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The Impact of a School-Based Program on Diabetes and Cardiovascular Risk Factors

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Bachelor of Science in Nursing

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**Abstract**

Obesity is an increasing health issue both in the United States and worldwide. Furthermore, childhood obesity is increasing in prevalence. Childhood obesity is associated with an increased risk of comorbidities in adulthood. Obesity in childhood and adolescence makes one more likely to become obese during adulthood. This study sought to determine the effect of a school-based obesity prevention program on diabetes and cardiovascular risk factors such as body mass index (BMI), blood pressure, waist circumference, and acanthosis nigricans. Measurements were taken before education in the fall semester, and again after two education sessions in the spring semester. Student and faculty researchers at the University of Arkansas developed the *Eat Better, Move More* program to be implemented in two classrooms in George Elementary School. Teaching points were developed and given to teachers who implemented the education in their classrooms. Topics covered in the teaching included sleep habits, exercise, nutrition, and healthy habits. A paired sample T-test was used to evaluate the difference in pre- and post-education data points. Results showed a significant difference in pre- and post-education BMI; however, the BMI increased significantly instead of the desired decrease. Results showed no significant difference in pre- and post-education blood pressure or waist circumference. Results of a Wilcoxon sign-rank test showed no significant difference in pre- and post-education acanthosis nigricans. Results of the study indicate that the school-based program did not have a positive impact on obesity and cardiovascular risk factors such as BMI, waist circumference, blood pressure, and acanthosis nigricans. Further research can be done to determine the effects of a long-term program on these risk factors.

## Introduction

The rate of obesity in children and adolescents ages 2-19 has remained stable from 2011 to 2014, yet childhood obesity continues to be a significant problem in the United States and remains a complex health issue. 13.7 million children and adolescents in the United States are considered obese, with higher rates noted in the minority and low-income population (CDC, 2018). Obesity is the most important (and preventable) risk factor for type II diabetes (Scott, 2013). It is also an associated risk factor for cardiovascular disease (CVD), asthma, sleep apnea, joint and musculoskeletal problems, as well as psychological problems (CDC, 2016). Screening and early identification of at-risk individuals aids in reducing the prevalence of type II diabetes among adolescents. It is essential to identify individuals at risk for developing diabetes and CVD and reducing risk factors before they develop into the diseases.

Public schools have a unique opportunity to implement health promotion and illness prevention programs for overweight or at risk children because they interact with children five days a week. The focus on healthy choices can result in the integration of these lifestyle modifications into the children's lives. A multifactorial approach, including the educational needs of both teachers and parents, can result in student adherence to a healthy lifestyle year-round.

The *Eat Better Move More* program, developed by student and faculty researchers of the Eleanor Mann School of Nursing at the University of Arkansas, worked with both parents and teachers to encourage healthy lifestyle choices to decrease the risk of diabetes and CVD, and lower body mass index (BMI) in elementary age children. The program provided education regarding lifestyle modifications to teachers for implementation in the classroom as well as nutrition, activity, and behavior modification education to Hispanic and Marshallese mothers for

their children. The purpose of this study was to identify how the *Eat Better Move More* program affects diabetes risk, cardiovascular risk, and BMI of children and adolescents exposed to the program.

### **Background and Significance**

George Elementary in Springdale, Arkansas, has a large number of Hispanic and Pacific Islander students, comprising 78% of the school population. Individuals from a Hispanic/Latino background are at a higher risk for the development of type II diabetes than non-Hispanic Caucasians (Alexandria, 2014). A 2017 study reported that 20.1% of Hispanic youth have been diagnosed with diabetes (Lee et al., 2017). While the exact prevalence of diabetes in Pacific Islander adolescents is unknown, the U.S. Department of Health and Human Services Office of Minority Health states that Pacific Islanders are 2.4 times more likely to be diagnosed with diabetes than their non-Hispanic white counterparts (OMH, 2016). Additionally, Pacific Islanders are 20% more likely to be obese (OMH, 2017). This project focused on developing a program that decreases the prevalence of obesity and obesity-related illnesses in adolescents.

In Arkansas, adolescent BMI is measured in the public-school system in kindergarten and even-numbered grades 2-10 yearly (ACHI, 2018). BMI is a measurement of weight in proportion to height; it is used as a standard measurement of obesity status. The child's BMI is graphed on a chart that uses age and gender-specific percentiles. Students are classified as underweight, healthy weight, overweight, or obese. An overweight BMI is a BMI-for-age greater than or equal to the 85<sup>th</sup> percentile but less than the 95<sup>th</sup> percentile. An obese BMI is a BMI-for-age greater than or equal to the 95<sup>th</sup> percentile (ACHI, 2018). In 2018, the Arkansas Center for Health Improvement determined that 47.8% of the students at George Elementary are considered overweight or obese.

## Literature Review

### *In School Health Education Programs*

Schools have a unique advantage to influence the behaviors of students related to obesity and diabetes prevention. Children's health behaviors are influenced by the community in which they reside, including their school (CDC, 2016). Limited research has been conducted to determine the impact of a school-based prevention program on diabetes and cardiovascular risk factors for students. A literature review conducted by Wang et al. (2015) argued that school-based interventions were moderately effective at preventing obesity for students. The studies focused only on physical activity or dietary interventions; data was insufficient that using a combined method (nutrition education, physical activity, and nutritional interventions) helped prevent obesity (Wang et al., 2015). A study conducted in Australia resulted in a significant decrease in the prevalence of obesity and overweight students in two out of three intervention schools (Malakellis et al., 2017). Interventions in the study were focused on increasing physical activity, encouraging healthy nutritional choices, and supporting mental well-being. Interventions took place at the individual, community, and school policy level (Malakellis et al., 2017).

A longitudinal study conducted on a large sample size (n=4,603) revealed no significant impact on health behavior after a 2-year intervention. The components of this study included nutrition, exercise, behavior therapy, and more. Although there was no significant change in health behavior, the study argues that students who were more involved in the research experienced metabolic improvements (Brackney & Cutshall, 2015). Overall, Brackney & Cutshall (2015) argue that all students would benefit from increased physical activity and nutrition education. One study examined the barriers that school-based obesity prevention

programs can encounter. They found that barriers such as lack of a clear program, stakeholder resistance, and need for training and support hindered the implementation of such obesity prevention programs (Totura, Figueroa, Wharton, & Marsiglia, 2015).

### *Implications of Childhood Obesity*

Childhood obesity is associated with complications of diabetes and CVD during adulthood (CDC, 2016). McCurley, Crawford, and Gallo (2017) argue that once diagnosed with type II diabetes, Hispanics have worse glucose control, more vascular and organ complications, increased depression, increased prevalence of CVD, and increased mortality than non-Hispanic whites. Studies show that being overweight or obese as a child or adolescent makes one more likely to be obese as an adult (Pandita et al., 2016). Additionally, childhood obesity is associated with comorbidities such as coronary artery disease, hypertension, ischemic heart disease, stroke, and insulin resistance (Pandita et al., 2016).

Not only is childhood obesity associated with numerous physiologic issues, but it is also associated with the development of psychological problems (CDC, 2016). Rankin et al. (2016) discuss that childhood obesity is associated with a diagnosis of depression, emotional and behavioral disorders, and negative self-esteem. Researchers recommend that treatment of overweight and obese children include psychological and social support services (Rankin et al., 2016).

Prevention, early detection and early treatment of childhood obesity alleviate the risk of complications and comorbidities in adulthood. Obese children are now affected by complications that once only occurred in adulthood. Treatment of obesity and related comorbidities is costly and not without risks; therefore, prevention of obesity in childhood and adolescents is ideal (Pandita et al., 2016).

## Methodology

Approval for performing this study was obtained from the University of Arkansas Institutional Review Board and Springdale School District. This exploratory study consisted of the administration of physical measurements after the presentation of healthy lifestyle behaviors in the classroom.

**Sample:** This study used a convenience sample of 21 students in two classrooms at George Elementary School whose teachers provided program education during the 2018-2019 school year.

**Design:** Parents completed a demographic survey which included student gender, race, ethnicity, parent age, highest level of education, child's date of birth, and whether the child received free or reduced lunch. Parents also completed a diabetes and cardiovascular risk assessment survey. Anthropometric measures were taken two times throughout the study to determine the child's BMI, using height, weight, age, and gender according to The Center for Disease Control guidelines. Blood pressure, measurement of acanthosis nigricans, and waist circumference were collected pre-education in the fall semester and again in the spring semester after completion of education material. Acanthosis nigricans was measured on the back of the neck and was given a numerical rating between 0-2. 0 indicated no presence of acanthosis nigricans, 1 indicated mild acanthosis nigricans, and 2 indicated moderate acanthosis nigricans.

**Data Analysis:** A paired samples t-test was used to analyze pre- and post-education BMI, blood pressure, and waist circumference data points. A Wilcoxon sign-ranks test was used to analyze pre- and post-education acanthosis nigricans data points.

**Null hypothesis:** The *Eat Better Move More* program has no effect on diabetes risk, cardiovascular risk, or BMI of the children exposed to the program.



## Results

Twenty-seven students from two different classrooms elected to participate in the study, however only 21 students participated (n=21). Four students were not included in the study due to missing consent or failing to report the date of birth. Two students were excluded from the study due to their absence on data collection dates. A paired samples T-test was used to evaluate the difference in pre-education and post-education data points. An alpha of 0.05 was used. A critical T value of 2.086 was determined using 20 degrees of freedom and a 95% confidence level. Results of the paired samples T-test can be seen in table 1. The only significant difference in pre- and post-education values was in BMI ( $t=-2.691$ ,  $p=.014$ ). However, the BMI experienced a significant increase from pre-education to post-education (mean pre- and post-education, respectively, 19.9 to 20.567). There was no statistically significant difference in systolic blood pressure ( $t=-.941$ ,  $p=.358$ ), diastolic blood pressure ( $t=1.549$ ,  $p=.137$ ), or waist circumference ( $p=.558$ ,  $t=-.596$ ) between pre- and post- education data points.

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Weight before treatment (kg) - Weight after treatment (kg)	-2.5143	2.6764	.5840	-3.7326	-1.2960	-4.305	20	.000
Pair 2	Height before treatment (cm) - Height after treatment (cm)	-1.9857	1.4830	.3236	-2.6608	-1.3107	-6.136	20	.000
Pair 3	BMI before treatment - BMI after treatment	-.6667	1.1355	.2478	-1.1835	-.1498	-2.691	20	.014
Pair 4	Systolic blood pressure before treatment - Systolic blood pressure after treatment	-2.810	13.688	2.987	-9.040	3.421	-.941	20	.358
Pair 5	Diastolic blood pressure before treatment - Diastolic blood pressure after treatment	3.238	9.581	2.091	-1.123	7.599	1.549	20	.137
Pair 6	Wasit circumference before treatment - Wasit circumference after treatment	-.8333	6.4075	1.3982	-3.7500	2.0833	-.596	20	.558

Table 1. Results of the paired samples test.

A Wilcoxon sign-ranks test was performed to determine the difference in acanthosis nigricans pre- and post-education. Results of the Wilcoxon test are displayed in tables 2 and 3.

Results showed no significant difference in pre- and post-education acanthosis nigricans ( $Z = -1.633, p = .102$ ).

		N	Mean Rank	Sum of Ranks
Acanthosis after treatment - Acanthosis before treatment	Negative Ranks	5 <sup>a</sup>	3.50	17.50
	Positive Ranks	1 <sup>b</sup>	3.50	3.50
	Ties	15 <sup>c</sup>		
	Total	21		

a. Acanthosis after treatment < Acanthosis before treatment

b. Acanthosis after treatment > Acanthosis before treatment

c. Acanthosis after treatment = Acanthosis before treatment

Table 2. Ranks of Wilcoxon sign-ranks test

	Acanthosis after treatment - Acanthosis before treatment
Z	-1.633 <sup>b</sup>
Asymp. Sig. (2-tailed)	.102

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

Table 3. Test statistics of Wilcoxon sign-ranks test

Results from the demographic questionnaire filled out by parents show that 14 students identified as being of Hispanic or Latino ethnicity, one student identified as being of Native Hawaiian descent, two students identified as being of Asian descent, and the remaining four students identified as non-Hispanic Whites. All students are from low socioeconomic status.

**Discussion**

While we are able to reject the null hypothesis in the case of BMI, the BMI pre-education increased significantly rather than the desired decrease. The mean BMI increased by 3%; according to CDC charts, the adolescent’s BMI was expected to increase by 2% during the 22-weeks. We are unable to reject the null hypothesis based on systolic blood pressure, diastolic

blood pressure, waist circumference, and acanthosis nigricans. An increase in BMI was to be expected because the children grew in both height and weight during the 22-weeks. While the diastolic blood pressure did experience a decrease, it was not substantial enough to be considered significant. The student's height, weight, BMI, systolic blood pressure, and waist circumference all increased from pre- to post-education. This is expected because the students grew substantially during the 22-weeks. Five students experience a decrease in acanthosis nigricans measurement post-education, one student experienced an increase in acanthosis nigricans measurement, and 15 students maintained the same measurement. Based on guidelines established by the CDC, pre-education, seven students were classified as obese (BMI  $\geq$  95<sup>th</sup> percentile), 13 students were classified as healthy weight (BMI  $>5^{\text{th}}$  to  $<85^{\text{th}}$  percentile), and one student was classified as underweight (BMI  $<5^{\text{th}}$  percentile). Post-education, one obese student experienced a decrease in BMI percentile and is classified as overweight (85<sup>th</sup> to  $<95^{\text{th}}$  percentile), while the remainder of the students remained the same (CDC, 2014).

While the program did not create a significant decrease in obesity or cardiovascular risk factors, it was beneficial to the student's overall health. Students experienced a reduction in diastolic blood pressure (pre- and post-education mean, respectively, 61.24 mmHg to 58 mmHg). Likewise, five students experienced a decrease in acanthosis nigricans measurement.

Limitations of this study include the absence of students from school. Two students were excluded from the study due to school absence on data collection dates. Additionally, students may have been absent from school on the days that education was presented. Another limitation of the study is the small sample size. The sample size represents a small portion of the student population of George Elementary School. Similarly, there was no control group tested to compare the outcomes of the intervention group. The same researcher measured blood pressure,

waist circumference and acanthosis nigricans each measurement; and the same researcher measured height, weight and calculated BMI with each measurement to decrease the chance of error.

### **Conclusion**

There is a lack of research specific to obesity prevention in adolescent minorities. This 22-week study is a portion of a 2-year longitudinal study that measures the impact of a school-based program on diabetes and cardiovascular risk factors. The purpose of the study is to measure the effectiveness of a program targeted at decreasing diabetes risk, cardiovascular risk, and BMI in Hispanic and Pacific Islander adolescents. Results of the study indicate that the school-based program had no positive, significant impact on diabetes and cardiovascular risk factors such as BMI, blood pressure, waist circumference, and acanthosis nigricans. Had the results of the study been significant, they could have been used to design and implement school-based programs nationwide to decrease the prevalence of childhood obesity in ethnic minorities.

Further research ought to be conducted to determine the long-term impact of a school-based program on risk factors. Additionally, further research can be performed to assess the effect of a more intensive school-based program on risk factors. There is a need for the creation of programs targeted at decreasing the prevalence of childhood obesity.

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