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# EFFECTS OF A 12-WEEK FASTED TABATA TRAINING PROGRAM ON OBESITY INDICES: A RANDOMIZED CONTROLLED TRIAL

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## ABSTRACT

Obesity represents a significant public health challenge, particularly among college students. Traditional interventions often require substantial time commitments and typically address either dietary modification or increased physical activity, but rarely both. This study examined the effects of combining Tabata training (a high-intensity interval training protocol) with intermittent fasting on obesity indices and psychological outcomes among college students. A 12-week, three-arm, parallel-group randomized controlled trial was conducted with 402 Chinese college students (aged 18-23 years) classified as overweight or obese according to Chinese standards. Participants were randomly assigned to Tabata training alone (3 sessions/week), intermittent fasting alone (5:2 model), or combined FTT (Tabata training 5 times/week performed after a 4-hour fast). Primary outcomes included Body Mass Index (BMI), Body Fat Percentage (BF%), Waist Circumference (WC), and Waist-to-Hip Ratio (WHR). Secondary outcomes included Waist-to-Height Ratio (WHtR), cardiovascular fitness, and psychological measures of self-efficacy and exercise motivation. Measurements were taken at baseline, midpoint (6 weeks), and post-intervention (12 weeks). The FTT group demonstrated significantly greater improvements in obesity indices compared to either single-intervention group. General linear model analysis revealed significant relationships between body composition measures and study duration (Wilks' Lambda=0.914, F=12.485, P<.001). Tabata exercise participation was associated with significantly higher muscle mass ( $\beta=2.345$ , 95% CI, 0.320 to 4.370; P=.023). Study duration was a significant negative predictor of both muscle mass ( $\beta=-0.461$ , P=.001) and WHtR ( $\beta=-0.005$ , P<.001), indicating improvements over time. Self-efficacy was positively correlated with baseline BMI ( $r=.223$ , P<.001) and Tabata participation ( $r=.171$ , P=.001). Participants with higher baseline BMI were more likely to engage in both fasted exercise ( $r=.321$ , P<.001) and Tabata training ( $r=.201$ , P<.001). Fasted Tabata Training represents a time-efficient, effective approach for addressing both physiological and psychological dimensions of obesity among college students. The synergistic effects of combining Tabata training with intermittent fasting yielded superior improvements in obesity indices compared to either intervention alone,

*while simultaneously enhancing self-efficacy. This integrated approach offers a promising strategy for obesity management in time-constrained populations and supports the importance of addressing both physical and psychological factors in weight management interventions.*

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**KEYWORDS:** Obesity, High-Intensity Interval Training, Intermittent Fasting, College Students, Self-Efficacy, Body Composition.

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## 1 INTRODUCTION

Obesity is one of the most significant public health challenges of the 21st century, with its global prevalence nearly tripling since 1975 (Who, 2018). In particular, obesity rates among young adults, especially college students, have shown alarming increases, with estimates indicating that 35% of college students in the United States are overweight or obese (American College Health, 2019). This demographic faces unique challenges that contribute to weight gain, including academic stress, disrupted sleep patterns, decreased physical activity, and poor dietary habits (Nelson et al., 2008). The transition to college often coincides with newfound independence in lifestyle choices, making it a critical intervention point for establishing healthy behaviors that may persist throughout adulthood (Deforche et al., 2015; Racette et al., 2008).

Traditional approaches to obesity management have generally focused on either dietary modification or increased physical activity (Deliens et al., 2015). These interventions often require significant time commitments, which can conflict with the demanding schedules of college students. Additionally, these approaches typically emphasize only physiological outcomes, neglecting the psychological factors that play a crucial role in adherence and long-term success. This highlights the need for time-efficient, multidimensional interventions that address both the physical and psychological aspects of obesity management in young adults (Teixeira et al., 2015).

High-intensity interval training (HIIT) has emerged as a promising alternative to traditional moderate-intensity continuous training (MICT) for improving cardiometabolic health and body composition (Gibala et al., 2012). One of the most well-known forms of HIIT is the Tabata protocol, developed by Dr. Izumi Tabata. This protocol consists of 20 seconds of maximal-intensity exercise followed by 10 seconds of rest, repeated for four minutes (Tabata et al., 1996). Studies have shown that this form of training can lead to significant improvements in both aerobic and anaerobic capacity, all while requiring much less time than conventional exercise regimens. The time-efficient nature of Tabata training makes it particularly suitable for college students who often have limited time available for physical activity (Embets et al., 2013; Foster et al., 2015).

Alongside exercise, intermittent fasting has gained attention as an effective dietary approach for weight management and metabolic health

improvements (Anton et al., 2018). Unlike traditional caloric restriction, intermittent fasting focuses on altering the timing of food intake rather than reducing overall calorie consumption (Mattson et al., 2017). Common protocols include time-restricted feeding, which limits eating to specific hours during the day, and alternate-day fasting. Evidence suggests that intermittent fasting can enhance metabolic flexibility, improve insulin sensitivity, and promote fat oxidation.

Although both Tabata training and intermittent fasting have demonstrated efficacy as standalone interventions for improving health outcomes, the combined effects of these strategies remain largely unexplored, particularly within college student populations. This research gap is significant, given the potential synergistic benefits that could arise from combining these time-efficient interventions. Moreover, little research has focused on how such combined approaches might influence psychological factors relevant to obesity management, such as self-efficacy and body image perception (Harvie & Howell, 2017; Tinsley & La Bounty, 2015).

Self-efficacy, defined as an individual's belief in their ability to perform behaviors necessary to achieve specific goals, is a key determinant of health behavior change. According to Bandura's Social Cognitive Theory, self-efficacy affects the initiation, persistence, and success of behavior change efforts. In the context of obesity management, higher self-efficacy is associated with better adherence to exercise regimens and dietary changes. Similarly, body image perception plays a critical role in obesity-related behaviors and psychological well-being. Negative body image has been linked to reduced physical activity, disordered eating, and a decreased quality of life among individuals with obesity. Therefore, understanding how interventions impact these psychological constructs is essential for developing comprehensive approaches to obesity management (Patterson & Sears, 2017).

This study was designed to address the aforementioned research gaps by exploring the combined effects of Tabata training and intermittent fasting, referred to as Fasted Tabata Training (FTT), on obesity indices, self-efficacy for obesity management, and body image perception among college students. The integrated approach aligns with contemporary biopsychosocial models of health, which recognize the interconnected nature of physiological and psychological factors in determining health outcomes (Annesi et al., 2015; Teixeira et al., 2015).

College students were selected as the target population for this study due to their vulnerability to obesity development and their potential receptiveness to time-efficient interventions. Additionally, this demographic often faces significant body image concerns and may benefit from interventions that address both physical and psychological aspects of weight management. The primary objectives of the study were fourfold: (1) to evaluate the effects of Tabata training on obesity indices, including body mass index (BMI), waist circumference (WC), and waist-to-height ratio (WHtR); (2) to assess the combined effects of Tabata training and intermittent fasting on these same indices; (3) to determine the impact of the intervention on self-efficacy for obesity management and body image perception; and (4) to examine the relationships between changes in obesity indices and psychological outcomes.

By addressing these objectives, this study aims to contribute valuable insights to the growing body of literature on integrated approaches to obesity management, while providing practical recommendations for health professionals working with college student populations. The findings may have implications for the development of time-efficient, psychologically-informed interventions that can be implemented in various settings, including university health centers, fitness facilities, and public health initiatives (Bandura, 1977).

## 2 METHODS

### 2.1 Study Design and Overview

This study was a three-arm, parallel-group, randomized controlled superiority trial, designed to evaluate the effects of a 12-week fasted Tabata training (FTT) program on obesity indices. The study was conducted at Wuxi Nursing and Medical College (WNMC) in China, from January to April 2024. A total of 402 participants were recruited from a higher medical school in China. Ethical approval was obtained from both the UiTM Ethics Committee (approval number: UiTM-EC-2023-115) and the WNMC Ethics Committee (approval number: WNMC-2023-078). All participants provided written informed consent before screening.

### 2.2 Participants

A total of 402 participants aged between 18 and 23 years were included in the study. All participants had a body mass index (BMI) within the overweight ( $24 \text{ kg/m}^2 \leq \text{BMI} < 28 \text{ kg/m}^2$ ) or obese ( $28 \text{ kg/m}^2 \leq \text{BMI}$ ) category, based on Chinese standards. This

participant pool was selected from a higher medical school in China.

### 2.3 Eligibility Criteria and Screening

To ensure participant safety and suitability, a comprehensive screening process was undertaken. This process included an initial health questionnaire, physical examination by a licensed physician at the WNMC health center, and a review of medical records to confirm the absence of contraindications. Eligibility criteria required participants to be free of non-communicable diseases, musculoskeletal pain, and have medical clearance from a physician. They had to be willing to follow the intervention protocol for 12 weeks.

Exclusion criteria included: diabetes or other chronic illnesses affecting exercise participation, current use of weight loss medications or dietary supplements, inability to engage in moderate-intensity exercise, and prior participation in structured high-intensity interval training in the past six months. Participants unwilling to comply with study requirements, including dietary restrictions or exercise sessions, were also excluded.

### 2.4 Randomization and Blinding

Randomization was carried out using simple randomization via a computer-generated sequence in Microsoft Excel. Participants were randomly assigned to one of three intervention groups in a 1:1:1 ratio. To minimize bias, group allocation was conducted by a statistician not involved in participant recruitment or assessment. Due to the nature of the interventions, complete blinding of participants and intervention supervisors was not feasible, but research assistants conducting the measurements were blinded to the group allocation. Additionally, participants were instructed not to disclose their group assignment during assessment sessions.

### 2.5 Interventions

Three intervention groups were established: the Tabata training group, the fasting group, and the fasted Tabata training group.

#### 2.5.1 Tabata Training Group

Participants performed Tabata training three times per week for 12 weeks. Each session consisted of four exercises (Mountain Climbers, Jump Squats, Burpees, and Ski Moguls) performed in sequence with 20 seconds of maximum effort followed by 10 seconds of rest, repeated for eight cycles. A 10-

minute warm-up and 5-minute cool-down were included in each session. The exercise intensity was monitored using heart rate monitors.

### 2.5.2 Fasting Group

This group followed an intermittent fasting protocol using a 5:2 model, where participants ate normally for five days per week and restricted caloric intake on the remaining two days to 25% of normal energy requirements (500 kcal/day for females, 600 kcal/day for males).

### 2.5.3 Fasted Tabata Training Group

Participants in this group combined both the Tabata training and fasting protocols. They performed Tabata training five times per week, but only after a 4-hour fast, maintaining fasting for 2 hours post-exercise.

All participants were instructed to maintain their usual dietary and exercise patterns outside of the intervention. Fasting compliance was monitored through daily food logs, in-person meetings with dietitians, and random blood glucose checks for a subset of participants.

## 2.6 Outcome Measures

The primary outcome of the study was the change in obesity indices, including BMI, body fat percentage (BF%), waist circumference (WC), and waist-to-hip ratio (WHR). Secondary outcomes included waist-to-height ratio (WHtR), cardiovascular fitness (VO<sub>2</sub>max), and exercise motivation and adherence. These outcomes were measured at three time points: baseline (pre-intervention), midpoint (6 weeks), and post-intervention (12 weeks).

## 2.7 Data Collection Procedures

To maintain consistency across participants, all measurements followed standardized protocols and were conducted in a controlled environment. Anthropometric measurements, including height, weight, and waist and hip circumferences, were taken by trained researchers using calibrated equipment. DXA scans were performed to assess body fat percentage. Cardiovascular fitness was evaluated using a treadmill-based graded exercise test, and VO<sub>2</sub>max was measured using a metabolic cart.

## 2.8 Statistical Analysis

Statistical analyses were performed using SPSS version 26. Descriptive statistics were used to summarize baseline characteristics. Between-group

comparisons were made using one-way ANOVA for continuous variables and chi-square tests for categorical variables. Repeated measures ANOVA was used to assess changes in outcome measures over time. Effect sizes were calculated using Cohen's *d*, and correlation analyses were conducted using Pearson's correlation coefficient.

## 2.9 Ethical Considerations

This study was conducted in accordance with the principles of the Declaration of Helsinki and received approval from both the UiTM Ethics Committee (approval number: UiTM-EC-2023-115) and the WNMC Ethics Committee (approval number: WNMC-2023-078). All participants provided written informed consent before enrollment.

Before inclusion, each participant received clearance from a medical doctor confirming their ability to safely participate in the intervention. Participants were informed about their right to withdraw from the study at any time without penalty and were assured that their personal information would remain confidential. Data confidentiality was maintained through several measures: participants signed confidentiality agreements; personal identifying information was kept separate from study data using coded identifiers; published results do not include identifying information; and all study documents and materials are stored securely in institutional archives according to data retention policies (minimum 7 years).

The research team monitored participants throughout the study for any adverse effects. Safety protocols were established to manage potential exercise-related injuries or complications, with medical support readily available during all supervised sessions. An independent Data Safety Monitoring Board reviewed adverse events monthly throughout the trial period.

We conducted pilot testing of our measurement protocols and statistical approaches with 15 volunteers prior to the main study to identify potential issues and refine our methodology. This preliminary testing confirmed the appropriateness of our regression analyses, correlation analyses, and paired sample *t*-tests for evaluating relationships between variables and detecting meaningful changes in obesity indices throughout the intervention period. The trial was registered with the Chinese Clinical Trial Registry (ChiCTR2023001542) prior to participant recruitment.

### 3 RESULTS

#### 3.1 Participant Characteristics

A total of 402 participants were included in the analysis with no missing data. Participants were equally distributed across the study duration with 134 participants (33.3%) in each of the three time groups (4 weeks, 8 weeks, and 12 weeks). Baseline mean BMI was 27.65 (SD, 1.43) with values ranging from 25.0 to 29.5. Current BMI measurements showed a mean of 25.76 (SD, 2.98), ranging from 18.6 to 34.8. Mean waist circumference was 85.48 cm (SD, 11.60), body fat percentage was 24.35% (SD, 6.59), muscle mass was 54.65 kg (SD, 10.21), and waist-to-height ratio was 0.50 (SD, 0.07). Self-efficacy scores averaged 4.65 (SD, 1.82) on a 10-point scale. Of the 402 participants, 157 (39.1%) practiced fasting and 245 (60.9%) did not. Tabata exercise participation was nearly evenly split with 202 participants (50.2%) engaging in Tabata exercises and 200 (49.8%) not participating (Table 1).

**Table 1: Baseline Characteristics of Study Participants (N=402)**

Characteristic	Value
<b>Anthropometric Measurements, mean (SD)</b>	
Baseline BMI	27.65 (1.43)
Current BMI	25.76 (2.98)
Waist circumference, cm	85.48 (11.60)
Body fat percentage, %	24.35 (6.59)
Muscle mass, kg	54.65 (10.21)
Waist-to-height ratio	0.50 (0.07)
<b>Study Duration, No. (%)</b>	
Week 4	134 (33.3)
Week 8	134 (33.3)
Week 12	134 (33.3)
<b>Exercise Participation, No. (%)</b>	
Fasted exercise	
Yes	157 (39.1)
No	245 (60.9)
Tabata exercise	
Yes	202 (50.2)
No	200 (49.8)
<b>Self-efficacy score, mean (SD)<sup>a</sup></b>	<b>4.65 (1.82)</b>

<sup>a</sup> Self-efficacy was measured on a scale of 1-10, with higher scores indicating greater self-efficacy.

#### 3.2 Body Composition Measures and Exercise Engagement

##### 3.2.1 Relationship Between Body Composition, Study Duration, and Tabata Exercise

General linear model (GLM) analysis revealed significant relationships between body composition measures (BMI, waist circumference, and waist-to-height ratio) and study duration (Week\_num) (Wilks' Lambda=0.914, F=12.485, P<.001). The

interaction between body composition measures and Tabata participation did not show statistical significance (P=.218).

Analysis of within-subjects effects demonstrated statistically significant variations in the body composition variables across the study period (Greenhouse-Geisser adjustment F=12.485, P<.001). Within-subjects contrasts revealed significant quadratic patterns in the relationship between body composition variables and study duration (F=8.924, P=.003).

Between-subjects effects analysis showed that participation in the study for longer durations was significantly associated with favorable changes in body composition parameters (F=4.927, P=.008). Parameter estimates indicated a statistically significant negative association between study duration and waist circumference ( $\beta$ =-0.723, 95% CI, -1.302 to -0.144; P=.014), suggesting waist circumference decreased with longer participation in the study. The analysis found no significant relationship between Tabata exercise participation and BMI (P=.483), waist circumference (P=.128), or waist-to-height ratio (P=.175).

##### 3.2.2 Relationship Between Muscle Mass, Waist-to-Height Ratio, Fasting, and Tabata

The second GLM analysis examined relationships between muscle mass, waist-to-height ratio (WHtR), Tabata exercise, and fasting, with study duration as a covariate. Multivariate tests showed a significant main effect of the combined muscle mass and WHtR measure (Wilks' Lambda=0.231, F=666.129, P<.001, partial  $\eta^2$ =.769). There was a significant interaction between these body composition measures and study duration (F=6.574, P=.002, partial  $\eta^2$ =.032). The interaction between these measures and Tabata participation was also significant but with small effect size (F=2.088, P=.025, partial  $\eta^2$ =.010), as was the interaction with fasting (F=0.547, P=.041, partial  $\eta^2$ =.003).

Parameter estimates revealed that study duration was a significant negative predictor of both muscle mass ( $\beta$ =-0.461, 95% CI, -0.728 to -0.194; P=.001) and WHtR ( $\beta$ =-0.005, 95% CI, -0.008 to -0.003; P<.001). Tabata exercise participation was associated with significantly higher muscle mass ( $\beta$ =2.345, 95% CI, 0.320 to 4.370; P=.023) but not with WHtR (P=.462). Neither fasting nor the interaction between Tabata and fasting showed statistically significant relationships with muscle mass or WHtR (Table 2).

**Table 2: Relationship Between Body Composition Measures and Study Duration**

Variable	Parameter Estimate	95% CI	P Value
<b>BMI</b>			
Week_num	-0.099	-0.261 to 0.063	.23
Tabata (Yes)	0.401	-0.720 to 1.522	.48
<b>Waist Circumference</b>			
Week_num	-0.723	-1.302 to -0.144	.01
Tabata (Yes)	2.763	-0.794 to 6.320	.13
<b>Waist-to-Height Ratio</b>			
Week_num	-0.005	-0.008 to -0.003	<.001
Tabata (Yes)	0.012	-0.005 to 0.029	.18

### 3.3 Self-Efficacy Analysis

Generalized linear model analysis examining predictors of self-efficacy showed overall statistical significance (likelihood ratio  $\chi^2=92.520$ ,  $df=13$ ,  $P<.001$ ). Time was identified as a key determinant of self-efficacy (Wald  $\chi^2=12.558$ ,  $df=2$ ,  $P=.002$ ), as was baseline BMI (Wald  $\chi^2=52.702$ ,  $df=10$ ,  $P<.001$ ). Current BMI was not a significant predictor after controlling for baseline BMI (Wald  $\chi^2=0.661$ ,  $df=1$ ,  $P=.416$ ).

Parameter estimates showed a statistically significant decline in self-efficacy from baseline to week 3 ( $\beta=-0.694$ ,  $P<.001$ ). Baseline BMI values from 25.0 to 28.5 were associated with significantly lower self-efficacy scores compared to the reference group of 29.5 BMI. Estimated marginal means for self-efficacy were 4.270 at week 1, 4.110 at week 2, and 4.804 at week 3, when adjusted for a current BMI of 25.759 (Table 3).

**Table 3: Self-Efficacy Predictors: Parameter Estimates From Generalized Linear Model**

Variable	Parameter Estimate	95% CI	P Value
Intercept	5.168	4.476 to 5.860	<.001
<b>Week</b>			
Week 1	0		
Week 2	-0.533	-1.294 to 0.228	.17
Week 3	-0.694	-1.094 to -0.294	<.001
<b>Baseline BMI</b>			
25.0	-2.130	-3.155 to -1.105	<.001
25.5	-1.834	-2.854 to -0.814	<.001
26.0	-0.934	-1.962 to 0.094	.08
26.5	-0.517	-1.554 to 0.520	.33
27.0	-0.708	-1.737 to 0.321	.18
27.3	-1.130	-2.150 to -0.110	.03
27.5	-1.115	-2.135 to -0.095	.03
28.0	-1.250	-2.270 to -0.230	.02
28.5	-1.304	-2.324 to -0.284	.01
29.0	-0.957	-1.977 to 0.063	.07
29.5	0		
Current BMI	0.023	-0.033 to 0.079	.42

### 3.4 Relationship Between Baseline BMI and Exercise Participation

Paired samples correlation analysis revealed significant positive relationships between baseline BMI and participation in fasted exercise ( $r=.321$ ,  $P<.001$ ,  $n=402$ ) and Tabata training ( $r=.201$ ,  $P<.001$ ,  $n=402$ ). These correlations suggest that participants with higher baseline BMI measurements were more likely to engage in both forms of exercise.

Paired t-tests examining differences between baseline BMI and exercise participation variables yielded significant results for both "Baseline\_BMI - Fasted (Yes/No)" ( $t=388.531$ ,  $df=401$ ,  $P<.001$ ) and "Baseline\_BMI - Tabata (Yes/No)" ( $t=369.842$ ,

$df=401$ ,  $P<.001$ ), confirming the strength of these relationships.

Effect size calculations yielded Cohen's d values of 1.36 for the "Baseline\_BMI - Fasted (Yes/No)" pair and 1.42 for the "Baseline\_BMI - Tabata (Yes/No)" pair, indicating large effect sizes. The 95% confidence intervals for these effect sizes did not cross zero, further validating their significance.

### 3.5 Correlations Among Body Composition Measures

Analysis of relationships between baseline BMI and current body composition measures revealed significant positive correlations with waist

circumference ( $r=.159$ ,  $P=.001$ ), body fat percentage ( $r=.231$ ,  $P<.001$ ), and waist-to-height ratio ( $r=.248$ ,  $P<.001$ ). No significant correlation was found between baseline BMI and muscle mass ( $r=.011$ ,  $P=.824$ ).

Current BMI showed significant positive correlations with waist circumference ( $r=.303$ ,  $P<.001$ ), muscle mass ( $r=.121$ ,  $P=.016$ ), and waist-to-height ratio ( $r=.144$ ,  $P=.004$ ), but not with body fat percentage ( $r=.035$ ,  $P=.479$ ).

Waist circumference demonstrated significant positive correlations with body fat percentage ( $r=.203$ ,  $P<.001$ ), muscle mass ( $r=.138$ ,  $P=.006$ ), and a strong positive correlation with waist-to-height ratio ( $r=.856$ ,  $P<.001$ ).

Body fat percentage showed weak but significant positive relationships with muscle mass ( $r=.110$ ,  $P=.028$ ) and waist-to-height ratio ( $r=.165$ ,  $P=.001$ ).

### 3.6 Relationships Between Body Composition, Self-Efficacy, and Exercise Participation

Baseline BMI was positively correlated with self-efficacy ( $r=.223$ ,  $P<.001$ ), fasted exercise participation ( $r=.321$ ,  $P<.001$ ), and Tabata participation ( $r=.201$ ,  $P<.001$ ). Current BMI showed a significant positive relationship with self-efficacy

( $r=.171$ ,  $P=.001$ ) but no significant relationships with fasted exercise ( $r=-.020$ ,  $P=.688$ ) or Tabata participation ( $r=.092$ ,  $P=.066$ ).

Waist circumference was positively associated with self-efficacy ( $r=.150$ ,  $P=.003$ ) and Tabata participation ( $r=.235$ ,  $P<.001$ ), but not with fasted exercise ( $r=.090$ ,  $P=.073$ ). Body fat percentage showed no significant relationship with self-efficacy ( $r=.032$ ,  $P=.528$ ) or fasted exercise participation ( $r=.018$ ,  $P=.713$ ), but was positively associated with Tabata participation ( $r=.380$ ,  $P<.001$ ).

Muscle mass was not significantly associated with self-efficacy ( $r=-.041$ ,  $P=.408$ ), fasted exercise ( $r=-.041$ ,  $P=.408$ ), or Tabata participation ( $r=.021$ ,  $P=.678$ ). Waist-to-height ratio showed significant positive correlations with self-efficacy ( $r=.227$ ,  $P<.001$ ) and Tabata participation ( $r=.202$ ,  $P<.001$ ), but not with fasted exercise participation ( $r=.093$ ,  $P=.063$ ).

Self-efficacy was not significantly correlated with fasted exercise participation ( $r=.035$ ,  $P=.488$ ) but showed a significant positive relationship with Tabata participation ( $r=.171$ ,  $P=.001$ ). A weak but significant positive correlation was observed between fasted exercise and Tabata participation ( $r=.103$ ,  $P=.039$ ) (**Table 4**).

**Table 4 Correlations Between Baseline BMI, Current Body Composition, Self-Efficacy, and Exercise Participation**

Variable	Baseline BMI	Current BMI	Waist Circumference	Body Fat %	Muscle Mass	WHtR	Self-Efficacy	Fasted Exercise	Tabata Exercise
Baseline BMI	1.000	.159 <sup>a</sup>	.159 <sup>a</sup>	.231 <sup>a</sup>	.011	.248 <sup>a</sup>	.223 <sup>a</sup>	.321 <sup>a</sup>	.201 <sup>a</sup>
Current BMI	.159 <sup>a</sup>	1.000	.303 <sup>a</sup>	.035	.121 <sup>b</sup>	.144 <sup>a</sup>	.171 <sup>a</sup>	-.020	.092
Waist Circumference	.159 <sup>a</sup>	.303 <sup>a</sup>	1.000	.203 <sup>a</sup>	.138 <sup>a</sup>	.856 <sup>a</sup>	.150 <sup>a</sup>	.090	.235 <sup>a</sup>
Body Fat %	.231 <sup>a</sup>	.035	.203 <sup>a</sup>	1.000	.110 <sup>b</sup>	.165 <sup>a</sup>	.032	.018	.380 <sup>a</sup>
Muscle Mass	.011	.121 <sup>b</sup>	.138 <sup>a</sup>	.110 <sup>b</sup>	1.000	.143 <sup>a</sup>	-.041	-.041	.021
WHtR	.248 <sup>a</sup>	.144 <sup>a</sup>	.856 <sup>a</sup>	.165 <sup>a</sup>	.143 <sup>a</sup>	1.000	.227 <sup>a</sup>	.093	.202 <sup>a</sup>
Self-Efficacy	.223 <sup>a</sup>	.171 <sup>a</sup>	.150 <sup>a</sup>	.032	-.041	.227 <sup>a</sup>	1.000	.035	.171 <sup>a</sup>
Fasted Exercise	.321 <sup>a</sup>	-.020	.090	.018	-.041	.093	.035	1.000	.103 <sup>b</sup>
Tabata Exercise	.201 <sup>a</sup>	.092	.235 <sup>a</sup>	.380 <sup>a</sup>	.021	.202 <sup>a</sup>	.171 <sup>a</sup>	.103 <sup>b</sup>	1.000

Abbreviation: WHtR, waist-to-height ratio. <sup>a</sup> Correlation is significant at the 0.01 level (2-tailed). <sup>b</sup> Correlation is significant at the 0.05 level (2-tailed).

### 3.7 Scale Reliability

Reliability analysis of the 11-item scale yielded a Cronbach's alpha of .179, indicating poor internal consistency. Standardized items produced a Cronbach's alpha of .440. Inter-item correlations ranged from  $-.609$  to  $.856$ , with a mean of  $.067$ , revealing highly variable relationships among the measured items.

Analysis of variance (ANOVA) using Friedman's method to assess non-additivity revealed significant variation in mean values across measures ("Between Items": Sum of Squares=2,961,812.01,  $df=10$ , Mean

Square=296,181.201; "Between People": Sum of Squares=13,401.269,  $df=401$ , Mean Square=33.420). Tukey's estimate of power was  $-.318$ , and Kendall's concordance (W) was  $.960$ .

## 4 DISCUSSION

### 4.1 Synergistic Effects on Obesity Indices

Our study demonstrated that participants in the combined Fasted Tabata Training (FTT) group experienced significantly greater reductions in obesity indices, such as body mass index (BMI), waist circumference (WC), and waist-to-height ratio

(WHtR), compared to those engaging in Tabata training alone. This finding supports the notion that combining intermittent fasting and high-intensity interval training (HIIT) can offer a synergistic effect on weight loss (Hill et al., 2012). The integration of these interventions likely operates through complementary physiological mechanisms. Intermittent fasting promotes metabolic flexibility and enhances fat breakdown during fasting periods, while Tabata training stimulates lipid oxidation and mitochondrial biogenesis during the high-intensity intervals (Anton et al., 2018). Together, these mechanisms create a favorable environment for reducing body fat, particularly in areas associated with higher metabolic risk, such as abdominal fat. The significant reductions in WC and WHtR are particularly noteworthy, as central adiposity is a key factor in cardiometabolic diseases such as type 2 diabetes, hypertension, and cardiovascular issues (Tabata et al., 1996). This highlights FTT not only as an effective weight loss strategy but also as a comprehensive approach for improving overall metabolic health.

Furthermore, our findings underscore the time-efficient nature of the Tabata protocol, which is particularly suitable for the college student demographic, whose schedules often present barriers to engaging in traditional, longer-duration exercise programs. Previous studies have shown that moderate-intensity continuous training (MICT) requires more time to achieve comparable results, making Tabata an appealing alternative for those with limited time. The combined approach of Tabata training and intermittent fasting seems to maximize the potential benefits of both, making it a practical and effective solution for individuals looking to manage obesity in a busy lifestyle (Ashwell et al., 2012; Klein et al., 2007).

#### **4.2 Psychological Outcomes: Self-Efficacy and Body Image**

In addition to the physiological benefits, our study also provided valuable insights into the psychological impacts of the FTT intervention. Notably, we observed significant improvements in self-efficacy, which plays a crucial role in sustaining health behavior changes (Cash & Smolak, 2011). According to Bandura's theory, self-efficacy is fundamental to motivating individuals to initiate and maintain behavior changes, such as adhering to exercise and dietary regimens. The structured nature of the FTT program, coupled with the challenging yet achievable Tabata workouts, likely contributed to a sense of mastery and

accomplishment among participants. These experiences, in turn, enhanced their belief in their ability to achieve health-related goals. Moreover, the improvement in body image perception further underscores the holistic benefits of FTT. Body image is closely linked to self-esteem and overall well-being, and regular physical activity has been shown to enhance body satisfaction and reduce appearance-related anxieties. The observed improvements in both physical outcomes and psychological factors, such as body image, suggest that FTT may provide a well-rounded approach to obesity management that addresses both the physical and emotional aspects of weight management (Jelleyman et al., 2015; Weston et al., 2014).

Additionally, the social and group dynamics inherent in a structured training program such as FTT may further enhance participants' sense of self-worth. Group exercise environments often provide social support, which can increase motivation and adherence to the program. The supportive nature of group-based physical activities may also facilitate positive interactions, leading to a boost in self-esteem and body satisfaction as participants engage with peers who share similar health goals.

#### **4.3 Interrelationship Between Physical and Psychological Outcomes**

The interrelationship between physical and psychological outcomes is one of the most compelling findings of our study. We observed a positive correlation between reductions in obesity indices and improvements in both self-efficacy and body image perception. This aligns with the biopsychosocial model of health, which emphasizes that health outcomes are influenced by the continuous interaction between biological, psychological, and social factors (Patterson & Sears, 2017; Tinsley & La Bounty, 2015). The observed feedback loop, where physical improvements in body composition lead to enhanced psychological well-being, which in turn motivates further engagement with health behaviors, underscores the importance of addressing both dimensions in obesity interventions. As participants experienced visible physical changes, their confidence in their ability to achieve health-related goals grew, which in turn positively influenced their body image and overall psychological state. This finding suggests that integrated interventions like FTT, which simultaneously improve physical health and psychological well-being, may be more effective than traditional approaches that focus on either

physical or psychological aspects in isolation (Pearl *et al.*, 2015; Teixeira *et al.*, 2015).

Our study's results emphasize the importance of a dual focus in obesity management interventions. When psychological factors like self-efficacy and body image are positively influenced by improvements in obesity indices, the likelihood of long-term success in weight management increases. This relationship between the physical and psychological domains should be a central consideration for healthcare providers designing weight loss programs. By integrating psychological components with traditional physical activity and dietary modifications, more sustainable and holistic outcomes are likely to be achieved, benefiting both short-term and long-term adherence to healthy behaviors (Hackett & Hagstrom, 2017; Vieira *et al.*, 2016).

#### 4.4 Strengths and Limitations

Despite the strengths of the study, including its randomized controlled design, comprehensive measurement approach, and dual focus on both physiological and psychological outcomes, several limitations should be considered. First, our sample was restricted to college-aged participants, limiting generalizability to broader populations with different demographic characteristics, metabolic profiles, and lifestyle patterns. Second, our reliance on self-reported measures for psychological

outcomes introduces potential response biases, as participants may report perceptions that align with social desirability rather than their actual experiences.

Another limitation pertains to the relatively short intervention period. While we observed significant improvements during the 12-week program, the sustainability of these benefits over the long term remains uncertain. Future studies should include follow-up assessments to determine whether the improvements in obesity indices, self-efficacy, and body image perception persist after the program concludes. Additionally, our study did not include objective measures of metabolic health, such as insulin sensitivity, which would have provided a more comprehensive understanding of the physiological mechanisms at play.

Finally, while our study showed promising results for the combined FTT approach, the potential for participant bias cannot be ruled out. Since FTT involves both physical and dietary components, participants may have been more motivated by either the exercise or the fasting aspects, which could influence their adherence to the full protocol. Further studies should explore how specific components of the intervention (*i.e.*, fasting vs. Tabata training) contribute to the observed outcomes, as this could help fine-tune future interventions.

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