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THE IMPACT OF MODERATE-INTENSITY AEROBIC EXERCISE ON THE PREVENTION AND MANAGEMENT OF OBESITY: A CASE STUDY OF OBESE BOYS AGED 12–16 YEARS IN PESHAWAR DISTRICT

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Abstract

Obesity among adolescents is a growing global health concern, with escalating prevalence linked to sedentary lifestyles and poor dietary habits. In Pakistan, particularly in Peshawar, rising obesity rates among boys aged 12–16 necessitate effective interventions. This study investigates the impact of a 12-week moderate-intensity aerobic exercise program on obesity-related indicators in obese boys from Peshawar District. Using a quasi-experimental pre-test/post-test design, 50 obese boys (BMI ≥ 95th percentile) were recruited via purposive sampling. The intervention included 45-minute aerobic sessions (brisk walking, jogging, cycling) five times weekly at 50–70% maximum heart rate. Anthropometric measurements (BMI, waist circumference, body fat percentage) were recorded before and after the intervention. Results demonstrated significant reductions in BMI (mean difference: -1.4 kg/m², *p* < 0.001), waist circumference (-3.8 cm, *p* < 0.001), and body fat percentage (-2.4%, *p* < 0.001). Private school participants showed greater improvements than government school students (BMI: -1.5 vs. -1.2 kg/m², *p* = 0.023), suggesting socioeconomic influences. Strong negative correlations (*r* ≈ -0.55 to -0.62, *p* < 0.001) between exercise adherence and obesity markers highlighted the importance of consistency. Effect sizes (Cohen's *d* = 0.58–0.72) indicated moderate-to-large clinical benefits. This study concludes that moderate-intensity aerobic exercise significantly reduces obesity markers in adolescent boys, advocating for school-based interventions and community awareness programs in Peshawar. Limitations include a small sample size and short duration, warranting further longitudinal research. These findings support integrating structured aerobic exercise into adolescent obesity management strategies in similar urban settings.

Keywords: Adolescent obesity, aerobic exercise, BMI, waist circumference, Peshawar, physical activity intervention.

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BACKGROUND

Obesity among adolescents has emerged as a significant public health concern globally, with its prevalence escalating at an alarming rate. The World Health Organization (WHO) defines obesity as an abnormal or excessive fat accumulation that presents a risk to health. Globally, the prevalence of overweight and obesity among children and adolescents aged 5–19 has risen dramatically, from just 4% in 1975 to over 18% in 2016. This surge is attributed to a combination of factors, including sedentary lifestyles, unhealthy dietary habits, and reduced physical activity levels.

In Pakistan, the situation mirrors global trends. Rapid urbanization, coupled with lifestyle changes, has led to an increase in obesity rates among children and adolescents. A systematic review highlighted that the prevalence of obesity among Pakistani children and adolescents ranges from 5% to 15.2%, with overweight prevalence varying from 0.5% to 23%. These figures underscore the pressing need to address obesity through effective interventions (Khan et al., 2023)

OBESITY IN PESHAWAR DISTRICT

Peshawar, the capital of Khyber Pakhtunkhwa province, has witnessed a notable rise in obesity rates among its youth. A cross-sectional analytical study conducted between February 2020 and October 2022 assessed overweight and obesity status among school-going children in Peshawar. The study revealed that overweight and obesity were significantly higher among private school children compared to those in government schools. Specifically, 36% of overweight and 33.3% of obese children were from government schools, while 64% of overweight and 66.7% of obese children were from private schools. The study also identified a positive correlation between the consumption of eggs and fried foods with obesity, and an inverse relationship between the duration of outdoor sports and obesity levels.

These findings highlight the multifaceted nature of obesity in Peshawar, influenced by dietary habits, physical activity levels, and socio-economic factors. The urban environment, characterized by limited open spaces and increased availability of calorie-dense foods, further exacerbates the problem (Alam et al., 2023)

IMPORTANCE OF PHYSICAL ACTIVITY

Physical activity plays a pivotal role in the prevention and management of obesity. Regular engagement in physical activities, especially aerobic exercises, has been shown to improve cardiovascular health, enhance metabolic functions, and reduce body fat. Aerobic exercises, characterized by rhythmic and continuous movements, increase heart rate and breathing, thereby promoting calorie expenditure (Niemiro et, al., 2019).

A systematic review and meta-analysis examined the effects of aerobic exercise combined with resistance training on body composition and metabolic health in overweight or obese children and adolescents. The study concluded that such combined interventions significantly reduced body mass index (BMI), waist circumference, and body fat percentage. Moreover, improvements were observed in metabolic parameters, including triglycerides, total cholesterol, and insulin sensitivity (Jayedi et, al., 2024).

Another meta-analysis focusing on aerobic plus resistance exercise interventions in overweight and obese youth found that programs lasting at least 60 minutes per session led to greater reductions in body weight, fat mass, and BMI. These findings underscore the efficacy of structured exercise programs in combating obesity among adolescents (Huang et, al., 2025)

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RATIONALE FOR THE STUDY

Despite the established benefits of aerobic exercise in managing obesity, there is a paucity of localized studies in Pakistan, particularly focusing on adolescent boys in the Peshawar District. Cultural norms, socio-economic disparities, and infrastructural limitations pose unique challenges in implementing and sustaining physical activity programs in this region.

Given the rising obesity rates and the associated health risks, there is an urgent need to explore effective, culturally appropriate interventions tailored to the local context. This study aims to fill this gap by investigating the impact of moderate-intensity aerobic exercise on obese boys aged 12–16 years in Peshawar. By focusing on this specific demographic, the study seeks to provide actionable insights that can inform public health strategies and school-based programs.

OBJECTIVES OF THE STUDY

The primary objectives of this study are:

i. To assess the current obesity levels among obese boys aged 12–16 years in Peshawar District.
ii. To implement a 12-week moderate-intensity aerobic exercise program tailored to the participants.
iii. To evaluate the effects of the program on obesity-related indicators such as BMI, waist circumference, and body fat percentage.
iv. To provide recommendations for integrating aerobic exercise into school curricula and community health initiatives.

RESEARCH QUESTIONS

The study seeks to answer the following research questions:

I. What is the current prevalence of obesity among boys aged 12–16 years in Peshawar District?
II. Does a 12-week moderate-intensity aerobic exercise program lead to significant reductions in BMI, waist circumference, and body fat percentage among the participants?
III. What are the perceptions and attitudes of participants towards the exercise program, and what factors influence their adherence?

SIGNIFICANCE OF THE STUDY

This study holds significant value for multiple stakeholders:

PUBLIC HEALTH AUTHORITIES: The findings can inform policy decisions and the development of targeted interventions to address adolescent obesity in Peshawar and similar urban settings.

EDUCATIONAL INSTITUTIONS: Schools can utilize the insights to integrate structured physical activity programs into their curricula, promoting healthier lifestyles among students.

PARENTS AND GUARDIANS: Understanding the benefits of aerobic exercise can encourage families to support and facilitate active lifestyles for their children.

Researchers: The study adds to the existing body of knowledge on obesity management, providing a foundation for future research in similar contexts.

LIMITATIONS OF THE STUDY

While the study aims to provide comprehensive insights, certain limitations must be acknowledged:

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SAMPLE SIZE: The study focuses on a specific age group and gender within a single district, which may limit the generalizability of the findings.

DURATION: A 12-week intervention may not capture long-term adherence and sustainability of the exercise program.

EXTERNAL FACTORS: Dietary habits, socio-economic status, and environmental factors, which also influence obesity, are not the primary focus of this study.

LITERATURE REVIEW

Obesity is a major global health issue, with increasing prevalence among children and adolescents (World Health Organization [WHO], 2022). In Pakistan, the obesity rate among adolescents has risen due to sedentary lifestyles, poor dietary habits, and limited physical activity (Khan et al., 2023). The Peshawar District, with its urban and rural disparities, presents a unique case for studying obesity interventions. Moderate-intensity aerobic exercise has been recognized as an effective, low-cost strategy for weight management (Janssen & LeBlanc, 2023). This review synthesizes current evidence on the impact of such exercise on obese boys aged 12–16, focusing on physiological, metabolic, and psychological outcomes.

OBESITY IN ADOLESCENTS: A Global and Local Perspective

GLOBAL TRENDS IN ADOLESCENT OBESITY

The WHO (2022) reports that over 340 million children and adolescents worldwide are overweight or obese. The rise in obesity is linked to increased consumption of processed foods, decreased physical activity, and socioeconomic factors (Sahoo et al., 2023).

OBESITY IN PAKISTAN AND PESHAWAR DISTRICT

In Pakistan, approximately 10–15% of adolescents are obese, with higher rates in urban areas due to lifestyle changes (Khan et al., 2023). A study by Ullah et al. (2023) in Peshawar found that 18% of boys aged 12–16 were obese, with poor dietary habits and low physical activity as major contributors.

THE ROLE OF MODERATE-INTENSITY AEROBIC EXERCISE IN OBESITY MANAGEMENT

DEFINITION AND CHARACTERISTICS OF MODERATE-INTENSITY AEROBIC EXERCISE

Moderate-intensity aerobic exercise includes activities like brisk walking, cycling, and swimming, performed at 50–70% of maximum heart rate (American College of Sports Medicine [ACSM], 2023). Such exercises enhance cardiovascular health, improve insulin sensitivity, and promote fat oxidation (Swift et al., 2025).

PHYSIOLOGICAL BENEFITS

- Studies indicate that moderate-intensity aerobic exercise:
- Reduces body fat percentage (Donnelly et al., 2023)
- Improves lipid profile by lowering LDL cholesterol (Katzmarzyk et al., 2023)
- Enhances insulin sensitivity, reducing type 2 diabetes risk (Ekelund et al., 2023)

PSYCHOLOGICAL AND COGNITIVE BENEFITS

Regular exercise has been linked to:

- Reduced symptoms of depression and anxiety (Biddle & Asare, 2023)
- Improved self-esteem and body image (Lubans et al., 2023)
- Better academic performance due to enhanced cognitive function (Hillman et al., 2023)

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CASE STUDY: OBESE BOYS IN PESHAWAR DISTRICT

CURRENT PHYSICAL ACTIVITY LEVELS

A survey by Ahmad et al. (2023) found that only 20% of boys in Peshawar engage in regular physical activity, with most time spent on sedentary behaviors like screen use.

BARRIERS TO EXERCISE

Key challenges include:

i. Lack of safe spaces for physical activity (Rehman et al., 2023)
ii. Cultural norms discouraging outdoor sports for boys (Khan & Shah, 2023)
iii. Limited school-based physical education programs (Ali et al., 2023)

EFFECTIVENESS OF MODERATE-INTENSITY AEROBIC INTERVENTIONS

A 12-week intervention study in Peshawar (Hussain et al., 2023) found that obese boys who engaged in 45-minute aerobic sessions five times per week showed:

- A 5% reduction in BMI
- Improved cardiovascular endurance
- Enhanced mood and motivation

METHODOLOGY

RESEARCH DESIGN

This study adopts a quasi-experimental, single-group pre-test/post-test design to evaluate the impact of a 12-week moderate-intensity aerobic exercise program on obesity-related indicators in obese boys aged 12–16 years in Peshawar District. The absence of a control group is due to logistical constraints, but the pre- and post-intervention comparisons provide meaningful insights into the effectiveness of the intervention.

STUDY POPULATION AND SAMPLING

TARGET POPULATION

The study focuses on obese adolescent boys (aged 12–16 years) from both government and private schools in Peshawar District.

INCLUSION CRITERIA

- Boys aged 12–16 years
- BMI ≥ 95th percentile for age and sex (as per WHO growth standards)
- No pre-existing medical conditions that restrict physical activity
- Parental consent and participant assent

EXCLUSION CRITERIA

- Participation in other structured exercise programs
- Chronic illnesses (e.g., cardiovascular disease, diabetes)
- Use of medications affecting weight or metabolism

SAMPLING TECHNIQUE

A purposive sampling technique was used to recruit 50 obese boys from schools in Peshawar. Schools were selected based on accessibility and willingness to participate.

DATA COLLECTION METHODS

ANTHROPOMETRIC MEASUREMENTS

Body Mass Index (BMI): Weight (kg) and height (m) were measured using a digital scale and stadiometer. BMI was calculated as weight/height^2 (kg/m^2).

WAIST CIRCUMFERENCE: Measured at the midpoint between the lower rib and iliac crest using a non-stretchable tape.

BODY FAT PERCENTAGE: Assessed using bioelectrical impedance analysis (BIA) scales.

EXERCISE INTERVENTION

Duration: 12 weeks

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Frequency: 5 sessions per week (Monday–Friday)
Intensity: Moderate (50–70% of maximum heart rate, estimated as 220 – age)

EXERCISE PROTOCOL

- Warm-up (10 min): Stretching and light jogging
- Aerobic exercises (30 min): Brisk walking, jogging, cycling, and sports (e.g., football)
- Cool-down (10 min): Stretching and relaxation

ADHERENCE MONITORING

1. Attendance logs
2. Heart rate monitors to ensure exercise intensity
3. Weekly follow-ups with participants and parents

DIETARY AND LIFESTYLE ASSESSMENT

A brief questionnaire assessed dietary habits and physical activity levels before and after the intervention to account for confounding factors.

ANALYSIS

DESCRIPTIVE STATISTICS (PRE- AND POST-INTERVENTION)

TABLE 1: MEAN CHANGES IN OBESITY INDICATORS (N=50)

Indicator	Pre-Intervention (Mean ± SD)	Post-Intervention (Mean ± SD)	Mean Difference	p-value
BMI (kg/m²)	28.5 ± 2.3	27.1 ± 2.1	-1.4	<0.001*
Waist Circumference (cm)	92.4 ± 5.7	88.6 ± 5.2	-3.8	<0.001*
Body Fat (%)	32.6 ± 3.4	30.2 ± 3.1	-2.4	<0.001*

BMI decreased significantly by 1.4 kg/m² ($p < 0.001$), indicating a reduction in overall body weight relative to height. Waist circumference reduced by 3.8 cm ($p < 0.001$), suggesting a decrease in abdominal fat, a key risk factor for metabolic diseases. Body fat percentage declined by 2.4% ($p < 0.001$), confirming fat loss due to aerobic exercise.

CORRELATION BETWEEN EXERCISE ADHERENCE AND OBESITY REDUCTION

TABLE 2: PEARSON CORRELATION (EXERCISE ATTENDANCE VS. CHANGE IN OBESITY MARKERS)

Variable	Correlation Coefficient (r)	p-value
BMI Reduction	-0.62	<0.001*
Waist Circumference Reduction	-0.58	<0.001*
Body Fat % Reduction	-0.55	<0.001*

A strong negative correlation exists between exercise adherence and obesity markers ($r \approx -0.55$ to -0.62, $p < 0.001$). Participants with higher attendance showed greater reductions in BMI, waist circumference, and body fat percentage.

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COMPARISON BETWEEN GOVERNMENT AND PRIVATE SCHOOL PARTICIPANTS

TABLE 3: MEAN DIFFERENCES BY SCHOOL TYPE

Indicator	Government School (n=20)	Private School (n=30)	p-value
BMI Reduction (kg/m²)	-1.2 ± 0.4	-1.5 ± 0.5	0.023*
Waist Reduction (cm)	-3.2 ± 0.8	-4.1 ± 1.0	0.008*
Body Fat % Reduction	-2.0 ± 0.6	-2.6 ± 0.7	0.015*

The comparison between government and private school participants revealed statistically significant differences in obesity reduction, with private school students showing greater improvements in BMI (-1.5 vs -1.2 kg/m², p=0.023), waist circumference (-4.1 vs -3.2 cm, p=0.008), and body fat percentage (-2.6% vs -2.0%, p=0.015). These findings suggest that private school students responded better to the aerobic exercise intervention, which may be attributed to factors such as higher baseline obesity levels, better compliance, or more supportive school environments for physical activity. The consistent pattern of greater reductions across all three obesity indicators in private schools highlights potential socioeconomic or institutional influences on the effectiveness of exercise interventions for adolescent obesity management.

EFFECT SIZE (COHEN'S D) FOR KEY OUTCOMES

TABLE 4: EFFECT SIZE OF AEROBIC EXERCISE INTERVENTION

Outcome	Effect Size (d)	Interpretation
BMI Reduction	0.65	Moderate effect
Waist Circumference Reduction	0.72	Moderate to large effect
Body Fat % Reduction	0.58	Moderate effect

The effect size analysis revealed that the aerobic exercise intervention had a clinically meaningful impact across all obesity measures, with moderate effects on BMI reduction (d=0.65) and body fat percentage (d=0.58), and a moderate-to-large effect on waist circumference reduction (d=0.72). These results indicate that the program was particularly effective at reducing abdominal adiposity, as evidenced by the strongest effect size for waist circumference, which is significant since abdominal fat carries greater metabolic risks. The consistent moderate effect sizes across all three outcomes demonstrate that the 12-week moderate-intensity aerobic exercise program produced substantial, clinically relevant improvements in obesity markers among adolescent boys.

CONCLUSION

This study examined the impact of a 12-week moderate-intensity aerobic exercise program on obesity-related indicators among obese boys aged 12–16 years in Peshawar District. The findings demonstrated significant reductions in BMI, waist circumference, and body fat percentage, reinforcing the effectiveness of structured aerobic exercise in managing adolescent obesity. The intervention also revealed that private school students exhibited

greater improvements compared to their government school counterparts, suggesting potential socioeconomic or institutional influences on exercise adherence and outcomes.

The strong negative correlation between exercise adherence and obesity markers further highlights the importance of consistent physical activity in weight management. Additionally, the moderate to large effect sizes (Cohen's *d* = 0.58–0.72) indicate clinically meaningful benefits, particularly in reducing abdominal fat, which is a critical risk factor for metabolic diseases.

Despite its limitations—such as a small sample size, short duration, and lack of a control group—this study provides valuable insights for public health strategies in Peshawar and similar regions. Schools, parents, and policymakers should prioritize integrating structured aerobic exercise programs into adolescents' routines to combat the growing obesity epidemic. Future research should explore long-term sustainability, dietary influences, and tailored interventions for different socioeconomic groups to enhance obesity prevention and management efforts.

KEY RECOMMENDATIONS

SCHOOL-BASED INTERVENTIONS: Incorporate daily moderate-intensity aerobic exercises into school curricula to promote consistent physical activity.

COMMUNITY AWARENESS: Educate parents and guardians on the benefits of aerobic exercise to encourage support for active lifestyles at home.

POLICY DEVELOPMENT: Advocate for government and NGO-funded programs to provide safe exercise spaces and resources, especially in underserved areas.

FURTHER RESEARCH: Conduct longitudinal studies with larger, diverse samples to assess long-term adherence and additional health impacts.

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