EFFECT OF HIGH INTENSITY INTERVAL TRAINING VERSUS INTERMITTENT FASTING ON ATHEROGENIC INDEX AMOUNG OVERWEIGHT SUBJECTS

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ABSTRACT

Background: *Being overweight rises the risk of cardiovascular disease and death, which is a global public health concern so, studies suggest that exercise and food modification to be complementary component to prevent cardiovascular risk.* ***Purpose:*** *To assess the differences between the effect of intermittent fasting and high intensity interval exercise on the atherogenic index in overweight individuals...* ***Subjects & Methods:*** *forty overweight subjects of both sexes from el kasr el Eini hospitals were enrolled. subjects ranged from 25 to 35 years in age. subjects had been assigned into three groups. Group A: participated (HIIT) three times/week with basic diet regimen for 8 weeks, Group B: followed a basic diet plan and intermittent fasting (IF) 16/8 protocol for eight weeks. and group C: control group followed only basic diet regimen. The subjects were assessed by body mass index, atherogenic index, waist hip ratio, functional capacity, and quality of life questionnaire.* ***Result:*** *Results of the comparisons showed that the IF group and the HITT group had statistically significant improvements in all of the assessed variables ($P<0.05$), but the control group did not show any meaningful changes ($P>0.05$). In the meantime, comparisons between groups revealed noticeably greater gains that have been documented in support of all HITT outcomes.* ***Conclusion*** *: Both high intensity interval training and intermittent fasting have a significant effect on body mass index and waist hip ratio among overweight subjects, but HITT is more effective to improve atherogenic index, quality of life and functional capacity compared to IF. This suggests that exercise may be more effective for managing obesity, but IF can help subjects especially those who with exercise limitation.*

Keywords: *Atherogenic index; high intensity interval training; Intermittent fasting.; overweight*

INTRODUCTION

Shooting needs complete control over The worldwide obesity epidemic is caused by the accessibility of unhealthy food options and a dearth of physical activity. Cutting back on daily calories results in weight loss, which is associated with improved general health. In relation to LDL, total cholesterol, TG, insulin, blood pressure, glucose levels, and C-reactive protein [1] which ultimately causes the atherogenic index—which is determined by log (TG/HDL-C)—to improve.

Obesity is linked to an increased risk of cardiovascular disease events and death, raising serious concerns for public health. Along with additional obesity-related issues like increased body fat mass, diabetes type 2, and obstructive sleep apnea. Heart problems are directly associated with ectopic fat deposition. [2]

Another innovative marker to determine the risk of cardiovascular disease (CVD) has been proposed: the atherogenic index of plasma (AIP). This evaluates the risk of predictable variables. [3].

The association between AIP and elevated BMI, aberrant lipid metabolism, and dietary fat quality may eventually be utilized to calculate the risk of CVD. [4].

Managing CVD risk factors during primary prevention may involve engaging in physical activity. Training decreased the levels of plasma LDL-C and triglycerides (TG), while increasing HDL-C and the HDL-C/LDL-C ratio (HDL-C/LDL-C). [5].

High-intensity interval training (HIIT) improved the lipid profile, cardio-respiratory fitness, and body composition of obese people. [6].The majority of exercise requires many days per week to provide benefits, and some people are unable to follow an exercise regimen because of a medical condition that could make it difficult for them to exercise, so the search for another alternative methods that need less effort is still ongoing.

Diet improves blood pressure, lipids, glucose, inflammatory indicators, and body composition, exercise capacity, and the function of the muscle [7] .One of the most effective type of diet restriction is intermittent fasting which is an alternative technique for restricting daily calories intake and reducing body weight which enhances other lipids and serum high density lipoprotein, lowering the chance of cardiovascular diseases, which can be caused by a variety of strategies, including alternate-day fasting or time-restricted eating. Intermittent fasting is a safe and effective treatment option for obesity, according to a number of published studies. [1].

Research has demonstrated that intermittent. fasting (IF) 16/8 can improve blood lipid and glycemic control, lower blood pressure, lower circulating insulin, lower inflammatory markers, and reduce fat mass even for brief periods of time, it may be a helpful strategy for enhancing population health overall [8].

Purpose of this study: To assess the differences between the effect of intermittent fasting and high intensity interval exercise on the atherogenic index in overweight individuals.

PATIENTS AND METHODS

Study Design

clinical trial: forty participants, aged 25 to 35, of both sexes were chosen randomly from the EL KASR EL EINY outpatient clinic and divided into three groups. There were 17 male participants and 23 female participants. Group A: For eight weeks, fifteen subjects—seven men and eight women—participated in HIIT three times a week while following a basic dietary

plan. Group B: For eight weeks, fifteen subjects—six males and nine females—followed a basic diet plan and intermittent fasting protocol (16/8). Group C: (Control group): Six females and four males made up the ten subjects who only followed a basic diet plan.

Participants

Subjects have been randomly assigned into three different groups (A&B&C)

Group A: Included 15 subjects (7 males and 9 females) Who participated in high intensity interval training (HIIT) three times \week with basic diet regimen for 8 weeks.

Group B: Included 15 subjects (6 males and 9 females) who followed a program of intermittent fasting 16/8 protocol with basic diet regimen for 8 weeks.

Group C (Control group): that included 10 subjects (4 males & 6 females) followed only basic diet regimen.

The following conditions had to be met for a subject to be considered for inclusion: the subject had to be overweight, aged 25 to 35, with a body mass index between 25 and 29.9 kg/m2. The subject's waist circumference had to be 80 to 88 cm for women and 94 to 102 cm for men. The diet and exercise program must be followed by at least 70% .

Cardiovascular or musculoskeletal conditions, asthma, chronic obstructive pulmonary diseases, any systemic diseases, or any condition that could impair tolerance or adherence to exercise or fasting, as well as a history of stroke, were excluded from consideration. Individuals who fulfilled the inclusion criteria were given information about the study's objectives and asked to fill out consent forms after agreeing to participate. Study was given ethical committee approval at the Faculty of Physical therapy (NO P.T.REC/012/004215).

After measuring the baseline of demographics, the randomization was carried out for 40 patients utilizing closed envelopes. A researcher prepared forty closed envelopes, and each envelope had a card labelled as HITT group or IF group or control group. Each patient was requested to choose a closed envelope through 1:1:1 simple randomization, which determined whether they were randomly allocated to the HITT group (n=15) or IF group (n=15) or control group (n=10).

Measurement procedures:

Participants were divided into three groups randomly: group A, group B, and group C. Before the study began a consent form was taken from all subjects who participated in this study, after complete explanation of the exercise testing procedure all anthropometric measurements were evaluated ,Body weight (Kg) and height (m2) were measured to calculate the body mass index (Kg/m2) in order to determine the inclusion criteria, to be limited to overweight individuals [9].Waist and hip circumferences were measured for each subject to be used for calculation of waist hip ratio[5] . Blood samples were taken to evaluate lipid profiles in order to calculate the atherogenic index, which was calculated using the formula = log (TG/HDL-C). Functional capacity(estimated VO2 max) was evaluated using Standard treadmill Bruce protocol exercise testing (JOHNSON FITNESS, T6000). In the Bruce protocol participants started exercising at a treadmill speed of 2.7 km·h−1 with 10% grade (inclination), speed and grade of inclination then increased in every stage of 3 minutes and end at stage 7 or till exhaustion [10]. Maximum heart rate has also been detected for all subjects in group A by using the pulse oximeter (model: CONTEC, CMS50D, China) . All evaluating measurements tested before and after this study including the Quality of life questionnaire: using short form health survey (SF-12).

Treatment procedures:

Group A: (High intensity interval training with basic diet regimen). Since the HIIT program was carried out individually for each participant [11]. Intensity percentage desired for the training: 80–90% Max HR(MHR): the maximum heart rate attained during the test with the greatest amount of effort. All subjects received two weeks of training to increase their

level of fitness and compliance before the program started.

The participants gradually increased their intensity levels, having started the program at the lower limit (80%) for first two weeks of the program and gradually toward the upper limit (90%) [12]. Prior to starting the treadmill's active training phase, each participant was permitted to warm up for five minutes at intensity equivalent to 65-75% of their maximum heart rate. The 30-minute training phase has been divided into four intervals of exercise in the form of four minutes in length of high intensity (80-90%) of MHR interspersed by 3 minutes of low 65-75% of MHR

The treadmill speed and inclination were increased during the exercise training so that the subjects' heart rates may rise gradually and reach the desired Heart rate . Each session has been terminated with a 5-minute cooling-down time at 50–60% of the Maximum HR.

In conjunction with the HITT, a basic diet plan is prescribed based on the individual's basal metabolic rate, calculated for males using the following formula: BMR = 66.5 + (13.75× weight by kg) + (5.003× height by cm) - (6.755× age in years). For females: BMR = 655 + (9.563×weight by kg) + (1.850× height by cm) - (4.676× age by years) [13].

Group B: (Intermittent fasting 16/8 protocol with basic diet regimen). Depending on their lifestyle and sleeping patterns, each participant was instructed to fast for 16 hours during the study period, and then eat for 8 hours. During the fasting hours, water, tea, and coffee with no calories were permitted. Every day during the feeding hours, calorie-containing beverages were consumed. Based on their basal metabolic rate—which was previously determined—each participant was advised of their optimal daily caloric need [14].

Group C : (also referred to as the control group), consisted of individuals who solely adhered to a basic diet plan determined by their basel metabolic rate as previously mentioned.[13]

DATA ANALYSIS

To compare the subject characteristics between groups, an ANOVA test was performed. A chi-squared test was used to compare the distribution of sexes among the groups. Before analysis, the Shapiro-Wilk test was used to .check the normality of data .To evaluate the homogeneity between groups, Levene's test for homogeneity of variances was used. There was homogeneity of variance and a normal distribution of the data. To compare within and between groups effects on BMI, W/H ratio, AIP, VO2 max, and SF-12, Mixed MANOVA was used. The Bonferroni correction was used in post-hoc tests to perform multiple comparisons later on. All statistical tests were conducted with a significance level of $p < 0.05$. The statistical package for social studies (SPSS) version 25 for Windows (IBM SPSS, Chicago, IL, USA) was used for all statistical analysis.

Results

***- Subject characteristics*:**

Table (1) shows the subject characteristics of group A (High intensity interval training), B (Intermittent fasting) and C (control group) There was no significant difference between groups in age, weight, height, BMI, and sex distribution ($p > 0.05$).

Table 1. Basic characteristics of participants.

	Group A	**Group B**	**Group C**	**p-value**
	Mean ± SD	**Mean ± SD**	**Mean ± SD**	

Age (years)	٢٩,٢٠ ± ٢,١١	28.07 ± 2.46	28.20 ± 2.30	0.36
Weight (kg)	80.70 ± 4.89	82.81 ± 3.02	81.16 ± 4.96	0.39
Height (cm)	169.20 ± 5.39	170.47 ± 3.81	169.80 ± 4.80	0.76
BMI (kg/m²)	21.10 ± 1.85	21.87 ± 1.65	21.56 ± 2.01	0.417
Sex. N (%)				
Females	8 (٥٣%)	9 (٦٠%)	6 (٦٠%)	0.91
Males	7 (4٧%)	6 (٤٠%)	4 (٤٠%)	

SD, standard deviation; p-value, level of significance

Effect of treatment on BMI, W/H ratio, AIP, VO2 max and SF-12:

Mixed MANOVA revealed that there was a significant interaction of treatment and time (F = 73.58, p = 0.001). There was a significant main effect of time (F = ٥١٤,٩١, p = 0.001). There was a significant main effect of treatment (F = 17.17, p = 0.001).

Within group comparison

There was a significant decrease in body mass index (BMI), waist to hip ratio (W/H ratio), atherogenic index of plasma (AIP) and a significant increase in VO2 max post treatment compared with that pretreatment in group A and B (p < 0.001), while there were no significant changes in group C (p > 0.05). (Table 2).

There was a significant increase in Quality-of-life questionnaire short form SF-12 post treatment compared with that pretreatment in group A and B (p < 0.001) while there was no significant changes in group C (p > 0.05). (Table 3).

Between group comparison

There was no significant difference between groups pretreatment (p > 0.05).

There was a significant decrease in body mass index (BMI), waist hip ratio (W/H ratio), atherogenic index of plasma (AIP) of group A and B compared with that of group C post treatment (p < 0.05).

There was a significant increase in VO2 max, quality of life questionnaire (SF-12) of group A and B compared with that of group C post treatment (p < 0.01).

There was a significant decrease in AIP and a significant increase in VO2 max and SF-12 of group A compared with that of group B post treatment (p < 0.01). There were no significant difference BMI and W/H ratio between group A and B post treatment (p > 0.05). (Table 2-3).

Table 2. ***Mean BMI, W/H ratio, AIP and VO2 max pre and post treatment of group A, B and C: pre and post treatment of group A, B and C:***

	Group A	**Group B**	**Group C**	**p-value**		
	mean ± SD	**mean ± SD**	**mean ± SD**	**A vs B**	**A vs C**	**B vs C**
BMI (kg/m²)						
Pre treatment	28.18 ± 0.92	28.67 ± 0.89	28.13 ± 0.75	0.28	0.99	0.3

Post treatment	26.٢٦ ± ٠,٨٣	٢٦,٧٦ ± 0.٦٣	٢٧,٧٣ ± 0.٨٥	0.49	0.001	0.02
MD (% of change)	1.92 (6.81%)	1.91 (6.66%)	0.40 (1.42%)			
	p = 0.001	***p = 0.001***	***p = 0.12***			
W/H ratio						
Pre treatment	0.913 ± 0.053	0.٨٩5 ± 0.061	0.911 ± 0.041	0.65	0.99	0.75
Post treatment	0.٨٣6 ± 0.059	0.843 ± 0.0٥7	0.905 ± 0.0٣8	0.92	0.009	0.02
MD (% of change)	0.08 (8.43%)	0.05 (5.81%)	0.01 (0.66%)			
	p = 0.001	***p = 0.001***	***p = 0.17***			
AIP						
Pre treatment	٠,١٣ ± 0.05	0.15 ± 0.06	0.14 ± 0.04	0.77	0.98	0.9
Post treatment	0.05 ± 0.01	0.09 ± 0.04	0.1٢ ± 0.04	0.01	0.001	0.03
MD (% of change)	0.08 (61.54%)	0.06 (40%)	0.02 (14.29%)			
	p = 0.001	***p = 0.001***	***p = 0.23***			
VO2 max (ml/kg/min)						
Pre treatment	34.41 ± 2.74	33.57 ± 3.87	33.64 ± 4.56	0.81	0.87	0.99
Post treatment	58.37 ± 3.49	40.17 ± 3.59	33.95 ± 4.57	0.001	0.001	0.001
MD (% of change)	-23.96 (69.63%)	-6.60 (19.66%)	-0.31 (0.92%)			
	p = 0.001	***p = 0.001***	***p = 0.71***			

SD, Standard deviation; MD, Mean difference; p-value, Level of significance

Table 3. ***Mean SF-12 pre and post treatment of group A, B and C:***

	Group A	**Group B**	**Group C**	**p-value**		
	mean ± SD	**mean ± SD**	**mean ± SD**	**A vs B**	**A vs C**	**B vs C**
SF-12 physical domain						
Pre treatment	34.08 ± 4.20	35.70 ± 4.38	35.47 ± 5.49	0.6	0.74	0.99
Post treatment	50.53 ± 2.61	43.91 ± 5	37.00 ± 6.67	0.002	0.001	0.003
MD (% of change)	-16.45 (48.27%)	-8.21 (23%)	-1.53 (4.31%)			
	p = 0.001	***p = 0.001***	***p = 0.41***			
SF-12 mental domain						
Pre treatment	37.53 ± 7.08	39.61 ± 4.34	38.93 ± 4.86	0.57	0.82	0.95
Post treatment	53.92 ± 5.27	47.63 ± 3.15	39.57 ± 5.51	0.002	0.001	0.001
MD (% of change)	-16.39 (43.67%)	-8.02 (20.25%)	-0.64 (1.64%)			
	p = 0.001	***p = 0.001***	***p = 0.75***			

SD, Standard deviation; MD, Mean difference; p-value, Level of significance

DISCUSSION

This randomized controlled trial set out to evaluate the effects of intermittent fasting versus high intensity interval training on individuals who were overweight. Comparing all variables pre- and post-study revealed statistically significant changes in the IF and HITT groups ($P<0.05$), but no significant changes in the control group ($P>0.05$).

Atherogenic index

in the current study after eight weeks of HITT, the current study showed improved atherogenic index of plasma (AIP) by 61.54% which is agreed with the results declared by [15] who compared the effects of continuous aerobic training with high intensity interval training on inflammatory and atherosclerotic biomarkers in overweight boys and concluded that HIIT for 12 weeks can improve atherogenic index in boys with overweight/obesity. Moreover, [16] who examined the effects of following four weeks of continuous walking and high-intensity intermittent training on atherogenic indices in middle-aged, obese men and reported that after 4 weeks of HIIT improve HDL-C and reduce triglyceride significantly which led to improvement in atherogenic index in obese middle-aged.

Also, [17] who assessed the lipid profiles of overweight women before and after 12 weeks of high-intensity interval training and concluded that after engaging in high-intensity interval training for 12 weeks, there was a significant reducing in TG, LDL, and total cholesterol levels, as well as a raise in HDL. Additionally, the indices linked to lipid profile showed greater alterations following high-intensity exercise.

The explanation of this improvement of atherogenic index stated by [18] that HITT raises the release of post-heparin lipoprotein lipase (LPL), which raises the clearance of triglycerides and lowers the clearance of HDL-c from plasma. The most significant enzyme in the breakdown of plasma fatty acids is LPL which is assumed to be increased in the plasma, adipose tissue, and skeletal muscle of people who have active lifestyles.

In contrast with this finding a study by [19]who examined the differential effects of interval exercise training on the atherogenic index of plasma in the young male and he approved that 8-week exercise interval training program has no significance difference on atherogenic index of plasma and these discrepancies in the results might be associated with the diversity of training programs and the degree of obesity as in this study the researcher recruited non obese individuals.

also [20] who investigated the effects on cardiometabolic risk indicators in obese adults of high-intensity interval training and moderate-intensity continuous exercise and reported that 8 weeks of HIIT has no significant effects on TC, LDL-C, HDL-C, and TG in obese adults. and this difference might be due to variation in age category or the degree of obesity among this study.

The current study's findings demonstrated a 40% improvement in atherogenic index (AIP) after 8 weeks of intermittent fasting. This can be explained by the findings of [21], who examined the effects of fasting during Ramadan on Apolipoproteins A and B and Atherogenic Index in Students Who Fasted and Students Who Did Not, finding that the fasting group had significantly lower levels of triglyceride, total cholesterol, low density lipoprotein, LDL-C/HDL-C, high density lipoprotein, and atherogenic index. Moreover, HDL increased during the fast. These findings are in line with those of [22], who looked at how intermittent fasting affected the lipid profile and concluded that six weeks of

intermittent fasting improved HDL (low-density lipoprotein) levels and changed the lipid profile, protecting cardiovascular health. Intermittent fasting may be adopted as a lifestyle intervention for the prevention, management, and treatment of cardiovascular disorders.

Moreover [1] stated that intermittent fasting maintains cardiovascular health by enhancing the lipid profile and increasing high density lipoprotein. Following intermittent fasting as a healthy lifestyle can help prevent, manage, and treat cardiovascular disease. The explanation of this improvement of atherogenic index is that During periods of fasting, triglycerides are broken down to fatty acids and glycerol, which are used for energy. [23]

BMI

The results of the current study revealed that 8 weeks of high intensity interval training had a significant difference in body mass index by 6.81% according to subjects in (group A). This result is coincided with [24] who examined the effect of low versus high intensity interval training in obese women and reported that high-volume HIIT group showed significant reductions in BMI by 8.53% ($p = 0.026$), WC by 7.58% ($p = 0.001$), and waist-to-hip ratio by 6.98% ($p = 0.031$) comparing to the baseline.

moreover [25] who reported the impact Moderate-Intensity Exercise and High-Intensity Interval Training in Obese Adults ana concluded that HIIT resulting in body mass loss and reducing waist hip ratio Which is in line [17] with who reported that 4 weeks of HIIT and Continuous Walking on in Obese Middle-Aged Men significantly reducing weight, BMI, and body composition.

The explanation of this improvement is that HIIT causes fat loss through generation of catecholamines which elevated after HITT resulting in increasing the oxidation and release of fat from visceral fat reserves, increased post-exercise excess oxygen consumption, and decreased post-exercise appetite thus resulting in an elevated fat loss state [26]

However, results of this study are inconsistent with the finding of [27] who found that there were non-significant changes in BMI, body weight after five weeks of HIIT. Also [28] reported that body weight did not change after 12 weeks of HIIT. As they thought that lower intensity exercise as continuous aerobic training conducted in the fat burning zone is more effective than HIIT in reducing body weight.

The intervention of intermittent fasting caused a reduction of BMI by 6.66%. The result of this study is consistent with [22] who studied the Impact of Intermittent fasting on lipid profile and showed that 12 hours fasting during day time, three times per week for 6 weeks improves the lipid profile and reduces body weight and waist circumference.

Moreover [1] who revealed that intermittent fasting had significant interaction effects and significant reductions in BW, BMI, and WC after fasting for 16 hours during day time for 5days/week for 6 months Parallel to [29] who revealed that 6 weeks of applying IF 16/8 protocol in overweight women decreasing the body weight by almost 2 kg. the explanation of this improvement is that the breakdown of stored triglycerides and fat oxidation increased after a 16–18 hour fast. increased lipolysis could be an outcome for managing obesity since it might improve fatty acid mobilization and usage in adipocytes as well as absorption and oxidation in other tissues. This would lead to an increase in energy expenditure. [30]

In contrast, [31] who reported no change in body weight and body composition in overweight healthy subjects after two weeks of IF, the minimal percentage of weight reduction recorded is certainly due to the short trial periods used.

Quality of life questionnaire

The results of this study had shown there was a significant increase in quality-of-life questionnaire (HITT group) the percent of improvement was 48.27%. in physical domain and 43.67% in mental domain

The findings of this study were also coincided with [32] who reported that performing High intensity interval training twice per week is useful in promoting cardiometabolic health-related adaptations and quality of life in inactive adults. Also, [33] who studied Effects of volume high intensity versus moderate intensity interval training in obese metabolic syndrome and stated that over 12 weeks HITT has a significant improvement in Quality of life in obese metabolic syndrome patients.

There was a significant increase in SF-12 physical domain by 23% and SF-12 mental domain by 20.25% in the intermittent fasting group. These results came in concordance with a study conducted by [34] who examined the effect of IF on Quality of Life, Fatigue, and Safety in Healthy subjects and stated that there is a significantly improved quality of life results after fasting 16 h for at least five days a week three months of IF.

Moreover, [35] who examined the effectiveness of intermittent fasting to enhance well-being and chronic musculoskeletal pain and reported that 12 weeks of intermittent fasting enhances quality of life and fatigue in healthy subjects.

As obesity is clearly associated with a lower.health.related.quality of life (HRQoL) [36] reducing obesity-related parameters can improve HRQoL. When considering that high-volume HIIT and intermittent fasting groups had significant decreases in adiposity measurements, it is possible that these groups had improvements in HRQoL in the current study are due to these changes. It has to be mentioned that poor HRQoL relates to higher cardiovascular mortality[37] and hence, the enhanced HRQoL reported in the current study may be associated with better cardiovascular health.

In contrast [38] who studied the effect of eight weeks of intermittent fasting versus calorie restriction in women with overweight and reported that there is no change in QOL after fasting 24 hours on 3 nonconsecutive days per week for Eight weeks in overweight women and this may be due to using a different type of intermittent fasting different from what we used.

Functional capacity

As shown by the result of this study that HIIT for 8 weeks has improved functional capacity (VO2max) by 69.63% which is agreed by, [33] who studied Effects of very low volume high intensity versus moderate intensity interval training in obese metabolic syndrome patients stated that HITT significantly improves vo2 max.

Furthermore, [39] found that performing high-intensity interval training (HIIT) three times a week for six weeks can increase VO2max in healthy overweight subjects by 10%. This finding is consistent with [40], who examined the effects of eight weeks of intermittent calorie restriction combined with high-intensity interval training in overweight women and found that both HIIT and continuous training

significantly increased the VO2max of overweight women.

The explanation provided by [41] for this increase in functional capacity is that HIITis strongly correlated with an increase in the demand chain (the mass of mitochondria) and the oxygen supply indicated by activity of citrate.synthase (CS). The number of mitochondria in skeletal muscle is determined by CS activity at its maximum, which is enhanced by aerobic training, particularly HIIT [42]. CS is a biochemical marker of the oxidative response of skeletal muscle to exercise.

Th capacity of HIIT to enhance adenosi ne triphosphate (ATP) generation by raising mitochondrial density, which results in incre ased muscle power production during exerci se, provides an additional scientific basis for how it can enhance functional capacity[43] .

The result of this study is that there is significant difference in functional capacity (vo2 max) in intermittent fasting group by 19.66%. These results agreed with [44] who studied the impact of intermittent fasting on certain performance outcomes from exercise and concluded that intermittent fasting has a greater effect on VO2 max.

The improvement of VO2max noted in this study is due to positive adaptation in body composition as it has been stated that there is an inverse correlation between body mass index and VO2max [45].to investigate the relationship between IF and exercise performance, more research is required.

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