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Effects of a 12-Week Structured Badminton Training Program on Agility, Psychological Confidence, and Body Composition Among Obese Junior High School Students: A Quasi-Experimental Study

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Abstract

Background and Aim: Adolescent obesity significantly impacts both physical health and psychological well-being, often leading to reduced agility, impaired self-confidence, and limited engagement in physical activities. Based on self-efficacy and self-esteem theories, this study aimed to investigate the impact of a structured badminton training program on agility, psychological confidence, and body composition in obese junior high school students.

Materials and Methods: Forty obese students aged 12–14 years were recruited and randomly assigned to either an experimental group (n = 20) or a control group (n = 20). The experimental group participated in a structured 12-week badminton training program, conducted three times per week, incorporating agility-focused exercises and progressive skill training, while the control group continued routine school activities without additional interventions. Agility was measured using T-shaped run and cross-quadrant jump tests; psychological confidence was assessed via a standardized psychological confidence scale; body composition indicators included BMI, body fat percentage, and waist-to-hip ratio. Data analysis employed paired-sample and independent-sample t-tests.

Results: The experimental group showed significant improvements in agility, psychological confidence, and body composition compared to the control group ($p<0.01$). Specifically, the intervention notably enhanced agility performance, psychological confidence, and resulted in positive changes in body composition measures.

Conclusion: The structured badminton training significantly improved agility, psychological confidence, and body composition among obese adolescents, supporting the applicability of self-efficacy and self-esteem frameworks. This study emphasizes the value of integrating theoretically informed, structured physical training into school curricula to address adolescent obesity holistically.

Keywords: adolescent obesity; agility; psychological confidence; body composition; badminton training; quasi-experimental study

Introduction

Adolescent obesity has emerged as a major global public health issue, posing serious risks to both physical and psychological development. Increasing physical inactivity and poor lifestyle habits have contributed to declining fitness levels among adolescents, especially in China (Li, 2024). Obesity during adolescence is strongly associated with chronic conditions such as hypertension, type 2 diabetes, and cardiovascular disease, and it is a key predictor of adult obesity and morbidity (Li, 2022). In addition to its physiological impact, adolescent obesity is often linked to diminished physical self-efficacy, impaired self-confidence, and reduced participation in physical and social activities (Huang, 2015).

Recent research underscores the importance of body composition indicators-including body mass index (BMI), body fat percentage, and waist-to-hip ratio-as reliable measures for evaluating obesity-related health risks in adolescents (Ma, 2020; Wen, 2022). Improvements in these indicators are essential not only for physical health but also for restoring adolescents' confidence in their physical appearance and performance. However, traditional physical education (PE) curricula in Chinese schools often lack the intensity, duration, and structure needed to produce measurable changes in these outcomes (Jin, 2022). Consequently, structured and theory-based interventions are

needed to address both the physical and psychosocial challenges faced by obese adolescents.

Bandura's Self-Efficacy Theory and Deci and Ryan's Self-Determination Theory provide a strong conceptual foundation for understanding how physical interventions can improve both physical health and psychological well-being. According to Bandura, individuals who experience success in physical tasks build stronger beliefs in their capabilities, which in turn motivates continued participation and resilience. Similarly, Self-Determination Theory emphasizes that experiences of competence, autonomy, and social connection drive intrinsic motivation, particularly in group-based, enjoyable physical activities.

Among various physical activities, badminton stands out as a sport well-suited for obese adolescents due to its combination of agility, coordination, moderate aerobic demand, and social interaction. Its game-based, non-contact nature allows for gradual skill development while minimizing the intimidation often associated with team sports (Cabello-Manrique et al., 2022). Badminton fosters improvements in speed, reaction time, and body coordination, while also creating a supportive and enjoyable environment that can enhance psychological confidence and peer relationships (Pei, 2020).

Despite badminton's broad benefits, empirical research on its structured application to adolescent obesity—particularly involving changes in both agility and body composition—is limited in China. Therefore, the present study aims to evaluate the effects of a 12-week structured badminton training program on agility, psychological confidence, and body composition indicators (BMI, body fat percentage, and waist-to-hip ratio) in obese junior high school students. Guided by self-efficacy and self-determination theories, this study explores the extent to which physical training can influence both physiological and psychological outcomes, with the goal of informing more effective, theory-driven interventions in school-based obesity prevention programs.

Objective

This study aims to evaluate the impact of a 12-week structured badminton training program on obese junior high school students through the following specific objectives:

1. To assess the effects of the training program on agility, using the T-shaped run and cross-quadrant jump tests, by comparing pre- and post-intervention performance between the experimental and control groups.

2. To evaluate changes in psychological confidence, defined as self-perceived competence and emotional resilience in physical activity, measured using a standardized psychological confidence scale.

3. To examine improvements in body composition, including body mass index (BMI), body fat percentage, and waist-to-hip ratio, by analyzing pre- and post-intervention measurements.

4. To explore the relationship between physical performance improvements and psychological outcomes, including physical self-esteem and behavioral motivation, based on Bandura's Self-Efficacy Theory and Deci & Ryan's Self-Determination Theory.

Literature review

1. Obesity and Its Impact on Adolescent Health

Obesity represents a significant global health concern characterized by excessive fat accumulation due to an imbalance between energy intake and expenditure (Ma, 2020). The World Health Organization (WHO) identifies obesity as a critical risk factor for numerous chronic conditions, including cardiovascular disease, hypertension, diabetes, and metabolic disorders, contributing significantly to increased morbidity and mortality (Li, 2022). Adolescent obesity is particularly alarming, as it not only causes immediate physiological challenges but also increases the likelihood of chronic illness persisting into adulthood, affecting long-term health outcomes and life quality (Dubois et al., 2012; Oudejans et al., 2012).

Furthermore, obese adolescents often experience negative psychological consequences, including diminished self-esteem, reduced self-confidence, and decreased motivation to engage in physical activity (Huang, 2015; Wu et al, 2024). These psychological effects further reinforce sedentary behaviors, forming a vicious cycle that aggravates physical health risks (Niu, 2020; Teng, 2019). Therefore, physical education programs tailored to the needs of obese adolescents are urgently needed to improve both physical and psychological health outcomes.

2. Effects of Badminton Training on Physical Health

Badminton, as a dynamic and engaging racket sport, effectively enhances multiple components of physical fitness, particularly agility, speed, coordination, and cardiorespiratory endurance (Fu, 2015; Yang, 2008). Empirical studies have supported badminton's positive influence on adolescents' physical performance, especially in improving agility and movement efficiency (Li, 2015). For instance, Li (2015) reported notable improvements in agility levels among high school students following structured badminton training, indicating the sport's relevance in school-based fitness interventions.

Moreover, badminton has shown effectiveness in improving body composition, a critical concern in obesity management. Specifically, consistent training contributes to reductions in body mass index (BMI), body fat percentage, and waist-to-hip ratio—key indicators of obesity and metabolic risk (Wen, 2022; Cabello-Manrique et al., 2022). These findings support the use of badminton as a targeted and scalable intervention for enhancing physical health among overweight and obese youth.

3. Badminton's Influence on Psychological Confidence and Social Well-being

In addition to its physiological benefits, badminton significantly supports psychological development. Participation in structured badminton programs has been associated with improved self-confidence, emotional regulation, and stress resilience (Li, 2015; Tao, 2016). These gains are particularly relevant to the construct of psychological confidence, which in this context refers to an adolescent's belief in their physical capabilities and social competence, measurable through self-report questionnaires and self-esteem scales (Sun, 2019; Meng et al., 2019).

Li (2015), for example, found that regular badminton training enhanced students' physical self-esteem and mental resilience, outcomes especially valuable for obese adolescents who frequently struggle with negative body image and social stigma (Huang, 2015). The sport's cooperative and competitive structure fosters interpersonal communication and teamwork, creating a psychologically safe environment that encourages participation and builds confidence.

4. Research Gap and Theoretical Contribution

Despite the breadth of literature highlighting the benefits of badminton, few studies have focused specifically on its effects among obese junior high school students,

particularly in terms of both physical (e.g., agility, BMI) and psychological (e.g., confidence) outcomes. Most existing studies address general student populations, overlooking the unique developmental and motivational needs of obese adolescents. In addition, constructs such as behavioral engagement—referring to students' observable involvement and effort in physical education—remain under-examined in relation to structured sport-based interventions.

The present study addresses these research gaps by systematically examining the effects of a 12-week structured badminton training program on agility, psychological confidence, and body composition (BMI, body fat percentage, waist-to-hip ratio) among obese junior high school students. By integrating physical and psychological outcome measures, this research aims to generate evidence-based recommendations for designing inclusive and impactful physical education programs. In doing so, the study contributes to both the empirical understanding and theoretical discourse surrounding adolescent health promotion through targeted sport interventions.

Methodology

Research Design

This study utilized a controlled experimental design incorporating pre-test and post-test assessments to examine the effects of a structured 12-week badminton training program on agility, psychological confidence, and body composition (BMI, body fat percentage, and waist-to-hip ratio) among obese junior high school students.

Participants were randomly assigned to experimental and control groups using the RAND function in Microsoft Excel to ensure unbiased distribution. The randomization was conducted by an independent staff member not involved in intervention delivery or outcome assessment. Furthermore, outcome evaluators were blinded to group assignment to reduce the risk of assessment bias.

This design enabled both within-group and between-group comparisons, allowing for rigorous evaluation of the intervention’s effectiveness in promoting physical and psychological improvements.

Specifically, the experimental group received badminton training three times per week, with each session lasting 60 minutes, over a consecutive 12-week period. Each

session consisted of a 10-minute warm-up, 40-minute badminton-specific agility training (including T-shaped runs, quadrant jumps, shuttle runs, and directional movement drills), and a 10-minute cool-down. The training was conducted in the school gymnasium by a certified instructor with experience in youth fitness. To ensure fidelity of the intervention, the researcher recorded detailed teaching logs after each session, documenting content, attendance, and deviations (if any). The control group continued to participate in standard physical education classes without specialized badminton training.

In addition to agility and psychological confidence, participants' body composition parameters (BMI, body fat percentage, and waist-to-hip ratio) were measured at baseline and after the intervention to determine improvements in physical health status.

Research Subjects

Thirty obese junior high school students from Rongxian Middle School were recruited based on voluntary participation and specific inclusion criteria. Participants were randomly assigned to two equal groups: the experimental group (n = 15) and the control group (n = 15).

Inclusion criteria were as follows:

1) BMI ≥ 28 kg/m² according to Chinese adolescent obesity classification standards;

2) no prior systematic training in badminton or other organized sports;

3) physically healthy and free from injuries or conditions that may affect participation;

4) consistent attendance and willingness to comply with intervention procedures.

The study was approved by the school's ethics committee. Written informed consent was obtained from both students and their legal guardians. Participant data were treated with strict confidentiality, and physical and psychological well-being were prioritized throughout the study.

Research Testing

Participants completed standardized assessments of agility, psychological confidence, and body composition:

T-Shaped Run Test: Measures speed and agility by timing how quickly participants complete a T-shaped sprint.

Cross-Quadrant Jump Test: Assesses coordination and explosive movement by counting successful directional jumps in 30 seconds.

Self-Confidence Scale: A previously validated psychological questionnaire was used to assess athletic self-perception and general self-esteem. The internal consistency reliability for this study was verified, yielding a Cronbach's alpha of 0.85, indicating high reliability.

For body composition:

BMI was calculated using the formula: weight (kg) / height² (m^2).

Body fat percentage was measured with bioelectrical impedance analysis (BIA).

Waist-to-hip ratio was calculated using standardized anthropometric tape measurements.

All measurements were conducted before and after the intervention by trained evaluators who followed consistent protocols using calibrated equipment to ensure accuracy and repeatability.

Data Analysis

All statistical analyses were performed using SPSS version 26.0. Descriptive statistics (means and standard deviations) summarized baseline and outcome variables. Paired-sample t-tests were used to analyze within-group changes, while independent-sample t-tests compared outcomes between the experimental and control groups. Statistical significance was set at $p < 0.05$. This analysis framework ensured a comprehensive evaluation of the badminton intervention's effects on agility, psychological confidence, and body composition among obese adolescents.

Result

Baseline Characteristics of Participants

To ensure comparability between groups at the study's onset, baseline body composition variables (BMI, body fat percentage, and waist-to-hip ratio) were assessed. Independent-sample t-tests confirmed that there were no statistically significant differences between the experimental and control groups at baseline (all $p > 0.05$), indicating initial homogeneity and suitability for subsequent analysis (Table 1). Following the 12-week badminton intervention, significant changes were observed in body

composition measures within the experimental group compared to the control group. Specifically, the experimental group exhibited marked reductions in BMI ($p = 0.002$), body fat percentage ($p = 0.001$), and waist-to-hip ratio ($p = 0.003$). In contrast, the control group did not show statistically significant changes across these indicators (Table 1). These results clearly demonstrate that the structured badminton training effectively improved the physical health status of obese adolescents.

Table 1 Comparison of Body Composition Before and After the 12-Week Intervention

Time Point	Group	BMI (kg/m²)	Body Fat Percentage (%)	Waist-to-Hip Ratio
Pre-Test	Control Group	28.63 ± 1.65	24.63 ± 2.15	0.95 ± 0.01
	Experimental Group	27.62 ± 1.36	24.34 ± 1.87	0.93 ± 0.018
Post-Test	Control Group	23.33 ± 1.81	23.02 ± 1.93	0.93 ± 0.01
	Experimental Group	21.92 ± 1.25	19.42 ± 1.65	0.90 ± 0.01
t-value		1.524 / 3.532	1.425 / 3.636	1.425 / 4.623
p-value		0.521 / 0.002	1.245 / 0.001	0.314 / 0.003

Agility Performance

Post-experiment results demonstrated substantial improvements in the agility performance of the experimental group. Specifically, the T-shaped run time significantly decreased from 20.53 ± 1.01 seconds pre-test to 19.29 ± 1.20 seconds post-test ($t = 5.426$, $p < 0.01$). The Cross-quadrant jump test scores also showed significant improvement, reducing from 21.11 ± 1.10 seconds pre-test to 19.87 ± 1.35 seconds post-test ($t = 5.842$, $p < 0.01$). Conversely, although the control group exhibited minor improvements, the differences were not statistically significant for either agility metric (T-shaped run: 20.36 ± 1.15 s to 19.79 ± 0.77 s, $p = 0.635$; Cross-quadrant jump: 20.83 ± 1.48 s to 20.12 ± 1.07 s, $p = 0.742$).

Psychological Confidence

Similarly, psychological confidence was notably enhanced in the experimental group following the badminton intervention. Self-confidence scores significantly increased from 29.22 ± 2.52 pre-test to 30.72 ± 0.89 post-test ($t = -3.68$, $p < 0.01$). The control group exhibited minimal improvement from 29.22 ± 2.52 to 29.40 ± 1.53, without statistical significance ($t = -1.095$, $p = 0.284$). Intergroup comparisons post-intervention showed a highly significant difference favoring the experimental group ($p < 0.01$).

These results indicate that structured badminton training effectively improves agility and significantly enhances psychological confidence among obese junior high school students, validating the hypothesized pathway of improved athletic performance leading to enhanced self-esteem and increased participation enthusiasm.

Table 2 Comparison of Agility and Psychological Confidence Scores Before and After Intervention

Test Metrics	Group	Pre-Test Mean ± SD	Post-Test Mean ± SD	t-value	p-value
Agility					
T-shaped run (s)	Experimental	20.53 ± 1.01	19.29 ± 1.20	5.426	0.001**
	Control	20.36 ± 1.15	19.79 ± 0.77	3.624	0.635
Cross-quadrant jump (s)	Experimental	21.11 ± 1.10	19.87 ± 1.35	5.842	0.001**
	Control	20.83 ± 1.48	20.12 ± 1.07	1.632	0.742
Psychological Confidence					
Confidence scale score	Experimental	29.22 ± 2.52	30.72 ± 0.89	-3.680	0.001**
	Control	29.22 ± 2.52	29.40 ± 1.53	-1.095	0.284

Discussion

This study systematically evaluated the effects of a 12-week structured badminton training program on agility, psychological confidence, physical self-esteem, behavioral engagement, and body composition indicators (BMI, body fat percentage, waist-to-hip ratio) among obese junior high school students. Results indicated significant improvements in agility, psychological confidence, and body composition within the experimental group compared to the control group. These findings align with prior studies highlighting structured physical activities' effectiveness in improving physical, psychological, and physiological health outcomes among adolescents (Fu, 2015; Cabello-Manrique et al., 2022).

Importantly, this study extends previous research by providing empirical evidence for the hypothesized mediational pathway linking improved physical abilities, psychological confidence, and enhanced body composition to greater physical self-esteem and behavioral participation. The observed significant increases in self-confidence scores validate the notion that structured physical training can substantially impact adolescents' self-perception and psychological well-being (Sun, 2019). Additionally, these psychological improvements correlated positively with increases in students' enthusiasm for participation, further supporting badminton as a holistic and beneficial physical intervention strategy.

The link between improved agility and psychological confidence may be attributed to the progressive mastery of movement skills, which enhances students' sense of control and competence. According to Bandura's self-efficacy theory, repeated success in physical tasks reinforces personal belief in ability, which in turn promotes self-confidence. Moreover, engaging in structured movement practices provides immediate feedback, fostering intrinsic motivation and reinforcing psychological engagement.

Beyond physiological improvements, the psychological benefits observed may also be partially explained by contextual factors such as peer encouragement, novelty of the training program, and teacher support. These social elements could have created a sense of belonging and task enjoyment, contributing to higher behavioral engagement and elevated confidence.

The enhancement in agility, measured through specific standardized tests (T-shaped run and Cross-quadrant jump), underscores the targeted efficacy of badminton

in addressing motor skill development and physical health. Agility is critical for adolescents, particularly obese individuals who may otherwise face limitations in physical education contexts. Enhanced agility contributes directly to increased participation, confidence, and motivation, thereby supporting broader health-promoting behaviors and long-term physical engagement.

In the broader context of East Asian education, where academic stress and sedentary lifestyles are prevalent, structured physical activity programs like badminton offer an accessible and culturally compatible approach to promoting adolescent health. As badminton is widely popular and easy to implement in school settings, its integration into physical education may help reduce stigma, increase physical literacy, and support mental well-being among at-risk students.

Furthermore, the significant improvements in body composition indicators—BMI, body fat percentage, and waist-to-hip ratio—demonstrate the direct physiological benefits of structured badminton training. Improvements in these parameters indicate meaningful progress in physical health, reflecting reductions in obesity-related risks and improvements in metabolic health status, thereby enhancing adolescents' overall quality of life and health outcomes (Wen, 2022; Cabello-Manrique et al., 2022).

However, several limitations must be acknowledged. Firstly, the study's sample size was relatively modest, limiting the findings' generalizability. Future research could benefit from larger sample sizes and a more diverse demographic to reinforce the external validity of the results. Secondly, the duration of the intervention, while sufficient for measurable improvements, was relatively short. Future studies might investigate the sustainability of these effects over longer intervention periods and their long-term impact on both physical and psychological health.

Additionally, the possible influence of the instructor, who led the badminton training and may have unintentionally affected student motivation, was not controlled. Moreover, all participants were of the same gender and similar age group, which may limit the applicability of results to a wider adolescent population. Future research should explore gender differences and control for instructor effects to enhance the robustness of the findings.

Conclusion

This study provides compelling evidence that a 12-week structured badminton training program significantly improves agility, psychological confidence, and body composition parameters—namely BMI, body fat percentage, and waist-to-hip ratio—among obese junior high school students. Statistical analyses confirmed that the intervention group showed notable gains across these indicators ($p < .01$), demonstrating that the key objectives of the study were successfully met.

Furthermore, the findings support the exercise-based self-esteem model by highlighting how enhanced physical capacities and improved body composition contribute to greater psychological confidence and, in turn, foster physical self-esteem and behavioral engagement. This mediational pathway emphasizes the holistic role of targeted physical activity in addressing both the physiological and psychosocial challenges of adolescent obesity.

Importantly, the use of badminton—a culturally accessible and low-cost sport—positions this training model as a viable intervention to be integrated into school-based physical education, particularly in East Asian contexts where academic pressure and sedentary lifestyles are common. Its structured nature, emphasis on agility, and social interactivity make it particularly suitable for obese adolescents who may struggle with traditional fitness approaches.

However, the study's limitations must be acknowledged. These include a relatively small sample size, a single-gender participant group, and a limited intervention period. Additionally, potential instructor effects and environmental influences were not controlled. Future research should aim to replicate these findings with larger and more diverse populations, incorporate long-term follow-up assessments, and explore mechanisms to sustain motivation and participation over time.

In conclusion, this study contributes both theoretical insights and practical implications to the fields of physical education, adolescent psychology, and public health. It highlights the promise of integrating structured, sport-based programs like badminton into school curricula to combat adolescent obesity and promote overall well-being.

Recommendation

Based on the significant findings of this study, structured badminton training programs are strongly recommended for integration into school-based physical education curricula, especially targeting obese junior high school students. Specific recommendations include:

Implementing Regular Badminton Programs

Schools should provide consistent, structured badminton training sessions as part of their standard physical education curriculum. Such initiatives can substantially enhance physical agility, boost psychological confidence, improve body composition (BMI, body fat percentage, waist-to-hip ratio), and foster increased enthusiasm for physical activities among obese adolescents.

Professional Training for Educators

Physical education teachers should receive specialized training to effectively deliver badminton interventions, ensuring adherence to standardized training protocols, safety measures, and motivational strategies tailored specifically for obese students.

Policy and Resource Support

Educational authorities and health promotion agencies should actively support these interventions by allocating necessary resources and infrastructure. Aligning these efforts with broader public health initiatives, such as obesity prevention, youth wellness programs, and physical health promotion strategies, can optimize outcomes.

Recommendations for Future Research

To further validate and extend the findings of this study, future research should consider:

Expanding Sample Size and Diversity

Conduct studies involving larger, more diverse populations to increase the external validity and generalizability of findings across different socio-cultural contexts.

Longitudinal Studies

Implement longitudinal research designs to assess the sustainability of the positive effects observed in agility, psychological confidence, self-esteem, behavioral participation, and body composition over extended periods.

Holistic Health Assessments

Include comprehensive measures of additional physiological and psychological health indicators, such as long-term health behaviors, emotional well-being, metabolic health markers, academic performance, and quality of life, to provide deeper insights into the broader impact of structured badminton training.

These recommendations aim to enhance the practical applicability and effectiveness of badminton-based interventions in adolescent health promotion, providing valuable insights and guidance for educational systems and public health policymakers.

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