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Effects of High Intensity Interval Games (Leisure Basketball) MSSG and High Intensity Interval Training HIIT on Body Composition and Lipid Metabolism in Obese College Students

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Abstract: To investigate the effects of Modified Small-Sided Games (MSSG) and Tabata High-Intensity Interval Training (HIIT) on body composition and lipid metabolism in obese college students, this study employed an experimental design with 30 enrolled participants. The comparative analysis between these two exercise regimens demonstrated that both high-intensity interval games (including recreational basketball) and HIIT effectively reduced body weight and improved lipid profiles among the subjects. However, HIIT showed slightly superior efficacy. These findings indicate that recreational basketball-based high-intensity interval training holds significant potential for practical implementation and promotion in obesity management programs.

Keywords: obesity; high intensity interval game; high intensity interval training; body composition; blood lipid metabolism

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1. Preface

Obesity, defined as excessive fat accumulation in the body, is the world's most prevalent chronic metabolic disorder affecting both children and adults, posing widespread health risks. Excessive obesity is a leading cause of chronic diseases including atherosclerotic cardiovascular disease. This complex condition involves multiple factors such as diet, developmental stage, age, physical activity, and genetics. Studies have shown that obese individuals exhibit significantly elevated lipid parameters except for high-density lipoprotein (HDL) levels, while HDL levels show marked reduction. The strong correlation between obesity and dyslipidemia highlights the critical importance of managing these lipid abnormalities for obesity prevention. High-intensity interval training (HIIT), recognized as an efficient exercise method to improve cardiovascular and metabolic health, has gained significant attention. Notably, this training regimen has effectively reduced cardiometabolic risk factors in adolescents, making it a promising alternative approach for youth health improvement. HIIT, characterized by alternating periods of high-intensity exercise with rest intervals, has become increasingly popular in recent years for enhancing cardiorespiratory fitness, strengthening muscle power, and optimizing body composition. High-intensity interval games, such as casual basketball, which combine the fun of exercise with the

characteristics of high-intensity interval training, may also have a positive impact on the body. Especially in the context of the increasingly serious problem of obesity, it is particularly important to explore the effects of these two forms of exercise on the body composition and lipid metabolism of obese college students[1].

With the improvement of living standards and changes in dietary patterns, obesity has become an increasingly severe global issue, particularly among younger populations. Obesity not only affects individuals' appearance and self-confidence, but more importantly, it is closely linked to various chronic diseases such as cardiovascular disorders and diabetes. Therefore, finding effective weight loss methods to improve body composition and lipid metabolism in obese individuals has remained a key research focus in medical and health fields[2].

High-Intensity Interval Training (HIIT), an emerging exercise paradigm, achieves rapid energy expenditure through alternating high-intensity bursts with low-intensity periods or rest intervals. Research confirms its effectiveness in enhancing cardiovascular endurance, reducing body fat, and improving body composition. Its adaptability makes HIIT suitable for people of all ages and fitness levels. Meanwhile, high-intensity interval games like recreational basketball have gained popularity among young adults. These activities blend competition with entertainment, allowing participants to enjoy physical activity while achieving fitness goals. By increasing intensity and fun, such games may stimulate obesity-related college students' interest in exercise, encouraging more active participation. However, comparative studies on the effects of high-intensity interval games versus training on body composition and lipid metabolism in obese students remain scarce. This study investigates their respective impacts on physical health. Through comparative analysis, we aim to uncover how different exercise formats influence obesity-related health mechanisms, providing scientific evidence for personalized workout prescriptions. Obesity often causes psychological stress and self-esteem issues, affecting social and academic performance. Therefore, developing exercise methods that improve physical condition while boosting confidence becomes crucial. High-intensity interval training and high-intensity interval games may be just such an ideal form of exercise, which not only help with weight loss and improve lipid metabolism, but also improve the self-confidence and social skills of obese college students by improving their performance and teamwork.

Furthermore, with technological advancements and evolving lifestyles, modern college students generally lack sufficient physical activity. High-intensity interval training (HIIT) and HIIT games, characterized by their efficiency and engaging nature, may prove more accessible and sustainable for this demographic. By investigating how these two exercise formats affect body composition and lipid metabolism in obese college students, we can provide robust evidence to promote healthy lifestyles and support obesity prevention and control. This study compares high-intensity interval games with HIIT exercises, analyzing their respective impacts on body composition and lipid metabolism among obese students.

2. Materials and Methods

2.1. Experimental subjects

Through WeChat groups, campus bulletin boards, and student organizations, 30 male college students with overweight or obesity were recruited and randomly divided into two groups: the MSSG group (15 participants) and the HIIT group (15 participants). The average age was 20.2±1.2 years. Selection criteria included: (1) Overweight or obese individuals (BMI ≥24 kg/m² or obesity BMI ≥28 kg/m2); (2) No significant changes in physical indicators within the past three months; (3) No contraindications to exercise, such as recent injuries or conditions like hypertension, osteoporosis, heart disease, or anemia; (4) No use of nutritional supplements or medications during the study period, and no participation in additional weight-loss programs.

Before the exercise training, interview method and questionnaire method were used to understand the daily intake of subjects. Subjects were required to keep their diet unchanged for 3 months to ensure that the intake time was consistent with that in the month before the experiment.

Prior to exercise intervention (Week 0) and post-intervention (Week 12), the research team recruited 30 participants for body composition measurements. These included weight, height, BMI, waist circumference, hip circumference, waist-

to-height ratio (WHR), maximal oxygen uptake (Bleep Test), and skinfold thickness measurements at the triceps, upper iliac muscle, abdomen, and thighs. Participants were also organized to undergo fasting blood lipid profile testing at a hospital near their school.

2.2. Exercise plan

Participants in the experimental group underwent a 12-week training program with three sessions per week. Each participant was required to perform a standardized 15-minute warm-up before starting exercise. The warm-up involved systematic stretching of the entire body from head to toe, preparing participants for both MSSG and HIIT training. A 5-minute cool-down period followed each training session.

The exercise protocol for the high-intensity interval training (HIIT) group was as follows: Fifteen participants in the HIIT group performed Tabata workouts while wearing FitMao smart fitness bracelets to monitor heart rate at their left elbow joints. Each session featured 4-minute Tabata videos played with audio cues. The workout consisted of eight exercises (including jump squats, high knees, bodyweight squats, back kicks, alternating leg twists, jump squats, lunges, and burpees) performed in sets of four minutes. After each set, a 3-minute passive recovery period was followed by immediate repetition of the high-intensity training. This cycle continued until participants completed 4-6 complete sets.

The exercise protocol for the High Intensity Interval Game (Leisure Basketball) group is as follows: The MSSG training duration matches Tabata training, with each session strictly controlled to 4 minutes (Ulltani et al., 2022). Participants will compete in a 3v3 match on a half-court (15m×14m) using three players per team. Each participant will be randomly paired with a teammate (guard, forward, or center) and wear a FitMao smart fitness tracker to monitor heart rate. The training session will run continuously for 4 minutes, followed by a 3-minute passive recovery period between groups. This cycle repeats until participants complete 4-6 training sets.

2.3. Indicator Test

2.3.1. Body composition index

Body composition indicators include weight, height, hip circumference, waist circumference, BMI, skinfold thickness (BF and FM), and VO2max. For height and weight measurements, the Shengyuan SY-300 Height and Weight Measuring Device was used. The waist and hip circumferences were measured using a soft tape measure, while skinfold thickness was assessed with Harperden skinfold gauges (Baty International, West Sussex, UK) at four body sites: triceps, upper iliac muscle, abdomen, and thighs. Subsequently, based on the 1985 Jackson AS et al. four-point skinfold equation (used to calculate body fat percentage) —%bodyfat = (0.29288 × total skinfold area) - (0.0005 × squared total skinfold area) + (0.15845 × age) -5.76377 (where skinfold measurements are in mm), body fat percentage (%BF) and fat mass (FM) were calculated. The four-point skinfold equation for males was used to estimate body fat percentage and FM[3].

The Bleep Test was employed to estimate maximum heart rate (VO2max), with participants' peak heart rate recorded at the test conclusion. Ten subjects were assigned for each Bleep Test session. Prior to the official test, participants wore a FitMao smart fitness bracelet heart rate monitor on their left arm near the elbow joint to track their heart rate. A cone obstacle marker was placed 20 meters apart on the running track. Participants stood in front of one of two pre-marked 20-meter sprint lines, prepared in a standing start position while listening attentively to Beep music. Each participant adjusted their running speed to match the arrival of the corresponding cone. The test concluded when participants could no longer maintain the required speed or reach the next cone within the specified time. The total distance covered and the Level grade achieved through the number of round-trip runs were recorded as final results. Notably, the 20-meter shuttle run (commonly known as the Bleep Test) has been proven to be a reliable tool for predicting maximum oxygen uptake (VO2max) and is widely recognized as the gold standard for on-site aerobic fitness assessment.

The above indicators were tested twice, once before the start of the experiment and once after the end of the experiment.

2.3.2. Hematological indicators

At both pre-intervention (week 0) and post-intervention (week 12), all participants underwent standardized blood sampling at a hospital near Hainan Vocational University of Science and Technology. Blood samples were collected from the antecubital vein after 8 hours of fasting in the morning. The hospital's professional medical staff performed fasting blood draws using serum separation techniques to measure total cholesterol (TC), triglycerides (TG), high-density lipoprotein (HDL), and low-density lipoprotein (LDL)[4].

2.4. Data processing

In this study, SPSS27.0 statistical software was used for data processing. Paired t-tests were employed to compare pre-intervention and post-intervention outcomes across each indicator within the same group. Changes in indicators before and after intervention were calculated, with one-way ANOVA conducted to evaluate differences among groups. Results were presented as mean ± standard deviation (M ± SD), where $P < 0.05$ indicated significant differences and $P < 0.01$ indicated highly significant differences.

3. Research results

3.1. Changes of physical indicators of subjects before and after exercise intervention

Table 1 presents the post-intervention and pre-intervention body morphology data for both groups. The analysis reveals that after a 12-week exercise intervention, both groups demonstrated significant changes in body composition metrics. Specifically, the BIM index decreased by 5.3% in the high-intensity interval exercise (HIIE) group and 4.6% in the HIIT training group. The waist-to-hip ratio decreased by 3.2% and 1.1% respectively. Body fat percentage dropped by 9.3% and 7.4%, while fat mass decreased by 9.0% and 8.3% respectively, with statistically significant reductions ($P<0.01$). These findings confirm that both training methods effectively improved body composition in obese college students, though the HIIE group showed superior results compared to the HIIT group[5].

Table 1. Descriptive statistics of body composition indexes before and after intervention in Group 2

	High intensity interval play group		High intensity interval training group	
	Before the intervention	After the intervention	Before the intervention	After the intervention
BMI（kg/m2）	30.1±2.1	28.5±1.9	30.0±1.8	28.6±1.4
Waist-to-hipratio （%）	0.92±0.03	0.89±0.02	0.91±0.02	0.9±0.02
Body fat percentage (%)	29.8±3.2	27.0±3.5	29.7±2.8	27.5±2.7
FM(kg)	26.6±5.1	24.2±4.0	26.5±5.0	24.3±4.6
VO2max(mL/kg/min)	29.0±2.4	31.6±2.6	29.1±2.1	31.0±2.2

3.2. Changes of blood lipid indexes before and after exercise intervention

As shown in **Table 2**, post-experiment analysis revealed that both the high-intensity interval exercise group and the high-intensity interval training group demonstrated significant reductions in total cholesterol, triglycerides, and low-density lipoprotein (LDL) cholesterol levels, while high-density lipoprotein (HDL) cholesterol levels showed marked improvement. These findings indicate that both groups effectively improved lipid profiles in obese college students. Notably, the high-intensity interval exercise group exhibited slightly better changes in lipid indicators compared to the high-intensity interval training group[6].

Table 2. Descriptive statistics of blood lipid indexes before and after exercise intervention in two groups of subjects

	High intensity interval play group		High intensity interval training group	
	Before the intervention	**After the intervention**	**Before the intervention**	**After the intervention**
Total cholesterol (mmol/L)	4.7±0.4	4.0±0.4	4.8±0.5	4.1±0.5
Triglycerides (mmol/L)	2.5±0.7	1.8±0.5	2.4±0.6	2.0±0.5
Low density lipoprotein cholesterol (mmol/L)	3.5±0.4	3.3±0.3	3.7±0.4	3.5±0.4
High density lipoprotein cholesterol (mmol/L)	1.2±0.2	1.5±0.3	1.2±0.1	1.4±0.2

4. Conclusion

Comparative value of high intensity interval game (leisure basketball) MSSG and high intensity interval training HIIT on body composition and lipid metabolism of obese college students

In today's world where obesity has become an increasingly prominent issue, the prevalence of obesity among college students is particularly concerning. This not only affects their appearance but also poses potential health risks. High-Intensity Interval Training (HIIT) and Moderate-Slow-Intensity Games (MSSG), as two innovative exercise methods, have demonstrated unique value in improving body composition and lipid metabolism among obese college students.

From the perspective of improving body composition, both Moderate-Intensity Strength and Conditioning (MSSG) and High-Intensity Interval Training (HIIT) can positively impact weight and body fat percentage among obese college students. HIIT is typically characterized by alternating high-intensity exercises with brief rest periods, such as sprinting followed by slow walking recovery. This training method burns a significant amount of energy in a short time, and after exercise, the body remains in a high metabolic state that continues to burn calories, effectively reducing fat accumulation. For obese college students, long-term adherence to HIIT can significantly lower body weight and body fat percentage, leading to more balanced body composition[7].

MSSG uses casual basketball as a vehicle to integrate game elements, making the exercise process more engaging and participatory. In basketball games, participants need to constantly run, jump, and pivot—movements that fully engage the entire body's muscles, particularly the lower limbs and core muscles. Compared to traditional basketball training, MSSG emphasizes the fun and unpredictability of the game, allowing participants to complete high-intensity workouts unconsciously. This approach also increases energy expenditure, promotes fat breakdown, and improves body composition. Moreover, due to its playful nature, college students who are overweight are more likely to stick with it long-term, leading to more sustained improvements in body composition.

In regulating lipid metabolism, both moderate-intensity strength training (MSSG) and high-intensity interval training (HIIT) play crucial roles. HIIT enhances insulin sensitivity, improves glucose uptake and utilization, thereby lowering blood sugar levels. Additionally, it modulates the activity of enzymes involved in lipid metabolism, promotes oxidative breakdown of fatty acids, reduces synthesis of triglycerides and low-density lipoprotein cholesterol (LDL-C), while increasing high-density lipoprotein cholesterol (HDL-C). For obese college students, these benefits help reduce cardiovascular disease risks and improve lipid metabolism status[8].

The impact of MSSG on lipid metabolism is equally significant. The varied intensity and rhythm of basketball games stimulate the body to release beneficial hormones like adrenaline through intermittent high-intensity exercise. These hormones enhance fat mobilization and utilization, thereby improving lipid profiles. Moreover, the team-building and competitive elements in MSSG ignite participants' enthusiasm, increasing both exercise intensity and duration– a dual boost that further strengthens its regulatory effects on lipid metabolism.

From a practical application perspective, MSSG demonstrates distinct advantages over HIIT. While HIIT delivers significant benefits, its high-intensity training format may deter obese college students, particularly those with limited exercise experience or poor physical fitness. By adopting the format of casual basketball games, MSSG reduces the monotony and stress associated with exercise, making it more accessible and appealing to overweight students. Additionally, as a team sport, MSSG provides social opportunities that enhance teamwork spirit and self-confidence among participants, which positively contributes to improving their mental health[9].

However, HIIT has unique advantages that set it apart. Its training programs are highly adaptable, allowing for customization based on individual physical conditions and fitness goals. With shorter workout durations, it particularly suits time-pressed college students. Furthermore, HIIT boasts robust theoretical foundations and practical experience in scientific research, enabling coaches to develop precise training plans that ensure both effectiveness and safety[10].

This study found that both 12-week high-intensity interval games (recreational basketball) and high-intensity interval training (Tabata) effectively improved body composition and lipid profiles in obese college students, promoting positive changes in most health-related physical fitness indicators. Both interventions not only controlled blood pressure but also reduced other cardiovascular risk factors such as total cholesterol, low-density lipoprotein (LDL), and triglyceride levels. The two intervention programs aim to encourage college students to engage more frequently in high-intensity interval activities to reduce obesity and enhance physical fitness. Future research should explore whether school-based interventions using different high-intensity interval game methods—such as small-scale competitions and modified versions of sports events—will have varying impacts on college students' health-related physical fitness levels.

Disclosure statement

The author declares no conflict of interest.

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