



(RESEARCH ARTICLE)



## The relationship between physical education requirements and childhood obesity rates in the United States among high school students

OREOLUWA GABRIEL OGinni \*

*Brown School, Washington University St. Louis, Missouri, United States.*

GSC Advanced Research and Reviews, 2024, 20(01), 274–282

Publication history: Received on 05 June 2024; revised on 16 July 2024; accepted on 19 July 2024

Article DOI: <https://doi.org/10.30574/gscarr.2024.20.1.0265>

### Abstract

**Objectives:** The study investigated the relationship between state laws requiring physical education in high schools and childhood obesity rates across the United States. The primary objective was to discern whether the presence of physical education requirements correlated with varying rates of childhood obesity.

**Methods:** A cross-sectional study design was employed, utilizing data from [stateofchildhoodobesity.org](http://stateofchildhoodobesity.org) and [edweek.org](http://edweek.org). The study population included all 50 states in the United States, focusing on children aged 10-17 in high schools. Simple convenience sampling was used, and data were collected on childhood obesity rates in the country and state laws mandating physical education in high schools. Multiple regression analysis was employed to evaluate the impact of state laws on obesity rates, controlling for potential confounding variables.

**Results:** Descriptive statistics revealed an even distribution of childhood obesity rates across the high, medium, and low categories. The contingency table and Pearson's Chi-squared test demonstrated a positive visual association between obesity rates and physical education requirements. However, the lack of statistical significance ( $p = 0.34$ ) suggested a nuanced relationship. The study's power analysis indicated a sufficient sample size, and the results underscored the need for a comprehensive understanding of childhood obesity beyond physical education requirements.

**Conclusions:** Despite a positive correlation, the study failed to establish a statistically significant connection between state laws mandating physical education and childhood obesity rates. This emphasizes the complexity of childhood obesity dynamics, indicating the need for comprehensive interventions. The study recommends further research incorporating a broader range of factors and adopting a more detailed approach to policy implications for effectively combating childhood obesity.

**Keywords:** Physical education; Physical activity; Childhood obesity

### 1. Introduction

Obesity is a significant health issue that results from an excessive accumulation of body fat, which can negatively impact various systems in the body.<sup>1,2</sup> This can lead to multiple health problems, such as type 2 diabetes, cardiovascular diseases, orthopedic problems, psychological issues,<sup>1,3-6</sup> and the development of cognitive abilities and attaining a superior level of education.<sup>7-9</sup> Other studies indicate pediatric obesity results in significantly higher health costs and reduced productivity during adulthood due to excessive sick days, affecting the physical, mental, and social development that might lead to death.<sup>7,10,11</sup>

\* Corresponding author: OREOLUWA GABRIEL OGinni

Childhood obesity is a severe problem that has increased over the past few decades.<sup>12</sup> This is a type of obesity that affects individuals under the age of 18, specifically children and adolescents who are overweight or obese. It is determined by their sex-adjusted BMI z-score, equal to or greater than the 85th percentile.<sup>7</sup>

Childhood Obesity has risen rapidly over the past decades, with over 340 million children and adolescents aged 5 – 19 estimated to be overweight or obese in 2016.<sup>13</sup> Approximately 22 million children under five are overweight or obese worldwide, indicating that 10% of schoolchildren globally are affected.<sup>10</sup> The increasing rates of overweight and obesity, combined with a lack of physical activity, raise the risk of chronic diseases in children and adolescents, with greater severity in adulthood.<sup>9</sup>

Physical Activity (PA) prevents and manages childhood obesity.<sup>6,14</sup> Studies have shown that physical inactivity is the fourth major cause of global mortality, resulting in almost three million deaths.<sup>6</sup> There has been a significant increase in obesity, physical inactivity, and unhealthy dietary habits across all age groups, as shown by various studies.<sup>15</sup> Insufficient physical activity in children and adolescents can result in an energy imbalance, whereby their diet intake exceeds their physical activity, leading to increased risks of obesity and associated complications.<sup>3,6</sup>

Hence, physical activity helps burn calories, improve metabolic health, enhance muscle strength, and reduce fat mass, leading to healthy lifestyles that can persist into adulthood, mitigating the risk of obesity-related diseases.<sup>16</sup> PA is highly recommended for promoting health and preventing diseases across all age groups because it involves increased energy expenditure and load-bearing forces essential for maintaining good health.<sup>17,18</sup> Increased physical activity during childhood is a crucial intervention to prevent obesity. It leads to improved health outcomes, including sustained weight loss.<sup>17</sup>

Physical activity helps children maintain a healthy weight and promotes overall physical and mental well-being.<sup>14</sup> Schools have a significant role to play in the battle against childhood obesity. Physical education programs have the potential to instill a lifelong appreciation for physical activity and equip children with the skills and knowledge needed to maintain a healthy lifestyle.<sup>19</sup>

Furthermore, the problem of overweight and obesity in school-aged children poses numerous challenges that can impact their health and academic performance and have far-reaching societal effects. The environment in which these children reside, encompassing their homes, schools, and communities, represents a multifaceted set of factors contributing to their weight status.<sup>8,10</sup> School-based interventions focus on improving students' dietary behaviors and increasing physical activity.<sup>2,6,14</sup> This is achieved through rigorous enhancement of the nutritional education curriculum, providing information through workshops, booklets, pamphlets, and posters to ensure effectiveness. Furthermore, interventions modify physical education sessions to reduce sedentary behavior.<sup>8</sup> Parental involvement, community initiatives, and public policy also shape the environment in which children grow and develop, as they can promote or hinder physical activity and healthy eating among children.<sup>20</sup> It will build upon previous research by exploring the specific strategies and programs to curb childhood obesity.<sup>2</sup>

This study seeks to compare childhood obesity rates by examining the state laws in the United States that require physical education in high schools (10-17 years) and offer evidence-based insights that can inform policy recommendations and practical interventions to combat this critical public health issue.

---

## 2. Material and Methods

### 2.1. Study Design

The study used a cross-sectional design to examine how state laws on childhood obesity correlate with obesity rates in the United States. The study drew data from reliable sources such as [stateofchildhoodobesity.org](http://stateofchildhoodobesity.org) and [edweek.org](http://edweek.org), which provide information on states that require physical education.

### 2.2. Data Sources

#### 2.2.1. Childhood Obesity Rates

Childhood obesity rates were collected from publicly available datasets and reports from [stateofchildhoodobesity.org](http://stateofchildhoodobesity.org). [Stateofchildhoodobesity.org](http://stateofchildhoodobesity.org) is a reliable platform that aggregates information from various trusted sources, including state health departments, legislative records, and public health initiatives. The platform serves as a comprehensive repository for data on policies and regulations addressing childhood obesity across all 50 states in the United States.

The data collection process involves regular updates and reviews of state policies related to childhood obesity. Researchers systematically gather, verify, and catalog information from official state documents, legislative records, and relevant health department publications. The data presented on the platform is highly accurate and reliable.

These datasets provide information on obesity rates among children and adolescents within each state, typically reported as a percentage of the population. They were collected from 2004 to 2022.

### *2.2.2. Physical Education Requirements*

Data on physical education requirements for each state were collected from edweek.org, which aggregates information on educational policies and conditions across the United States. This dataset includes details on whether states mandate physical education in their public schools, specifically high schools, and the specific requirements or regulations related to physical education programs. The variable related to physical education requirements is a binary variable that denotes whether states mandate physical education in their public high schools. This binary variable would have two distinct categories: "Yes" for states requiring physical education in their public high schools and "No" for states not requiring it. The binary representation of this variable simplifies the analysis and enables easy comparison across various states. It also makes it easier to distinguish between states with physical education requirements and those without, which can be beneficial for exploring potential correlations with childhood obesity rates.

### **2.3. Data collection**

The data were gathered on childhood obesity rates and state laws mandating physical education in high schools in all 50 states of the United States. The data were collected in the most recent years to ensure the information was current and relevant to the research goals.

Consolidating data from various sources can be daunting. However, following a structured process can make it much more manageable.

### **2.4. Study population**

The fifty states in the United States are used for this study. This covers the ages of the children in high school from 10 – 17 years. The obesity rates were collected based on the ages of the children in high school. The state laws were effective from 2016.

This study delves into the issue of obesity among high school students aged 10 to 17 years across all fifty states of the United States. The analysis primarily focuses on the relationship between state laws with physical education requirements and obesity rates among children within the high school setting. Specifically, the study examines the impact of state laws implemented in 2016 that targeted this age group. By solely analyzing high school data, the research aims to provide a comprehensive understanding of the trends in childhood obesity in the context of high school environments across the United States.

### **2.5. Sampling method**

The study takes an innovative approach by analyzing data from all fifty states in the United States, providing a comprehensive understanding of childhood obesity rates and state laws regarding physical education requirements across the nation. Analyzing data from the entire population of interest, every state in the U.S., eliminates the need for sampling variability, ensuring accurate and reliable results.

This study adopts a comprehensive approach by examining data from all fifty states in the United States, constituting a population study. Unlike traditional convenience sampling, which involves selecting participants based on convenience, this research analyzes data from the entire population of interest—every state in the U.S. This census approach eliminates the need for sampling variability and provides a holistic understanding of childhood obesity-related state laws, obesity rates, and physical education requirements across the entire nation.

### **2.6. Data analysis**

The study involved descriptive statistics, including the percentages, were calculated to summarize the data. This provided an overview of the obesity rates and the prevalence of state laws related to childhood obesity and physical education requirements in the United States.

Correlation analyses examined the relationship between state laws related to childhood obesity and obesity rates. Chi-square coefficients will be calculated to determine the strength and direction of the association between variables.

State laws related to childhood obesity and physical education requirements were analyzed using Pearson chi-square analysis with the RStudio package to evaluate their impact on obesity rates.

The data analysis plan provides a detailed approach to examining the relationship between state laws related to childhood obesity, physical education requirements, and childhood obesity rates across all fifty states in the United States. The first step in the analysis will be to conduct descriptive statistics to summarize the data. The dependent variable in this study is childhood obesity rates, reported as percentages, which represent the prevalence of obesity among children and adolescents in each state. The independent variable in this study is state laws mandating physical education in high schools. They are categorical variables indicating the presence or absence of specific legislative measures in each state.

Correlation analysis examined the relationship between the independent and dependent variables. The dependent variable, childhood obesity rates, was treated as categorical, and the independent variable, state laws mandating physical education in high schools, will also be treated as categorical. This analysis will help identify any potential relationships between the variables.

A chi-square analysis was conducted to assess the relationship between the dependent and independent variables. The dependent variable, obesity rates, will be categorized into high, medium, and low prevalence levels. The independent variables, state laws related to childhood obesity and physical education requirements, will be categorized as yes or no, indicating their presence or absence in each state. The chi-square analysis will be conducted using the RStudio package, and the steps will be documented to ensure replicability.

Overall, the data analysis plan provides a comprehensive approach to examining the relationships between the variables and ensures that the analysis is appropriate for the data. The plan also provides clear steps for replication, which is important for ensuring the reliability of the study's findings.

## 2.7. Ethical considerations

This study will use no individual-level data, only publicly available prevalence data and a compilation of state laws to avoid loss of confidentiality.

---

## 3. Results

Table 1 illustrates the distribution of childhood obesity rates across all 51 states in the United States. Obesity rates are categorized based on the prevalence of childhood obesity in each state. High, Medium, and Low categories represent the distribution of states with higher, moderate, and lower childhood obesity rates, respectively. The categorization is determined by the percentage of children and adolescents classified as obese within each state. Table 2 displays the percentage of the 51 states supporting the physical education requirement in High schools in each state in the United States; this shows that most states (92.2%) accepted the Physical education requirement in High schools. Table 3 above shows the relationship between obesity rates and US states requiring physical education in High school (11- 17 years).

Furthermore, figure 1 shows that states with a physical education requirement have a higher percentage of high school students who meet the CDC's recommendation for physical activity than states without a physical education requirement.<sup>8</sup> Then figure 2 shows the expected childhood obesity rates in the United States. The states that require physical education have the highest rates (15.7%), while those that do not have the lowest rates (1.30%).

The table shows a positive association between obesity rates and physical education programs in the United States. This means that more physically active people are less likely to be obese. The expected childhood obesity rates in the United States column shows the percentage of obesity rates that we would expect to be in each category if there were no relationship between obesity rates and states that require physical education in high schools. The Proportion of obesity for US states in each category column shows the proportion of obesity rates in each category of High, Medium, and low states. The standardized residual column indicates the number of standard deviations that each observed value is away from the expected value.

The chi-square test of independence is a statistical test that can be used to determine whether there is a relationship between two categorical variables. The chi-square test statistic for this table is 2.17, with 2 degrees of freedom and a p-

value of 0.34. This means there is no statistically significant relationship between childhood obesity rates and states that require physical education in high school at the 0.05 level of significance. The null hypothesis will not be rejected as there is no difference in the relationship between childhood obesity rates and states that require physical education in high schools.

Overall, the table shows a positive association between childhood obesity rates and states that require physical education in high schools. However, this relationship is not statistically significant.

#### 4. Discussion

The study aimed to investigate the association between childhood obesity rates and the requirements for physical education in high schools across the United States. The initial examination of the descriptive statistics indicated that the obesity rates were evenly distributed among the categories of High, Medium, and Low, with no apparent difference. However, further analysis sought to explore whether there was a relationship between these obesity rates and the state’s policies regarding physical education in high schools.

The detailed breakdown of obesity rates in states with and without physical education requirements revealed exciting patterns. In states with High obesity rates, the proportion of those with PE requirements (15 out of 17) closely matched the expected number, indicating a balanced distribution. Conversely, states with Low obesity rates exhibited a similar pattern. Interestingly, Medium obesity rates showed a slight divergence, with a standardized residual of 0.34, suggesting a potential trend.

Figure 1 shows the relationship between the percentage of high school students in each state who met the Centers for Disease Control and Prevention’s (CDC) recommendation for physical activity and the state’s physical education requirement.<sup>14,17</sup> The CDC recommends that high school students get at least 60 minutes of moderate-to-vigorous physical activity (MVPA) daily.<sup>17</sup>

In the states with a physical education requirement, 60% of high school students met the CDC's recommendation for physical activity, compared to 40% of students without a physical education requirement. This finding suggests that physical education requirements may effectively increase the percentage of high school students who meet the CDC's recommendation for physical activity. However, it is essential to note that the graph shows a correlation (association), not causation. This means that it is possible that other factors, such as the state's overall health and fitness culture, could be contributing to the differences in physical activity levels between states with and without physical education requirements.

However, the findings from Figure 2 suggest that physical education requirements may be a promising strategy for increasing physical activity levels and improving the health of high school students. This is a surprising finding, given that physical education is widely believed to be an important tool for preventing childhood obesity. However, there are a few possible explanations for this result. One possibility is that the states that require physical education are also more likely to have other factors that contribute to childhood obesity, such as unhealthy diets and sedentary lifestyles. Having similar studies with the physically active lifestyle would negate these actions.<sup>2,8,15</sup>

**Table 1** Distribution of Childhood Obesity Rates Across U.S. States

Obesity Rates	Overall N = 51
High	17 (33.3%)
Medium	17 (33.3%)
Low	17(33.3%)

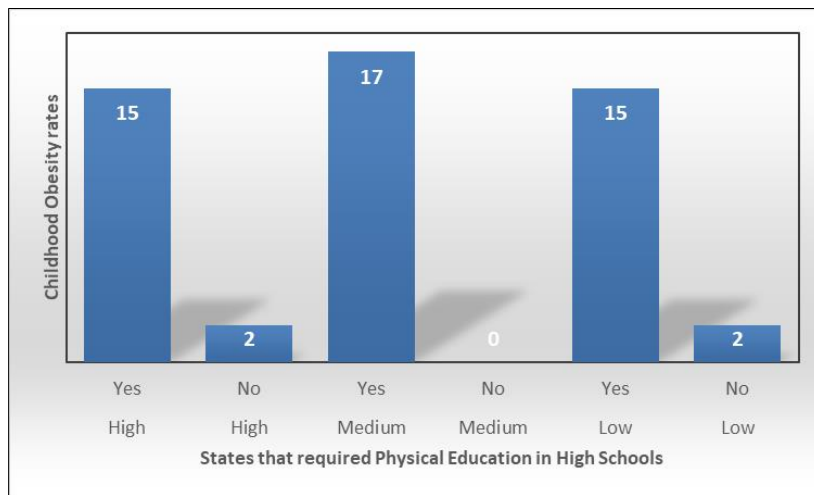
**Table 2** Requirements for Physical Education in High Schools Across the States

YES	47 (92.2%)
NO	4 (7.8%)
TOTAL	51(100%)

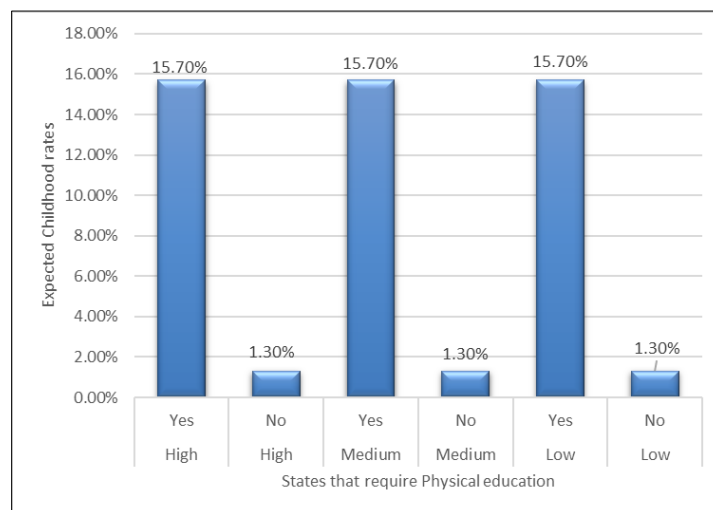
**Table 3** The Relationship between Obesity Rates and US States Requiring Physical Education in High Schools

Obesity Rates	PE Required in States	Number of States in the US that accepted the required PE in high schools.	Expected Childhood obesity rates in the United States	Proportion of obesity rates in the states in each category	Standardized Residual
High	Yes	15	15.7%	0.88	-0.17
High	No	2	1.3%	0.12	0.58
Medium	Yes	17	15.7%	1.00	0.34
Medium	No	0	1.3%	0.00	-1.16
Low	Yes	15	15.7%	0.88	-0.17
Low	No	2	1.3%	0.12	0.58

Pearson's Chi-squared test ;  $\chi^2 = 2.17$  degree of freedom = 2 p-value = 0.34



**Figure 1** States in the United States that require Physical education in High Schools



**Figure 2** Expected Childhood Obesity Rates in the United States

Another possibility is that the physical education programs in the states that require them are ineffective at preventing childhood obesity. For example, these programs may not provide enough time for students to engage in vigorous-intensity physical activity, or they may not be teaching students about healthy eating and other lifestyle habits that can help them maintain a healthy weight.<sup>17,19,21</sup>

Finally, it is also possible that the graph shows a correlation between physical education requirements and childhood obesity rates, but not necessarily a causal relationship. In other words, it is possible that other factors, such as those mentioned above, are causing the differences in childhood obesity rates between states with and without physical education requirements.

However, the findings from this graph suggest that physical education alone may not be enough to prevent childhood obesity. Other interventions, such as improving access to healthy food and opportunities for physical activity, may also be needed.<sup>6,15,19</sup>

The application of Pearson's Chi-squared test aimed to provide statistical evidence of any association. However, the obtained chi-squared value of 2.17 with 2 degrees of freedom and a p-value of 0.338 suggested that there was no statistically significant relationship between obesity rates and the presence of physical education requirements in high schools. Consequently, the null hypothesis, asserting no association, cannot be rejected at the 0.05 significance level.

The presented results suggest a positive association between childhood obesity rates and states with physical education requirements. However, the statistical analysis, including descriptive statistics and Pearson's Chi-squared test, does not establish a significant relationship. While the proportions of High, Medium, and Low obesity rates seem to align with the presence or absence of physical education requirements, the chi-squared test p-value of 0.34 exceeds the 0.05 significance level, indicating a lack of statistical significance.

This discrepancy between the visual association and statistical significance raises questions about the complexities of the relationship between childhood obesity rates and physical education requirements. The expected number of states column in the contingency table provides a baseline for comparison, showing that the observed proportions do not deviate significantly from what would be expected if there were no relationship among similar studies. Despite a positive association, the absence of statistical significance cautions against making definitive claims about causation.

### *Limitations*

While the study's cross-sectional design may present challenges in establishing causation, it still provides valuable insights into the subject matter. However, it should be noted that the reliance on publicly available data introduces the possibility of inaccuracies or variations in reporting across states, which could impact the comprehensiveness of the analysis. Additionally, the absence of individual-level data limits the depth of research, and the study's scope does not encompass all potential influencing factors. Overall, these limitations should be taken into consideration when interpreting the findings of the study.

### *Recommendations*

The following recommendations are provided in a broader view regarding childhood obesity:

- Additional research is required to understand better the factors contributing to childhood obesity. This may include examining additional variables such as dietary habits, socio-economic status, and cultural influences.
- Although this study did not establish a significant relationship, policymakers should recognize the potential impact of physical education on overall health. Encouraging physical activity in schools is essential for children's overall development. Policymakers should adopt a comprehensive approach to combating childhood obesity, addressing multiple contributing factors beyond physical education requirements.
- Conducting longitudinal studies could provide a better understanding of the relationship between physical education requirements and childhood obesity rates over time. This would enable researchers to identify emerging patterns and track changes in obesity rates and physical education policies.
- Collaborating with communities and schools to implement comprehensive wellness programs that include physical activity and nutritional education might contribute to a more holistic approach to combating childhood obesity.<sup>21</sup>
- Future research should take a more comprehensive approach and consider a broader range of factors related to childhood obesity dynamics to understand better the causal relationship between physical education requirements and physical activity levels in high school students.

---

## 5. Conclusion

The initial observation indicated a link between the obesity rate and physical education programs. However, the statistical analysis did not support the claim. The chi-squared test did not show any significant relationship between the prevalence of childhood obesity and the presence of physical education requirements in high schools across different states. Therefore, it can be concluded that while there seems to be a connection between childhood obesity rates and physical education requirements, this study failed to prove it statistically, suggesting that other factors may contribute to childhood obesity rates beyond the scope of this study. This highlights the need for comprehensive interventions that address physical activity, dietary habits, socioeconomic factors, and community influences. In summary, there is no significant relationship between childhood obesity rates and physical education requirements in high schools, which indicates that a more comprehensive approach is necessary to address the multifaceted factors that contribute to childhood obesity.

---

## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest is to be disclosed.

### *Statement of informed consent*

Informed consent was obtained from all individual participants included in the study.

---

## References

- [1] Lamas S, Rebelo S, Da Costa S, Sousa H, Zagalo N, Pinto E. The Influence of Serious Games in the Promotion of Healthy Diet and Physical Activity Health: A Systematic Review. *Nutrients*. 2023;15(6):1399. doi:10.3390/nu15061399
- [2] Brown T, Moore TH, Hooper L, et al. Interventions for preventing obesity in children. Cochrane Public Health Group, ed. *Cochrane Database of Systematic Reviews*. 2019;2019(7). doi:10.1002/14651858.CD001871.pub4
- [3] Franks PW, Bennett PH. Childhood Obesity, Other Cardiovascular Risk Factors, and Premature Death. *n engl j med*. Published online 2010.
- [4] Bendor CD, Bardugo A, Pinhas-Hamiel O, Afek A, Twig G. Cardiovascular morbidity, diabetes and cancer risk among children and adolescents with severe obesity. *Cardiovasc Diabetol*. 2020;19(1):79. doi:10.1186/s12933-020-01052-1
- [5] Flynn RJ, Pringle A, Roscoe CMP. Direct Parent Engagement to Improve Fundamental Movement Skills in Children: A Systematic Review. *Children*. 2023;10(7):1247. doi:10.3390/children10071247
- [6] Alalawi A, Blank L, Goyder E. School-based physical activity interventions among children and adolescents in the Middle East and Arabic speaking countries: A systematic review. Masanovic B, ed. *PLoS ONE*. 2023;18(7):e0288135. doi:10.1371/journal.pone.0288135
- [7] Segal AB, Huerta MC, Aurino E, Sassi F. The impact of childhood obesity on human capital in high-income countries: A systematic review. *Obesity Reviews*. 2021;22(1):e13104. doi:10.1111/obr.13104
- [8] Vega-Salas MJ, Murray C, Nunes R, et al. School environments and obesity: a systematic review of interventions and policies among school-age students in Latin America and the Caribbean. *Int J Obes*. 2023;47(1):5-16. doi:10.1038/s41366-022-01226-9
- [9] Oluwasanu AO, Akinyemi JO, Oluwasanu MM, et al. Temporal trends in overweight and obesity and chronic disease risks among adolescents and young adults: A ten-year review at a tertiary institution in Nigeria. Khurram H, ed. *PLoS ONE*. 2023;18(4):e0283210. doi:10.1371/journal.pone.0283210
- [10] Mohd Saat NZ, Abd Talib R, Alarsan SF, Saadeh N, Shahrouf G. Risk Factors of Overweight and Obesity Among School Children Aged 6 to 18 Years: A Scoping Review. *NDS*. 2023;Volume 15:63-76. doi:10.2147/NDS.S420370
- [11] Baker JL, Bjerregaard LG. Advancing precision public health for obesity in children. *Rev Endocr Metab Disord*. 2023;24(5):1003-1010. doi:10.1007/s11154-023-09802-8
- [12] Must A, Strauss R. Risks and consequences of childhood and adolescent obesity.



- [13] Green JE, Brown AG, Ohri-Vachaspati P. Sociodemographic disparities among fast-food restaurant customers who notice and use calorie menu labels. *J Acad Nutr Diet*. 2015;115(7):1093-1101. doi:10.1016/j.jand.2014.12.004
- [14] Strong WB, Malina RM, Blimkie CJR, et al. Evidence Based Physical Activity for School-age Youth. *The Journal of Pediatrics*. 2005;146(6):732-737. doi:10.1016/j.jpeds.2005.01.055
- [15] Obita G, Alkhatib A. Effectiveness of Lifestyle Nutrition and Physical Activity Interventions for Childhood Obesity and Associated Comorbidities among Children from Minority Ethnic Groups: A Systematic Review and Meta-Analysis. *Nutrients*. 2023;15(11):2524. doi:10.3390/nu15112524
- [16] Jiménez-Pavón D, Fernández-Vázquez A, Alexy U, et al. Association of objectively measured physical activity with body components in European adolescents. *BMC Public Health*. 2013;13(1):667. doi:10.1186/1471-2458-13-667
- [17] Eichner-Seitz N, Pate RR, Paul IM. Physical activity in infancy and early childhood: a narrative review of interventions for prevention of obesity and associated health outcomes. *Front Endocrinol*. 2023;14:1155925. doi:10.3389/fendo.2023.1155925
- [18] Haskell WL, Blair SN, Hill JO. Physical activity: Health outcomes and importance for public health policy. *Preventive Medicine*. 2009;49(4):280-282. doi:10.1016/j.ypmed.2009.05.002
- [19] McKenzie TL, Nader PR, Strikmiller PK, et al. School Physical Education: Effect of the Child and Adolescent Trial for Cardiovascular Health. *Preventive Medicine*. 1996;25(4):423-431. doi:10.1006/pmed.1996.0074
- [20] Kumanyika S, Jeffery R, Morabia A, Ritenbaugh C, Antipatis V. Obesity prevention: the case for action. *Int J Obes*. 2002;26(3):425-436. doi:10.1038/sj.ijo.0801938
- [21] Ojo A, Oginni OG, Akinrinola OE, Oginni RI. Impact of Cognitive-Behavioral Intervention on Alleviating Depression and Anxiety in Mathematics: Enhancing Students' Learning Experience and Academic Performance. *VP*. 2023;09(04):257-271. doi:10.4236/vp.2023.94020