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A Comparative Analysis of the Effects of CrossFit Training Using AMRAP and Tabata Methods on Selected Functional Performance Indices, Body Composition and Insulin Resistance in Obese Adult Males

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Abstract

Objective: The present study aimed to compare the effects of two common CrossFit regimens—AMRAP and Tabata on selected functional performance indices, body composition and insulin resistance in obese adult males.

Materials and Methods: A quasi-experimental study with a pretest-posttest design was conducted. Thirty obese adult males (age: 30.77 ±3.82 years; weight: 99.45 ±6.20 kg; height: 177.27 ±6.27 cm) were recruited through convenience sampling and randomly assigned to two training groups using a simple randomization method. Body Mass Index (BMI), aerobic and anaerobic power, Percentage Body Fat (PBF), Waist-to-Hip Ratio (WHR), blood glucose levels, insulin levels, and insulin resistance were measured before and after eight weeks of training using the AMRAP and Tabata methods. Paired-samples t-tests and analysis of covariance (ANCOVA) were conducted using SPSS version 26.

Results: The results indicate that an 8-week AMRAP and Tabata exercise program led to significant changes in BMI, WHR, PBF, power, Vo2max, glucose concentration, insulin level and insulin resistance ($P< 0.05$). And also the results indicate revealed significant differences between the two groups in these indicators ($P< 0.05$).

Conclusion: The findings suggest that AMRAP training may be associated with greater reductions in PBF and blood glucose level compared to the Tabata training regimen. In contrast, the Tabata method appeared to result in a more pronounced enhancement in performance metrics, as well as a greater reduction in both serum insulin levels and peripheral insulin resistance compared to the AMRAP protocol.

Keywords: Interval training, Insulin, Body composition

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Introduction

The World Health Organization defines obesity as an abnormal accumulation of adipose tissue, clinically indicated by a body mass index (BMI) of 30 kg/m2 or higher. In 2020, the World Health Organization reported that over 1.9 billion adults (aged 18 years and above) were classified as overweight, with more than 650 million meeting the criteria for obesity. The global prevalence of obesity has increased substantially over the past four decades and if current trends continue, the majority of the world's adult population will be overweight by 2030 (1). Obesity is associated with an elevated risk of cancer, stroke, metabolic disorders, and cardiovascular disease. Research indicates that over 46% of mortality in Iran is attributable to obesity-related complications, including cardiovascular disease (2).

Diabetes is a chronic condition characterized by hyperglycemia resulting from inadequate insulin secretion or impaired insulin function. Obesity can induce both systemic and local chronic inflammation, thereby contributing to the pathogenesis of diabetes. Conversely, insulin resistance and hyperinsulinemia may also play a role in the development of obesity (3). Regular physical activity is consistently recommended as a cornerstone strategy for the prevention of both obesity and diabetes. Exercise enhances insulin sensitivity, improves glucose uptake into skeletal muscle, increases muscle mass and upregulates insulin receptor substrate activity, thereby mitigating obesity and its associated complications (4).

Recent years have seen a substantial rise in new exercise modalities, with high-intensity interval training (HIIT) surpassing traditional training protocols (5). Studies indicate that these exercises decrease body fat while preserving muscle mass, an effect attributed to increased secretion of testosterone and growth hormone. Such exercises can elevate growth hormone levels by as much as 450% within 24 hours post-exercise, thereby enhancing metabolism (6). CrossFit is a HIIT-based approach that integrates strength and aerobic exercises, emphasizing the execution of multi-joint movements. These exercises aim to enhance work capacity and strength efficiently through varied and continuous activities that engage multiple energy systems at high intensity with minimal rest intervals (7). Eun-Ju et al. (2017) reported positive effects of CrossFit training on body mass index (BMI), percentage body fat (PBF) and total body weight in adult men and women (8). Similarly, Smith et al. (2013) investigated the impact of CrossFit-based high-intensity power training among women, confirming its beneficial effects on maximal aerobic fitness and body composition. (7).

Tabata and AMRAP are two of the many CrossFit training methods that have gained widespread popularity among coaches and athletes. Tabata training is a specific form of HIIT that involves 7 to 8 sets of 20-second high-intensity work intervals, interspersed with 10 seconds of recovery between cycles. Various exercise modalities can be employed based on available resources and facilities, including cycling, running, or bodyweight resistance exercises such as burpees and jump squats(9). The AMRAP (As Many Reps As Possible) training system specifies a work capacity task requiring an individual to perform as many repetitions of a specific movement or sequence of movements as possible within a set time limit, typically without prescribed rest periods. Rather than the coach determining the total number of circuits, only the maximum allowable duration for the athlete to execute maximal-effort movements is defined. AMRAP workouts are frequently used in High-Intensity Circuit Training (HICT) to optimize intensity and total work output within a limited time frame(10). The growing popularity of CrossFit and its diverse training protocols necessitate further comparative research evaluating the effects of two prominent training programs, Tabata and AMRAP, on body composition, exercise performance, blood glucose and insulin levels and insulin resistance in obese adult men.

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Material and methods

Subjects

The statistical population of the present study consisted of obese adult men in Bojnurd, northeastern Iran. Collaboration forms were distributed digitally through social networking sites, namely, Instagram, Telegram and Facebook. In-person outreach was subsequently conducted at high-traffic public locations, such as parks, sports facilities and cultural centers, to provide additional study information and facilitate enrollment. The sample size was determined via G*Power software (version 3.1.9) to achieve sufficient statistical power, assuming a large effect size (f= 0.6), α= 0.05 and 1−β= 0.90. Calculations indicated that a minimum of 15 participants per group was required. Accordingly, 30 obese men were recruited into the study using a convenience sampling method. (age: 30.77 ±3.82 years; weight: 99.45 ±6.20 kg; height: 177.27 ±6.27 cm). All 30 participants completed the full study protocol and no participant withdrew or was excluded from the analysis.

The study's inclusion criteria were as follows: male gender, age range of 20 to 35 years, BMI of 30 or higher, absence of participation in regular exercise programs during the past six months, completion of a consent form and non-use of weight control medications, blood sugar control medications, or steroids. The exclusion criteria comprised a history of nervous system disorders, including neuropathy, Parkinson's disease, and multiple sclerosis; uncontrolled cardiopulmonary issues; uncontrolled hypertension; tachycardia or arrhythmia at rest; active cancer; chronic liver or kidney disease and noncompliance with regular attendance at training sessions and assessments. All subjects were informed about the research procedures and measurement tests during an introductory session. The subjects approved the written consent form for participation in the research. Participants were permitted to withdraw from the study at any point during the tests or practice sessions, with assurances that their personal and medical information would remain confidential. Following an invitation, thirty adult men who met the research criteria voluntarily participated in the study. Participants were randomly allocated to the Tabata or AMRAP groups using a simple randomization method, with 15 individuals in each group. Participants were assigned to groups following a draw from numbered envelopes. Participants were instructed to document the quantity and type of food intake in a questionnaire three days prior to the initial blood draw. The researchers assessed the subjects' diets in terms of caloric count and formulated a comparable three-day diet for the subsequent blood draw.

Exercise intervention

Each training session started with a 15-minute warm-up, which included 5 minutes of general whole-body warm-up on a bicycle ergometer at 60 rpm with a resistance level of 4% of body weight. This was followed by 5 minutes of stretching exercises for the upper and lower limbs and concluded with 5 minutes of bodyweight resistance exercises. The CrossFit exercises, utilizing the Tabata and AMRAP methods, were conducted for about 15 minutes, four times a week, over an 8-week period (Table 1).

Tabata Protocol: It involved a training set comprising 20 seconds of high-intensity exercise followed by 10 seconds of rest. The number of sets was 7 during the first four weeks, while in the subsequent four weeks, it increased to 8 for the specified movements. Following each set of exercises, participants engaged in one minute of active rest, which involved walking and deep breathing (9).

- Push-ups
- Full Squat
- Sit-ups:

AMRAP Protocol: The regimen required completing as many circuits and repetitions of a workout sequence as possible within 15 minutes, without any breaks. The procedure was conducted in a circular format, comprising the following movements, each executed for 10 repetitions (11).

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- Leg Raises on the Sweden wall
- Handstand push-ups (feet on the wall)
- Elevated heels

Evaluation of performance indicators

Aerobic capacity

The Bruce treadmill protocol was used to assess aerobic capacity. The apparatus used in this investigation was the Med 2000 medical treadmill, manufactured by the Iranian company Avecinna. The testing procedure commenced with the participant walking at a velocity of 2.74 meters per second (m/s) on an incline of 10 degrees. After a three-minute interval, the velocity was increased to 4.02 m/s and the incline was raised to 12 degrees. Afterward, the treadmill's speed and gradient were increased following the standard protocol every three minutes. This progression persisted until the participant attained volitional exhaustion and stopped walking or running. The total time of activity cessation (T), recorded in minutes and hundredths of a minute, was utilized by the medical treadmill's software to calculate each participant's maximal oxygen consumption (VO2max) in milliliters per kilogram per minute (ml/kg/min), according to the following formula (12):

$VO2\ max = 14.8 - (1.379 \times T) + (0.451 \times T^2) - (0.012 \times T^3)$

Anaerobic capacity

The Sargent jump test, using the countermovement jump technique, was conducted to evaluate anaerobic power. Participants positioned themselves in front of a wall that featured a calibrated scale. Initially, participants, without jumping, reached upward with the hand nearest to the wall, placed their fingers on the scale and the resulting score was recorded as the standing reach height. Following this, individuals executed a jump after a shallow squat (half-squat) and the difference between the jump height and the standing reach height was recorded. The procedure was repeated three times, with the maximal jump height achieved designated as the primary measure of performance. Peak anaerobic power was calculated using the following formula (13):

Peak power (watts)= 78.6 × jump height (cm) + 60.3 × body weight (kg) – 15.3 × Height (cm) – 1308

Body composition indices

The InBody 230 body composition analyzer, made in South Korea, was used to evaluate body composition through the Bioelectrical Impedance Analysis method. A person stands on the device as a small electrical current flows through their body. Adipose tissue (fat) and water content create impedance or resistance to the flow of the applied electrical current. The differential alteration in the electrical signal and its potential difference (voltage) across biological structures helps quantify body composition parameters (14).

Blood sampling and biochemical evaluation

Volunteers were instructed to avoid strenuous physical activity for three days before the blood collection session. Five cc of blood were collected from the left antecubital vein in a seated position following a 30-minute rest between 8 am and 9 am, while the subject was fasting for 12 hours. Serum separation was conducted using a Behdad 16-place centrifuge, made in Iran, at a speed of 3000 rpm for 10 minutes at 4°C.

The serum insulin (Demeditec Diagnostics GmbH, Lise-Meitner-Straße, Germany) levels were measured using the ELISA kits according to the company manual. The glucose and lipid profile levels were measured by enzymatic methods (Parsazmoon Co., Karaj, Iran). Finally, insulin resistance was calculated using HOMA-IR (15).

Ethical considerations

The current study is a quasi-experimental with a pre- and post-test design. The study protocol received ethical approval from the ethics committee of biological sciences research at Bojnurd University (ID: IR.UB.REC.1404.001).

Statistical analysis

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The data were analyzed using the SPSS statistical package for Windows, version 26.0 (SPSS, Chicago, IL). The data are presented as mean ± standard deviation. First, the Shapiro–Wilk test was used to determine the normality of data distribution. Dependent t-test determined the mean differences between pre- and post-intervention values on all variables. Analysis of covariance (ANCOVA) was also used to compare the differences between the two groups, with the significance level set at $P< 0.05$.

Results

Based on the independent samples t-test results (Table 2), no significant differences were found between the two groups at baseline concerning age, BMI, fasting blood glucose, and insulin levels ($P> 0.05$).

The dependent t-test results indicate that an 8-week AMRAP exercise program led to significant changes in BMI (t= 10.850; $P< 0.001$), WHR (t= 8.548; $P< 0.001$), PBF (t=10.349; $P< 0.001$), power (t= 1.088; $P< 0.001$), Vo2max (t= 8.367; $P< 0.001$), glucose concentration (t= 7.126; $P< 0.001$), insulin level (t= 6.94; $P< 0.001$) and insulin resistance (t= 6.265; $P< 0.001$) and also tabata exercise program led to significant changes in BMI (t= 21.350; $P< 0.001$), WHR (t= 9.909; p<0.001), PBF (t= 12.364; $P< 0.001$), power (t= 12.153; $P< 0.001$), Vo2max (t= 21.50; $P< 0.001$), glucose concentration (t= 3.926; $P= 0.002$), insulin level (t= 11.29 ;$P< 0.001$) and insulin resistance (t= 10.280; $P< 0.001$). The analysis of covariance (ANCOVA) revealed significant differences between the two groups in BMI (F= 25.004; $P< 0.001$), WHR (F= 22.538; $P< 0.001$), PBF (F=17.588; $P< 0.001$), power (F= 75.354; $P< 0.001$), Vo2max (F= 53.380; $P< 0.001$), glucose concentration (F= 11.742; $P= 0.002$), insulin level (F= 20.240; $P< 0.001$) and insulin resistance (F= 8.474; $P= 0.007$). (Table 3).

Discussion

This study aimed to investigate and compare the effects of two types of CrossFit training methods, AMRAP and Tabata, across certain functional parameters, body composition and insulin resistance indices in obese adult men. Findings indicate that AMRAP and Tabata CrossFit exercises significantly alter body composition indices (BMI, WHR, PBF) in adult obese men.

Table1. Training protocol

Warm-up (15 min)	5 min cycling (60 rpm, 4% body weight resistance) + 5 min stretching (upper/lower limbs) + 5 min bodyweight resistance exercises
Tabata Protocol (~15 min)	**Weeks 1-4:** 7 circuits × (20 sec Push-ups + 10 sec rest) + (20 sec Full Squat + 10 sec rest) + (20 sec Sit-ups + 10 sec rest). 1 min active rest between circuits. **Weeks 5-8:** 8 circuits × (20 sec Push-ups + 10 sec rest) + (20 sec Full Squat + 10 sec rest) + (20 sec Sit-ups + 10 sec rest). 1 min active rest between circuits. **Exercises sequence:** Push-ups, Full Squat, Sit-ups
AMRAP Protocol (15 min)	As many rounds as possible in 15 min - continuous (no breaks), circular format, 10 reps/exercise **Exercises sequence:** Leg Raises (Sweden wall), Handstand push-ups (feet on wall), Elevated heels

Table 2. Results of an independent t-test comparing baseline differences in age, BMI, fasting blood glucose and insulin levels between study groups

Parameter	AMRAP Group	Tabata Group	*P*-value
Age (years)	30.40)± 3.83(	31.13 (± 3.90)	0.934
BMI (kg/m2)	31.77 (± 2.43)	31.58 (± 1.26)	0.268
Blood glucose level (mg/dl)	110.00 (± 10.88)	109.46 (± 10.06)	0.816
Insulin level (µU/ml)	6.439 (± 2.736)	6.688 (± 2.207)	0.566

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Table 3. Dependent t-test results assessing within-group differences and analysis of covariance (ANCOVA) examining between-group differences in pre- and post-test phases

Indicater	Exercise	Pretest	Posttest	$P^{\wedge}$	F	$P^{©}$
BMI (kg/m2)	AMRAP	31.77 (± 2.43)	30.53 (± 2.34)	< 0.001*	25.004	< 0.001*
	Tabata	31.58 (± 1.26)	30.93 (± 1.25)	< 0.001*		
WHR	AMRAP	1.16 (± 0.097)	1.11 (± 0.105)	< 0.001*	22.538	< 0.001*
	Tabata	1.15 (± 0.07)	1.13 (± 0.077)	< 0.001*		
PBF (%)	AMRAP	28.80 (± 3.70)	27.20 (±3.47)	< 0.001*	17.588	< 0.001*
	Tabata	27.74 (± 3.61)	26.88 (±3.63)	< 0.001*		
Power (W)	AMRAP	5551.37 (± 328)	5576 (± 340)	< 0.001*	75.354	< 0.001*
	Tabata	5606.72 (± 335)	5944.82 (± 316)	< 0.001*		
VO2max (ml/kg/min)	AMRAP	41.60 (± 2.50)	42.93 (± 2.68)	< 0.001*	53.380	< 0.001*
	Tabata	41.60 (± 2.61)	44.46 (± 2.69)	< 0.001*		
Glucose (mg/dl)	AMRAP	110 (± 10.88)	106.40(± 10.30)	< 0.001*	11.742	0.002 *
	Tabata	109.46 (± 10.0)	107.73 (± 9.94)	0.002		
Insulin (µU/ml)	AMRAP	6.40 (± 2.73)	5.98 (± 2.57)	< 0.001*	20.240	< 0.001*
	Tabata	6.68 (± 2.20)	5.77 (± 2.21)	< 0.001*		
Insulin resistance	AMRAP	1.80 (± 0.95)	1.62 (± 0.86)	< 0.001*	8.474	0.007*
	Tabata	1.85 (± 0.80)	1.57 (± 0.76)	< 0.001*		

BMI: Body mass index, WHR: Waist-Hip Ratio, PBF: Percentage Body Fat,
VO2max: Maximum Oxygen Consumption,*: $P \leq 0.05$, $P^{\wedge}$: Dependent t-test results,
$P^{©}$: Analysis of Covariance results

The results demonstrate that engaging in CrossFit exercises using the AMRAP method, when compared to the Tabata method, led to a significant decrease in body composition indices, including BMI, WHR and PBF. Alongside this, Nithya et al. (2023) found that CrossFit training resulted in a greater reduction in body fat compared to traditional resistance training in overweight men (16).

Wewege et al. (2017) conducted a meta-analysis of 13 studies examining the effects of HIIT versus traditional continuous training on the body composition of 424 overweight and obese individuals (17). A review study by Kazeminasab et al. (2023) indicated no difference in the effects of the two training methods on the body composition of the individuals examined, which contrasts with the findings of the present study (18). In contrast to traditional high-intensity interval and continuous training, CrossFit exercises not only challenge the cardiorespiratory system but also engage a significant portion of the muscular system through the use of resistance equipment. The diverse muscle groups engaged in CrossFit exercises, as opposed to traditional exercises, may significantly contribute to the variability of the results. Domaradzki et al. (2020) investigated the impact of Tabata exercises on adolescents' body composition. The study findings indicated that Tabata exercises lead to a significant reduction in body weight, waist-to-hip ratio and PBF in overweight adolescents, aligning with the results of the current study (19).

Moravska-Sialovic et al. (2020) likewise reported the beneficial effects of AMRAP exercise on body mass reduction. AMRAP exercises led to positive effects on fat loss, suggesting a potential increase in basal metabolism (20).

Previous studies indicate that HIIT requires significantly less energy expenditure than continuous exercise (21). In explaining these results, it is evident that CrossFit workouts using the AMRAP protocol achieved by performing the maximum number of movements or rounds within a set, uninterrupted, high-intensity time frame compared to the traditional high-intensity Tabata method, have led to greater total energy consumption, an increase in the basal metabolic rate, and a more substantial decrease in body fat levels. The mechanism leading to the improvement in lipid metabolism may involve changes in the activity of lipase enzymes, including lipoprotein lipase (LPL) and hormone-sensitive lipase (HSL). Perilipin, present around fat cells, inhibits the action of LPL. Glucagon and epinephrine activate

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Protein Kinase A (PKA) via adenylyl cyclase, thereby increasing cyclic AMP (cAMP) concentration. This activation causes the phosphorylation of both HSL and perilipin. HSL phosphorylation activates the enzyme. Concurrently, perilipin's phosphorylation causes a conformational change and displacement, allowing the enzyme to access the lipid droplet within the adipocyte. Insulin is a potent lipolysis inhibitor. Insulin reduces lipolysis by inhibiting adenylyl cyclase while simultaneously activating phosphodiesterase, resulting in a decrease in intracellular cAMP levels (22). The observed reduction in insulin levels in both study groups may be attributed to a decrease in fat percentage resulting from enhanced lipolysis.

Performance indicators

The findings of this study confirm the significant impact of both CrossFit training protocols on various performance indicators, such as aerobic and anaerobic power. Nonetheless, Tabata exercises demonstrate a greater effect on enhancing these indicators in obese men compared to AMRAP workouts.

From a functional perspective, both methods can lead to remarkable enhancements in performance indicators such as aerobic and anaerobic power, as they engage multiple muscle groups. Central and peripheral adaptations are likely among the most significant factors contributing to these improvements. Performing sports activities enhances plasma volume, subsequently boosting venous return to the heart and ventricular preload. This results in an increased stroke volume for a specific intensity of physical activity, ultimately contributing to an improvement in aerobic power. However, the difference in training volume and intensity between the two methods may result in varying physiological responses. The AMRAP method emphasizes the volume of the training program, enhancing its effectiveness on body composition indicators. In the Tabata training method, the substantially high intensity of work-to-rest periods over a short duration has resulted in a more pronounced effect on increasing VO_2max in obese men.

The power demands of most sports and training regimens are contingent upon the energy output per unit of time. Enhancing the performance of the two energy supply systems, aerobic and anaerobic, in conjunction with physical exercise, represents an effective strategy for improving overall performance (23). Historically, it was commonly believed that endurance training enhances aerobic power, whereas high-speed training involving brief, high-intensity intervals improves anaerobic power (10). Turker et al. (2020) compared the effects of AMRAP CrossFit training with interval CrossFit training in young male wrestlers, concluding that interval training was more effective than AMRAP training on anaerobic power. This finding aligns with the results of the present study (24).

At near-maximal exercise intensity, the anaerobic system contributes minimally to energy supply, primarily at the onset of exercise (24). The anaerobic energy-releasing system is markedly elevated during supramaximal intensity exercise (10). The findings of this study demonstrate that HIIT not only enhances anaerobic power but also exhibits superior effects relative to continuous training. The superiority of the Tabata method over the AMRAP approach in enhancing aerobic capacity may be attributed to ATP consumption during high-intensity exercise. The duration required for oxygen uptake to reach a steady state depends on the exercise intensity and is extended during high-intensity exercise compared to lower-intensity exercise (25). HIIT, such as Tabata, enhances both anaerobic and aerobic power capacity more effectively than lower-intensity continuous training. The subjects' weight and athletic level must be considered in this context.

Glucose

The findings of this study confirm the significant impact of both CrossFit training methods on blood glucose levels. Yet, our findings indicate that AMRAP training is more

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effective than Tabata workouts in lowering blood glucose levels in obese men.

As previously stated, engaging in CrossFit exercises using the AMRAP method yields more significant impacts on body composition metrics, including BMI, WHR and PBF, than Tabata workouts. Prior research has established a direct correlation between BMI, WHR, and PBF indicators and blood glucose levels, identifying these factors as predictors of diabetes onset (26). Recent research findings suggest a correlation between BMI and branched-chain amino acids (BCAAs), which likely elucidates this mechanism. BCAAs may impair insulin signaling, potentially contributing to the onset of insulin resistance (27).

The increase in fat metabolism following AMRAP CrossFit training, as opposed to the Tabata method, is more prevalent in obese individuals. Consequently, it can be concluded that the reduction of body fat is more closely associated with decreased blood glucose levels. Furthermore, exercise volume appears to be a more effective factor than exercise intensity in lowering blood glucose in obese men.

Insulin resistance

The current study confirms the significant impact of both CrossFit training methods on blood insulin levels and insulin resistance. However, the results demonstrate that Tabata CrossFit workouts are more effective than AMRAP workouts in reducing blood insulin levels and insulin resistance in obese men.

Amirsasan et al. (2025) demonstrated that an eight-week regimen of HIIT can enhance the insulin resistance index, body composition, and lipid profile in overweight and obese women. These findings align with the results of the current study, despite the gender differences observed in the two investigations (28). The study conducted by Rezaeimanesh et al. (2024) indicated no significant difference in the effects of two types of HIIT on the insulin resistance index among overweight men (29), which contradicts the findings of the current study. This discrepancy may be attributed to the differences in the two exercise regimens analyzed in the studies.

The decline in insulin secretion during exercise results in reduced baseline and glucose-induced insulin levels. Additionally, participation in exercise training lowers the pancreatic mRNA required to synthesis of proinsulin, glucokinase and associated mRNA (30). Thus, at least two cellular mechanisms have been identified for the reduction of insulin secretion. First, proinsulin signals a decrease in the synthesis of mRNA that regulates insulin production in the liver. Secondly the precence of glucokinase in the liver is essential for the sensitively of pancreatic beta cells to glucokinase mRNA. since the presence of glucokinase in the liver is essential for the sensitivity of pancreatic beta cells to glucokinase mRNA. Consequently, a reduction in this level may lead to diminished sensitivity of these cells to insulin, thereby resulting in decreased secretion (31).

Segerstrom et al. (2010) indicated that variations in insulin sensitivity are significantly associated with exercise intensity. Higher exercise intensity results in significant improvements over lower intensity exercise, particularly regarding insulin sensitivity in women with type 2 diabetes. Increased intensity reduces insulin secretion and enhances insulin activity for an extended duration. High-intensity exercise results in the swift depletion of glycogen reserves within contracting muscle fibers. The hyperglycemic and hyperinsulinemic states that arise immediately after high-intensity exercise are essential for enhancing glycogen replenishment in depleted muscle fibers and for improving insulin sensitivity (32).

Conclusion

CrossFit training is among the most effective methods for enhancing fitness globally. The results of this study indicate that CrossFit training using the AMRAP approach significantly improved body composition indices and blood glucose levels. It is suggested that obese men employ this training

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method to decrease weight and blood glucose levels. The results of this study indicate that Tabata CrossFit exercises lead to significant improvements in functional capabilities, including aerobic and anaerobic power, insulin levels and insulin resistance. The present study is limited by the lack of control over the diet during the research period, as well as the psychological characteristics and physical fitness levels of the subjects. The absence of a control group and the non-random selection of subjects further constrain the generalizability of the findings. Future studies should investigate gender differences as well as the combination and frequency of the two exercise programs.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this manuscript.

Authors' contributions

Conceptualization: A.Z, N.N, H.T and SH.A.
Data Collection and laboratory Analysis: A.Z, N.N, H.T and SH.A.
Writing - Original Draft Preparation: A.Z.
Writing - Review and Editing: N.N, H.T and SH.A.
Supervision: N.N and H.T.
All authors read and approved the final manuscript.

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