-00984-x

Kim, S. A., Moore, L. V., Galuska, D., Wright, A. P., Harris, D., Grummer-Strawn, L. M., Merlo, C. L., Nihiser, A. J., & Rhodes, D. G., (Division of Nutrition, Physical Activity, and Obesity, National Center for Chronic Disease Prevention and Health Promotion, CDC). (2014). Vital signs: Fruit and vegetable intake among children - United States, 2003-2010. *Morbidity and Mortality Weekly Report*, *63*(31), 671-676.

King, F. B., & LaRocco, D. (2006). E-journaling: A strategy to support student reflection and understanding. *Current Issues in Education*, *9*(4).

Lerner, R. M., Lerner, J. V., Almerigi, J. B., Theokas, C., Phelps, E., Gestsdóttir, S., Naudeau, S., Jeličić, H., Alberts, A., Ma, L., Smith, L. M., Bobek, D. L., Richman-Raphael, D., Simpson, I., Christiansen, E. D., & von Eye, A. (2005). Positive youth development, participation in community youth development programs, and community contributions of fifth-grade adolescents: Findings from the first wave of the 4-H Study of Positive Youth Development. *The Journal of Early Adolescence, 25*, 17-71. https://doi.org/10.1177/0272431604272461

Lerner, R. M., Lerner, J. V., Lewin-Bizan, S., Bowers, E. P., Boyd, M. J., Mueller, M. K., Schmid, K. L., & Napolitano, C. M. (2011). Positive youth development: Processes, programs, and problematics. *Journal of Youth Development, 6*(3), 38-62.

List, J. A., & Samek, A. (2017). A field experiment on the impact of incentives on milk choice in the lunchroom. *Public Finance Review*, *45*(1), 44-67. https://doi.org/10.1177/1091142115602061

Loewenstein, G., Price, J., & Volpp, K. (2016). Habit formation in children: Evidence from incentives for healthy eating. *Journal of Health Economics*, *45*, 47-54. https://doi.org/10.1016/j.jhealeco.2015.11.004

McCann, S. K. (2015). Can art journaling and narrative art benefit students experiencing crisis or trauma? *Action Research Projects.* Paper 1. Retrieved November 1, 2021, from https://digscholarship.unco.edu/cgi/viewcontent.cgi?article=1000&context=arp

McCormack, L. A., & Meendering, J. (2016). Diet and physical activity in rural vs urban children and adolescents in the United States: A narrative review. *Journal of the Academy of Nutrition and Dietetics*, *116*(3), 467-480. https://doi.org/10.1016/j.jand.2015.10.024

McWhinney, S., McDonald, A., Dawkins-Moultin, L., Outley, C., McKyer, E. L., & Thomas, A. (2011). Barriers affecting physical activity in rural communities: Perceptions of parents and children. *Journal of Family and Consumer Sciences*, *103*(4), 38-44.

Nanney, M. S., Davey, C. S., & Kubik, M. Y. (2013). Rural disparities in the distribution of policies that support healthy eating in U.S. secondary schools. *Journal of the Academy of Nutrition and Dietetics*, *113*(8), 1062-1068. https://doi.org/10.1016/j.jand.2013.04.021

Pulgarón, E. R. (2013). Childhood obesity: A review of increased risk for physical and psychological comorbidities. *Clinical Therapeutics*, *35*(1), A18-A32. https://doi.org/10.1016/j.clinthera.2012.12.014

Sahoo, K., Sahoo, B., Choudhury, A. K., Sofi, N. Y., Kumar, R., & Bhadoria, A. S. (2015). Childhood obesity: Causes and consequences. *Journal of Family Medicine and Primary Care, 4*(2), 187-192. https://doi.org/10.4103/2249-4863.154628

Sallis, J. F., Cervero, R. B., Ascher, W., Henderson, K. A., Kraft, M. K., & Kerr, J. (2006). An ecological approach to creating active living communities. *Annual Review of Public Health*, *27*, 297-322. https://doi.org/10.1146/ANNUREV.PUBLHEALTH.27.021405.102100

Sanyaolu, A., Okorie, C., Qi, X., Locke, J., & Rehman, S. (2019). Childhood and adolescent obesity in the United States: A public health concern. *Global Pediatric Health, 6*, 2333794X19891305. https://doi.org/10.1177/2333794X19891305

Saunders, R. P., Evans, M. H., & Joshi, P. (2005). Developing a process-evaluation plan for assessing health promotion program implementation: A how-to guide. *Health Promotion Practice*, *6*(2), 134-147. https://doi.org/10.1177/1524839904273387

Showalter, D., Hartman, S. L., Johnson, J., & Klein, B. (2019). Why rural matters 2018-2019: The time is now. *Rural School and Community Trust*. Retrieved November 1, 2021, from http://www.ruraledu.org/WhyRuralMatters.pdf

Stierman, B., Afful, J., Carroll, M. D., Chen, T. -C., Davy, O., Fink, S., Fryar, C. D., Gu, Q., Hales, C. M., Hughes, J. P., Ostchega, Y., Storandt, R. J., & Akinbami, L. J. (2021). National Health and Nutrition Examination Survey 2017–March 2020 prepandemic data files—Development of files and prevalence estimates for selected health outcomes. *National Health Statistics Reports, 158,* 1-21. https://doi.org/10.15620/cdc:106273

U.S. Department of Health and Human Services. (2010). *The Surgeon General's Vision for a Healthy and Fit Nation*. U.S.

Department of Health and Human Services, Office of the Surgeon General.

U.S. Department of Health and Human Services. (2018). *Physical Activity Guidelines for Americans, 2nd edition.* U.S. Department of Health and Human Services.

Yousefian, A., Ziller, E., Swartz, J., & Hartley, D. (2009). Active living for rural youth: Addressing physical inactivity in rural communities. *Journal of Public Health Management and Practice*, *15*(3), 223-231. https://doi.org/10.1097/PHH.0b013e3181a11822