EFFECT OF HIGH INTENSITY INTERVAL EXERCISE AND BLOOD GROUP (O) DIET ON WEIGHT REDUCTION IN OBESE SUBJECTS

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Abstract

Introduction. Blood group diet is a health concern in obese subjects. Therefore, this study aimed to investigate the effect of high intensity interval training (HIIT) and blood group (O) diet on weight reduction in obese subjects.
Methods. Sixty class II obese subjects between 40 and 45 years old with blood group (O) were randomly assigned into 2 equal groups. Group (A) included 30 subjects received blood group O diet and HIIT 3 sessions /week for 12 weeks. Group (B) included 30 subjects received caloric diet and HIIT 3 sessions /week for 12 weeks. Before and after the study, measurements including body weight, body mass index (BMI), waist-to- hip ratio (WHR), body fat percentage (BF%), basal metabolic rate (BMR), glycated hemoglobin (HbA1c), serum uric acid, creatinine and blood urea were done.
Results. Both groups (A and B) showed significant decrease in weight (10 and 5.4%), BMI (6.1 and 2.4%), WHR (5.3 and 2.1%), BF% (10.8 and 6.5%), BMR (7.8 and 4%), and HbA1c (8.6 and 3.5%) respectively. While serum uric acid level, creatinine level and blood urea increased significantly in group A (7.6, 8.8 and 21.4% respectively) with no significant change in group B (2, 3.3 and 0.9% respectively). When comparing both groups after the study, there were significant differences of all obesity measurements and glycemic control in favor of group (A) ($p<0.05$).
Conclusions. HIIT combined with blood group (O) diet can enhance weight loss and promote glycemic control in obese subjects.

Key Words: HIIT, blood group O diet, caloric diet.

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INTRODUCTION

Obesity is a metabolic disorder that causes the body to retain more body fat. It is a gate to poor health, and it has not only been one of the top causes of predicted adult impairment and mortality but also of children and adolescents over the world, Obesity is a reality peak cancer hazard factor, Cardiovascular illness, metabolism, and respiratory system **[1**]. In Egypt, Obesity is a major contributor to the development of diabetes mellitus, hypertension, obstructive sleep apnea and fatty liver, in addition to several serious diseases. The estimated annual deaths due to obesity are about 115 thousand **[2].**

According to the World Obesity Federation, more than 4 billion people, might gain excess weight or become obese in the next 12 years. The number of overweight people is increasing quickly in countries with low income **[3].**

The prevention and treatment of obesity can both be effectively achieved through physical exercise and integrated diet programs. Both enhance physical and mental health, which raise the quality of living **[4].**

Exercise is a crucial weight-loss strategy since it may decrease body fat, enhance lean body mass, and either maintain or raise resting metabolic rate **[5].** HIIT have shown significant weight reduction in sedentary obese and overweight people **[6].** Also, the BMI, WHR, and subcutaneous fats were significantly decreased after HIIT **[7].**

High protein (HP) blood group (O) diets, beside lowering triglycerides, blood pressure, and waist circumference (WC) as well as increasing satiety hormones and more reported fullness, demonstrated improved weight loss, fat mass loss, and maintenance of lean mass [8].

However, there is a lack of studies investigating the combined effects of high intensity interval exercise and blood group (O) diet on weight reduction in obese subjects.Thus, this study aimed to grant better understanding of the effect these two interventions on weight reduction in obese subjects.

SUBJECTS AND METHODS

Study design

The current trial is an interventional investigation distinguished by its randomization, control, and parallel group design. During the period spanning from August 2021 to January 2023, the study at hand was executed under the auspices of the Ethical Committee of Scientific Research at the Faculty of Physical Therapy, Cairo University, adhering to ethical guidelines with a designated approval registration number of (No: P. T. REC/012/002920) and in accordance the tenets of the Helsinki Declaration. Every patient provided their signature on a consent form as an indication of their willingness to participate in the clinical study.

Randomization and allocation

In the present study, a computer software program was employed to design a randomization table for the purpose of simple randomization. The allocation ratio used was 1:1. The allocation sequence was obfuscated by a series of sequentially numbered envelopes that were sealed in an opaque manner, thus ensuring that neither the researcher nor the participant were privy to the approaching assignment.

Sample size calculation:

The determination of the necessary sample size for the study groups in relation to the primary outcome of the current investigation, namely the body weight, was conducted using the G*POWER statistical tool (version 3. 1) based on the previous study of Chen et al. [9] with a predetermined power level of 0. 95 and a level of significance set at a p-value of 0. 05, ultimately resulting in a sample size of 22 subjects for each group. However, a total of 30 participants were enrolled in each group, with consideration given to potential dropouts.

Subjects

Sixty obese subjects (30 men and 30 women) with blood group (O) were recruited from the outpatient clinic of obesity at Al-Agouza Police hospital in Giza, Egypt. Subjects with class II obesity (BMI from 35 to ≤ 39.9 kg/ m^2), ages from 40 to 45 years old and blood group O were eligible. Exclusion criteria included cardiovascular and respiratory diseases, using weight loss medications, endocrine disorders as hypothyroidism, neurological and musculoskeletal disorders, patients on diuretics, liver and kidney diseases and alcohol consumption. They were assigned randomly into 2 equal groups.

The participants were randomly allocated into two equal groups. Group (A) included 30 subjects (15 men and 15 women) received blood group O diet and HIIT. Group (B) included 30 subjects (15 men and 15 women) received caloric diet and HIIT. The follow of participants in the all groups is shown in **Fig. 1.**

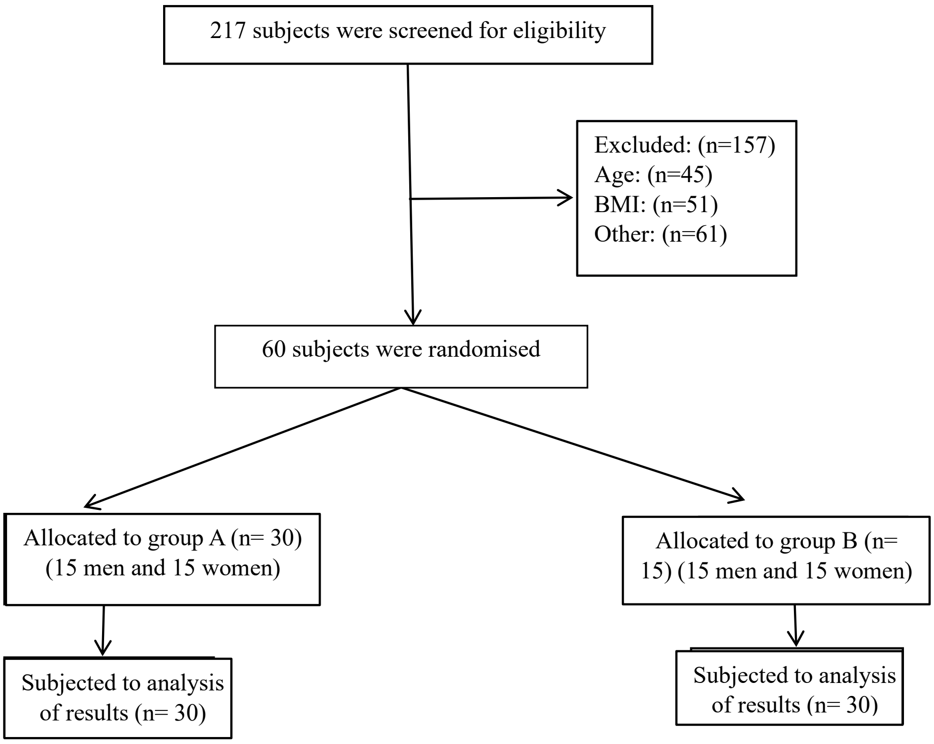

Fig. 1. Flow chart of the study.

Evaluations

Clinical examination and history taking:

The study included a comprehensive report on various baseline chractaristics, such as the age and height of subjects, their medical histories, and co-morbidities**.**

Weight and BMI:

BMI was assessed for every subject in both groups before and after the study. Before taking part in the study, the participants' weight and height were measured using a digital weight scale (model BYH01) manufactured in China while they were dressed in a thin layer of clothes. The individual stood on the scale straight while the weight and height were measured. Then, BMI was calculated according to the following equation: BMI (Kg/m^2) = Weight(kg)/Height^2 (m^2) [10].

Waist-to-hip ratio:

The waist and hip circumference values were measured using non-stretchable measuring tape to determine the WHR for every participant in both groups before and after the study. The WC was typically measured at the circumference that was the smallest above the umbilicus and below the xiphoid process. This measurement was performed on bare skin with the measuring tape placed parallel to the floor and pulled to lay flat on the skin without compressing the skin then the WC was measured at the end of a normal exhalation. Also, the hip circumference was measured using the same standardization techniques used for measuring the waist as the greatest circumference around the buttocks, above the gluteal fold [11].

Body fat percentage:

The BF% was assessed using body composition analyzer (Genexon N20, South Korea) for every participant in both groups before and after the study. Prior to testing, subjects were instructed to stop eating 4 hours before the procedure, avoid consuming alcohol within 48 hours and not exercising within 12 hours of the test. They were asked to stand barefoot on the electrode panel and hold the electrodes in both hands, with the electrodes in contact with the thumb and palm. A measurement current of 90μA or less at various frequencies such as 1 kHz, 5 kHz, 50 kHz, 250 kHz, 500 kHz, and 1000 kHz was applied. After approximately 30 seconds, the BF% was displayed on the screen and printed [12].

Basal metabolic rate:

The Harris-Benedict Equation (HBE) prediction equation including the patient's height, weight, gender, and age was used to estimate BMR for each person in both groups before and after the trial as follows:

In men, BMR= (9.65 × weight in kg) + (573 × height in m) − (5.08 × age in years) + 260.

In women, BMR= (7.38 × weight in kg) + (607 × height in m) − (2.31 × age in years) + 43 [13].

Blood parameters:

Serum Uric acid, kidney function (serum creatinine level – blood urea) and HbA1c were assessed for every participant in both groups before and after the study using the biochemistry analyzer (Targa BT 2000 Biotecnica instruments S.p.A, Rome, Italy). After 10 to 12 hours of fasting, a venous blood sample (5 mL) was taken from each individual in the Al-Agouza Police hospital laboratory through venepuncture. The immunoturbidimetric approach was used to determine HbA1c, which assessed the absorbance of the HbA1c fraction and total haemoglobin fraction at 415 nm. Serum samples were obtained by centrifuging the remaining collected specimens. Urea, urea, and creatinine were measured in the separated serum samples. The alkaline picrate technique, urease-hypochlorite method, and uricase-peroxidase method were used to measure creatinine, urea, and uric acid, respectively [14].

Interventions

High intensity interval training:

For both groups (A&B), all subjects participated in HIIT program 3 sessions /week for 12 weeks. In the beginning of each session, a 10-minute of warming-up in form of light treadmilling (3.5 mph speed with 0% incline) was conducted. Over the 12 weeks, the active phase of exercise included 2 minutes of hard workload at 80-90% of maximal heart rate (HRmax) (6-9 mph speed with 2-3%incline) followed by 3 minutes of light workload at 60% of HRmax (3.5 mph speed with 0% incline) repeated for 25 minutes. A pulse oximeter gave a continuous reading of heart rate throughout the session. Maximum heart rate was estimated through the age-predicted HRmax equation (HRmax= 220 − age) which is commonly used as a basis for prescribing exercise programs, as a criterion for achieving maximal exertion and as a clinical guide during diagnostic exercise testing [15]. Finally, a cooling down for 10 minutes in form of stretching exercises was done.

Blood group O (high protein) diet:

Blood group O (high protein) diet was applied for group (A) only. The high protein diet had 2000–2500 calories, 45% protein, 25% carbohydrate, and 30% fat. A changing menu for two weeks was available. The list of the ingredients in various diets was presented to participants. Natural foods were the mainstay of diets. The menus and recipes for different foods were standardised. All subjects participated in a weekly nutrition counselling session to achieve maximum compliance. The diet plan was changed every 2 weeks for 12 weeks for each subject.

Caloric diet:

A Caloric diet was solely used for group (B). The high-carb diet included 2000–2500 calories, 12% protein, 58% carbohydrate, and 30% fat. A changing menu for two weeks was available to each subject. The list of the ingredients in various diets was presented. Natural foods were the mainstay of diets. The menus and recipes for different foods were standardised. All subjects participated in a weekly nutrition counselling session to achieve maximum compliance. The diet plan was changed every 2 weeks for 12 weeks for each subject.

Statistical Analysis

Statistical analysis was conducted using SPSS for windows, version 22 (SPSS, Inc., Chicago, IL). Prior to final analysis, data were screened for normality assumption and presence of extreme scores. Data were normally distributed, as assessed by Shapiro-Wilk's test ($p > 0.05$). The data was collected and statistically analyzed by using mean, standard deviation, paired and unpaired T test for comparison between the two groups. Paired T-test was used for the comparison within the same group. Unpaired T-test was used for the comparison between groups. A significance level of 0.05 was employed in all statistical tests conducted in this study; a P- value of 0.05 indicated a significant result, while a P- value of 0.01 indicated a highly significant result; the lower the P- value, the more significant the results.

Results

Baseline

Initially, no significant disparities were observed at baseline between both groups in the patients' age and height ($p > 0.05$) (Table 1). Moreover, all the indicators of results, encompassing weight, BMI, WHR, BF%, BMR, HbA1c, serum uric acid, creatinine and blood urea, indicated non-significant disparities between the two groups ($p > 0.05$) at baseline (Table 2).

Obesity measurements:

The present study found that body weight decreased significantly in group A (P=0.001* and ↓

10%) and group B (P=0.001* and ↓5.4%) with significant difference between both groups in favour to group A (p=0.02*). BMI decreased significantly in group A (P=0.001* and ↓6.1%) and group B (P=0.01* and ↓2.4%) with significant difference between both groups in favour to group A (p=0.004*). WHR decreased significantly in group A (P=0.001* and ↓5.3%) and group B (P=0.001* and ↓2.1%) with significant difference between both groups in favour to group A (p=0.04*). BF% decreased significantly in group A (P=0.001* and ↓10.8%) and group B (P=0.001* and ↓6.5%) with significant difference between both groups in favour to group A (p=0.03*). BMR decreased significantly in group A (P=0.001* and ↓7.8%) and group B (P=0.001* and ↓4%) with significant difference between both groups in favour to group A (p=0.02*), as illustrated in Table 2.

Blood parameters:

When compared to the baseline, HbA1c decreased significantly in group A (P=0.001* and ↓8.6%) and group B (P=0.001* and ↓3.5%) with significant difference between both groups in favour to group A (p=0.03*). Uric acid increased significantly in group A (P=0.001* and ↑7.6%) and with no significant change in group B (P=0.24 and ↓2%). Serum creatinine increased significantly in group A (P=0.001* and ↑8.3%) and with no significant change in group B (P=0.17 and ↑3.3%). Blood urea increased significantly in group A (P=0.001* and ↑21.4%) and with no significant change in group B (P=0.8 and ↑ 0.9%), as indicated in Table 2.

Table 1. Baseline characteristics.

Variable	Group A	Group B	P-value
Age (years)	42.5± 1.7	42.6± 1.7	0.61
Height (cm)	164.7±6.3	162.8±6.9	0.44

Notes: The mean values and standard deviations have been utilized to express the data. The present investigation employed the unpaired t-test to analyze continuous variables across different groups. *Significant p value ($p < 0.05$). cm: centimeter.

Table 2. Outcome measures in both groups before and after the interventions.

Variable	Group	Baseline	Post	MD	% of change	P-value*
Weight(Kg)	**A**	95± 9.1	85.5±8.9	-9.5	↓10	0.001*
	B	95.7± 8.7	90.6±8	-5.2	↓5.4	0.001*
	p-value**	0.75	0.02**			
BMI(kg/m²)	**A**	37.4± 1.5	35.1±1.5	-2.3	↓6.1	0.001*
	B	37.2± 1.4	36.3±1.6	-0.9	↓2.4	0.01*
	p-value**	0.53	0.004**			
WHR	**A**	0.93± 0.07	0.88±0.07	-0.05	↓5.3	0.001*
	B	0.95± 0.09	0.92±0.07	-0.02	↓2.1	0.001*
	p-value**	0.54	0.04**			
BF(%)	**A**	34.2± 4	30.5±3.4	-3.7	↓10.8	0.001*
	B	35± 3.8	32.7±4.4	-2.3	↓6.5	0.001*

	p-value**	0.43	0.03**			
BMR (kcal/day)	**A**	1730.3± 175.6	1594.8±160.8	-135.5	↓7.8	0.001*
	B	1761.2± 186.3	1690.5±169.9	-70.7	↓ 4	0.001*
	p-value**	0.51	0.02**			
HbA1c(%)	**A**	5.8± 0.58	5.2±0.6	-0.5	↓10.8	0.001*
	B	5.7± 0.56	5.5±0.59	-0.2	↓6.5	0.001*
	p-value**	0.49	0.03*			
Uric acid (mg/dL)	**A**	5.2± 0.73	5.6±0.76	0.4	↑7.6	0.001*
	B	5± 0.71	4.9±0.72	-0.1	↓ 2	0.24
	p-value**	0.34				
Serum creatinine (mg/dL)	**A**	0.9± 0.15	0.98±0.15	0.08	↑8.8	0.001*
	B	0.9± 0.14	0.93±0.17	0.03	↑3.3	0.17
	p-value**	0.9				
Blood urea (mg/dL)	**A**	10.7± 3.8	13±4	2.3	↑21.4	0.001*
	B	10.4± 3.4	10.5±3.2	0.1	↑0.9	0.8
	p-value**	0.53				

Notes: The data are presented in Means ± SD, with statistical significant level assessed through both paired and unpaired t-tests denoted by p-value* and p-value**, respectively; p value < 0. 05 is statistically significant. MD**:** mean difference**;** Kg: kilogram;; BMI: body mass index; WHR: waist-to- hip ratio; BF%: body fat percentage; BMR: basal metabolic rate; kcal: kilocalories; HbA1c: glycated haemoglobin ;mg/dL: milligrams per deciliter.

DISCUSSION

In the current study, there was a significant improvement in the anthropometric measures of obesity in both groups (A and B) as presented by significant decreases in body weight (10 and 5.4%), BMI (6.1 and 2.4%), WHR (5.3 and 2.1%), BF% (10.8 and 6.5%) and BMR (7.8 and 4%) respectively with significant difference between the two groups in favour to group A.

The results of the present study were consistent with the results achieved by Sam et al. who stated that, HIIT can induce reductions in body weight while promoting enhancements in fat-free mass and preservation or improvement in resting metabolic rate. Thus, it may be considered a crucial intervention for weight loss [16].

Parallel to the results of this study, an investigation was administered to evaluate the effect of a six-week period of high-intensity interval training on the reduction of adipose tissue in 24 male and female participants. After completing the prescribed six-week exercise regimen, there was a notable reduction in the BMI, WHR, and overall quantity of skin folds [7].

Moreover, a systematic review was conducted to evaluate the efficacy and safety of HIIT as a therapeutic intervention for obesity. Eleven randomized controlled trials, encompassing a sample size of 488 adolescents with obesity, were identified. According to the meta-analysis, HIIT has demonstrated effective reduction of weight, BMI, and BF% [6] that was consistent with the results achieved by this study.

Also, a diet characterized by high protein content exhibits the potential to increase satiety and energy expenditure. Such a dietary strategy not only contributes to body weight reduction, but also enhances body composition by promoting the increase in fat-free mass percentage. This is achieved by producing a negative energy balance through the elevation of both diet-induced thermogenesis and sleeping metabolic rate [17].

In accordance with our study, Wycherley et al.'s meta-analysis comparing HPD and standard-protein diets with isocaloric, energy-restricted diets was done. The study included 1,063 participants and lasted an average of 12.1 weeks. HPD subjects had significant weight and fat loss, lower blood triglycerides, and increased fat-free mass and energy expenditure compared to those on the standard-protein diet [18].

Similarly, Santesso et al. analysed 74 dietary patterns with a maximum 5% caloric intake variance between groups. High protein diet group members who consumed 16%-45% protein had reduced weight, BMI, WC, and blood pressure compared to the standard-protein diet group (5%-23% protein) [19].

In contradiction, Antonio et al. studied high-protein diet's eight-week impact on body composition (weight, fat mass and BF%) in athletes. High-protein diet did not significantly affect body composition compared to the recommended athlete diet. Results vary may be due to population differences and short intervention duration [20].

In the same way, regarding glycemic control, HbA1c decreased significantly in both groups A and B (8.6 and 3.5% respectively) with significant difference between the two groups in favour to group A.

A randomized trial was conducted to assess the effects of HIIT on HbA1c levels in individuals diagnosed with diabetes over a short-term period (after 12 weeks of training). The findings indicated that the HIIT group demonstrated a statistically significant improvement in HbA1c in comparison to the control group in the short-term period [21] that was in line with our study.

The findings of the current study are also in line with those of Misra et al., who observed that after a period of three months of supervised progressive HIIT, insulin sensitivity and HbA1c significantly improved. Additionally, there was a reduction in both truncal and peripheral subcutaneous adipose tissue, as well as a decrease in blood lipid values [22].

Similar findings were observed in a meta-analysis conducted on individuals diagnosed with diabetes. This study analyzed 418 people in nine feeding experiments lasting four to 24 weeks. The high-protein diet contained 25-32% protein calories, while lower-protein diets had 15-20% protein calories. High protein diets lead to better weight loss, lower HbA1c levels, and reduced blood pressure compared to low protein diets [23].

Another study on short-term weight stability revealed significant reductions in HbA1c levels upon reducing carbohydrate intake by 25% energy and replacing it with fat and protein at a range of 15% to 30%. During a 10-week period, a reduction of approximately 35% in the glucose curve and a reduction of around 25% in HbA1c were observed [24].

The health advantages of HIIT, namely enhanced insulin sensitivity and glycemic control, are commonly associated with prolonged exercise adaptations, including enhancements in cardiorespiratory fitness, alterations in energy balance, and reductions in overall or regional adipose tissue [25].

Blood parameters including, uric acid, creatinine level and blood urea increased significantly in group A (7.6, 8.8 and 21.4% respectively) with no significant change in group B (2, 3.3 and 0.9% respectively).

Like our results, a meta-analysis was conducted to investigate the impact of high protein diets on renal function in individuals without pre-existing kidney disorders, with findings that were comparable to our own. When comparing the effects of high protein diet to those of standard or low protein diets, it was observed that it induced exhibited elevated levels of urea, creatinine, and uric acid in their blood [26].

Moreover, the findings of a community-based prospective study involving 9,226 participants indicated that prolonged intake of high protein diet leads to an elevated risk of renal hyperfiltration and a decline in renal function when compared to a standard-protein diet over a four-year period in the general population [27].

In contrast to a low-protein regimen, the ingestion of a high protein diet over a course of four weeks elicited a substantial amelioration in glomerular filtration rate by 33. 6%, renal blood flow by 38%, and an augmentation in the weight of the kidney by 25.7% [28]. Also, a high protein diet consumed over a period of six months resulted in a notable increase in renal filtration rate of approximately 10% among overweight participants, as determined through a randomized experimental design. Additionally, there were concomitant changes in renal size that were comparable to the observed alterations in renal filtration rate [29].

Additionally, according to Frank et al., a diet rich in protein increases glomerular filtration rate, albuminuria, serum uric acid, and urinary pH levels, potentially accelerating the progression of chronic kidney disease [30].

Limitations

This study was limited by HRmax that wasn't measured through direct means, such as cardiopulmonary exercise testing, owing to the unattainability of the necessary equipment. Moreover, there was no long- term follow-up permitting us to monitor the weight maintenance after the improvements achieved

Conclusion

The present study indicates that, high intensity interval exercise combined with blood group (O) diet can enhance weight management and glycemic control in obese subjects.

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Conflict of interest

No conflicts of interest.

Disclosure statement

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