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Effects of Nutrition and Physical Activity Intervention in Improving Children's BMI-for-Age Percentiles

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Abstract

According to the World Health Organization (WHO), globally 340 million school-aged children are obese. The Centers for Disease Control and Prevention (CDC) report that 13.7 million (19%) of U.S. children and adolescents age 2-19 years are obese. Obesity rates are 14% in 2- to 5-year-olds, 18% in 6- to 11-year-olds, and 21% in 12- to 19-year-olds. Hispanic children (26%) and non-Hispanic black children (22%) have higher obesity prevalence than non-Hispanic white children (14%). Non-Hispanic Asian children (11%) have lower obesity rates than non-Hispanic black children and Hispanic children. In Arkansas, 22% of school-aged children are obese and 39% are overweight and obese. In Arkadelphia, 19% of school-aged children are obese and 36% are overweight and obese. In Gurdon, 20% of school-aged children are obese and 37% are overweight and obese. Therefore, programs to lower body mass index (BMI) and increase physical activity in children are needed. The purpose of the study was to determine the effectiveness of a nutrition and physical activity intervention in improving the BMI-for-age percentiles of rural Arkansas children at risk for childhood obesity. The study consisted of a treatment group (n=62) and a control group (n=25) of children 2-12 years of age. Anthropometric data for each child in the control and the treatment group was collected at the beginning and the end of the seven-week intervention. Data was used to calculate BMI, BMI-for-age percentile, weight status category, and BMI z-scores. The researchers visited the treatment group weekly and taught 30-60 minute lessons on nutrition and physical activity. The control group did not receive treatment. All data was collated and analyzed to determine the effects of the treatment.

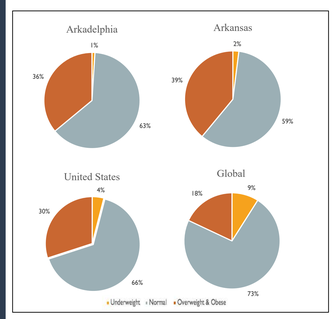

Figure 1.BMI-for-age weight status category percentages: Arkadelphia, Arkansas, United States, and Global

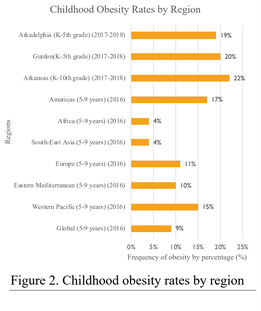

Figure 2. Childhood obesity rates by region

Hypothesis

There will be a statistical difference in the BMI change from pre-assessment to post-assessment of children completing a nutrition and physical activity treatment intervention and there will be no statistical difference in the BMI change from pre-assessment to post-assessment of a control group of children not completing a nutrition and physical activity treatment intervention.

Introduction

Childhood obesity is a global epidemic. Weight gain is expected and desired as children grow; however, overweight and obese children face challenges if the additional body weight is carried into adulthood.[1] According to data from the WHO, in 2016, the prevalence of obesity in children age 5-9 years in different geographical regions was: Africa 4%, Americas 17%, Eastern Mediterranean 10%, Europe 11%, South-East Asia 4%, and Western Pacific 15%.[2] In the U.S., rates have increased to over 18% in children 6-11 years old.[3] This is even more of a problem for the southern states, especially Arkansas with an astounding 22% of children obese and 39% of children overweight and obese.[4] The WHO considers childhood obesity one of the most serious health challenges of the 21st century.[2,5] Obesity which was once only a problem in countries that were more advanced and wealthy now affects countries with varying economic levels.[6] Research studies support the fact that diet, physical activity, screen time, sleep patterns, socioeconomic status, and family practices contribute to childhood obesity. Many children do not consume an adequate amount of fruits, vegetables, and whole grains. Because of deficiencies in their diets, they do not obtain adequate calcium, dietary fiber, potassium, and vitamin D, yet they consume above the recommendations for calories, added sugars, sodium and fat. Childhood obesity increases the risk of chronic health problems such as type 2 diabetes, cancer, hypertension, depression, cardiovascular diseases, and asthma.[7,8] Early childhood is a critical period for preventing obesity-related diseases.[9,10] Childhood is a prime time to lay physical and cognitive foundations for health, learning and well-being that children can carry throughout their lifespan.

Methods

A basic randomized control trial research study consisting of a treatment and control group was conducted during June and July 2019. Approval for the project was granted by the Ouachita Baptist University (OBU) Institutional Review Board. The control and treatment groups were children in childcare sites in Arkadelphia and Gurdon, Arkansas. Two childcare programs served as the control group and four childcare programs served as the treatment group. The participants ranged in age from 2-12 years. A total of 87 children, 62 in the treatment group and 25 in the control group, participated in the study. Informed consent was obtained from the parent or caregiver of each child.

Table 1. Participant demographics

	Females	Males	Caucasian	African American	Hispanic
Treatment (n=62)	32 (52%)	30 (48%)	52 (84%)	9 (15%)	1 (1%)
Control (n=25)	14 (56%)	11 (44%)	22 (88%)	3 (12%)	0 (0%)
Total (n=87)	46 (53%)	41 (47%)	74 (85%)	12 (14%)	1 (1%)

Anthropometrics

Control and treatment groups' anthropometrics (height and weight) were measured initially using a Health O Meter electronic standing scale for weighing to the nearest tenth and a SECA stadiometer for measuring height in inches. Weights and measurements were performed confidentially outside the classroom setting in the hallway. Children were called out into the hallway one at a time. They removed their shoes and told the researcher their name, age and grade completed; stood on the scale backwards; and stood on the stadiometer. Name, gender, age, ethnicity, grade completed, height and weight were entered into an Excel spreadsheet. Weights and measurements were collected for the control and treatment groups at the end of the study. BMI and BMI-for-age percentiles were calculated twice from the data to ensure accuracy. Z-scores were calculated and pre-assessment and post-assessment results were compared. Comparisons were also made to state and global BMI's.

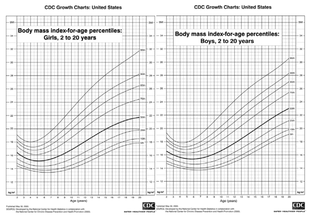

Figure 3. CDC's BMI-for age pediatric growth charts

Table 2. CDC's weight status categories

Weight Status Category	Percentile Range
Underweight	Less than the 5th percentile
Normal or Healthy Weight	5th percentile to less than the 85th percentile
Overweight	85th to less than the 95th percentile
Obese	Equal to or greater than the 95th percentile

Intervention

For the treatment group, two undergraduate research students in the OBU Nutrition and Dietetics Department taught a nutrition lesson with an activity for 30 minutes to an hour each week. The lessons consisted of information about MyPlate including fruits, vegetables, proteins, grains, and dairy along with the recommended daily amounts for specific age groups. Other lessons included information about sugar, fat, physical activity, and hydration. The children were involved in making crafts related to the lesson and also participated in a lesson game. They were encouraged to take home activities and to share the lesson with their guardian. Along with the activities sent home, two newsletters including information that the children had learned during the program were written by the researchers and sent home with the children to give to their guardian. The newsletters also included recipes that were easy, inexpensive and healthy for the family to make together. The control group did not receive the lessons or newsletters. At the end of the seven weeks, the children in the control group and treatment group were weighed and their height was measured.

Table 3. Intervention lesson topics

Week 1	MyPlate
Week 2	Eat the Rainbow
Week 3	Fishing for Protein
Week 4	Grow your Grains
Week 5	Don't Spill the Milk
Week 6	Sugar and Fat
Week 7	Physical Activity and Hydration

Image 1. Week One

Image 2. Week Five

Image 3. Week Six

Image 4. Week Seven

Statistical Analysis

Descriptive statistics included mean and frequency comparisons of pre-assessment and post-assessment data. A paired-sample t-test was run comparing pre-assessment BMI with post-assessment BMI for the control and treatment groups. Comparisons were also made between pre-assessment z-scores and post-assessment z-scores. Statistical significance was set at $p<0.05$. SPSS version 25 was used for all analysis.

Results

A total of 87 children were assessed, of which 41 (47%) were male and 46 (53%) were female. Ethnicities represented were Caucasian (n=74), African American (n=12), and Hispanic (n=1). The treatment group (n=62) consisted of 30 males and 32 females. Fifty-two of the children in the treatment group were Caucasian, 9 were African American and 1 was Hispanic. The control group (n=25) consisted of 11 males and 14 females. Twenty-two of the children were Caucasian and 3 were African American.

Analysis of the control data (n=25) revealed a mean pre-assessment BMI of 15.1±1.1 and a mean post-assessment BMI of 14.1±1.9. A paired sample t-test showed there was statistical significance between the pre-BMI and the post-BMI with a p=0.00. BMI-for-age weight status category changes from pre-assessment weights and measurements to post-assessment weights and measurements were that 15 children remained in the same weight status category, 1 child moved from obese to normal weight, and 9 children moved from normal weight to underweight.

Analysis of the treatment data (n=62) revealed a mean pre-assessment BMI of 17.6±4.5 and a mean post-assessment BMI of 17.6±3.8. A paired sample t-test showed there was statistical significance between the pre-BMI and the post-BMI with a p=0.00. BMI-for-age weight status category changes from pre-assessment weights and measurements to post-assessment weights and measurements were that 52 children remained in the same weight status category, 4 children moved from underweight to normal weight, 1 child moved from overweight to normal weight, 3 children moved from normal weight to overweight and 1 child moved from normal weight to obese.

Table 4. Pre- and post- assessment weight status category data

	Treatment (n=62)		Control (n=25)		Total (n=87)	
	Pre-Assessment	Post-Assessment	Pre-Assessment	Post-Assessment	Pre-Assessment	Post-Assessment
Underweight	7 (11%)	3 (4%)	4 (16%)	13 (52%)	11 (12%)	16 (18%)
Normal Weight	39 (63%)	40 (65%)	19 (76%)	11 (44%)	58 (67%)	51 (59%)
Overweight	5 (8%)	6 (10%)	1 (4%)	1 (4%)	6 (7%)	7 (8%)
Obese	11 (18%)	13 (21%)	1 (4%)	0 (0%)	12 (14%)	13 (15%)

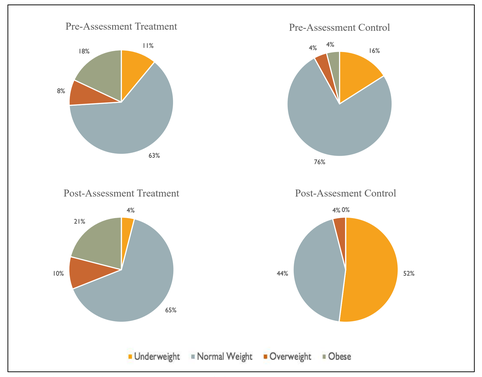

Figure 4. Pre-and post-assessment weight status category

Table 5. Mean, standard deviation, and standard error mean

		N	Mean	Standard Deviation	Standard Error Mean
Treatment	Pre-Assessment	62	17.6	4.5	0.6
	Post-Assessment	62	17.6	3.8	0.5
Control	Pre-Assessment	25	15.1	1.1	0.22
	Post-Assessment	25	14.1	1.9	0.4

Table 6. One sample t-test

		t	df	Sig. (2-tailed)	Mean Difference	95% Confidence of the Interval Difference Lower	Upper
Treatment	Pre-Assessment	30.6	61	0.00	17.6	16.4	18.7
	Post-Assessment	36.6	61	0.00	17.6	16.6	18.5
Control	Pre-Assessment	68.7	24	0.00	15.1	14.7	15.6
	Post-Assessment	37.9	24	0.00	14.1	13.3	14.8

Results

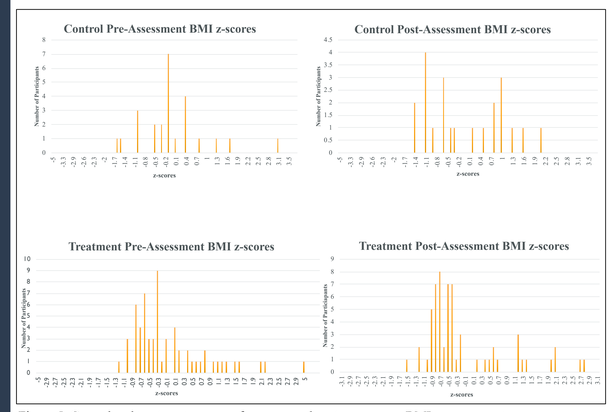

Figure 5. Control and treatment z-scores from pre- and post-assessment BMI measurements

Figure 5. Control and treatment z-scores from pre- and post-assessment BMI measurements

Conclusion

The goal of the summer research project was to teach children in the rural, southwest Arkansas communities of Arkadelphia and Gurdon about nutrition and physical activity to reduce or prevent the development of childhood obesity. The researchers reviewed the previous lesson's information with the children at the beginning of each session. Many of the children retained information presented to them this summer. Children shared practical changes they had made based on what they had learned from the nutrition and physical activity intervention.

The majority of the children in the treatment and control groups remained in the same weight status category. In the treatment group, 10 children changed their weight status category with 6 of the 10 improving their weight status category and moving into the normal weight category. For the control group, one child moved from the obese to the normal weight category. Often changes occur as a result of growth in the summer, but the influence of nutrition and physical activity on weight status category cannot be disregarded.

The first hypothesis was proven that there was a statistical difference ($p=0.00$) in the BMI change from pre-assessment to post-assessment of children completing a nutrition and physical activity treatment intervention. The null hypothesis was rejected ($p=0.00$) so there was a statistical significance between the BMI change from pre-assessment to post-assessment of a control group of children not completing a nutrition and physical activity treatment intervention.

The research project succeeded in educating children on the importance of nutrition and physical activity which has been shown to reduce the risk of obesity during childhood.

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