DOI: https://doi.org/10.53350/pjmhs211592793

ORIGINAL ARTICLE

The Effect of Intermittent Fasting and Exercise on Some Physiological Parameters

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ABSTRACT

Background: In this study, the effect of recently popular intermittent fasting on weight loss and the role of exercise combined with intermittent fasting on some physiological parameters were investigated.

Aim: This study was conducted to investigate the effect of intermittent fasting combined with exercise and intermittent fasting alone on some physiological parameters.

Methods: A total of 36 healthy individuals between 20 and 24 years of age, including 18 in the experimental group (exercising) and 18 in the control group (non-exercising), who were assigned by the random selection method, participated in the study. The individuals in the experimental group exercised 36 minutes a day, 5 days a week, along with intermittent fasting for 30 days. On the other hand, the control group did not exercise during this period.

Results: When the within-group pre-test and post-test physiological parameter values were compared, a significant difference was found in all values of the experimental group ($p<0.05$). Similarly, a significant difference was found in the physiological parameter values of the control group ($p<0.05$) too, with the exception of body mass index and body fluid ratio. A statistically significant difference was found between the two groups in terms of the mean differences between the pre-test and post-test physiological parameter values ($p < 0.05$).

Conclusion: Based on the findings, it could be concluded that intermittent fasting is an effective method for losing weight and reducing body fat and that adding low-intensity exercise to this routine ensures more effective weight reduction. Hence, starving for a certain period of time has a favorable effect on the physiological parameters, and the practice of exercising in addition to dieting further improves these values.

Keywords: Intermittent fasting, Exercise, Health

INTRODUCTION

It is known that exercise increases physical fitness, has a favorable impact on overall health, and plays an important role in protecting the body from diseases. Exercise is also important for maintaining a healthy body weight. Body composition and biochemical parameters vary according to the form, intensity, and duration of exercise[1,2]. The combination of high energy intake and sedentary lifestyle paves the way for obesity and chronic diseases[3]. It is known that losing weight through exercise or diet causes significant changes in body composition (fat ratio, muscle mass, lean body mass, etc.)[4]. In addition to these favorable effects, exercise helps manage metabolic diseases such as diabetes, hypertension, and hyperlipidemia and contributes favorably to overall health[5,6,7]. Therefore, it is important to engage in certain levels of physical activity both to lead a healthy life and to prevent obesity and chronic diseases.

Many scientific and non-scientific methods are used to prevent excessive weight gain and to make obese individuals lead a healthy lifestyle. Such individuals may follow various diet programs to regulate their energy consumption. Intermittent fasting method has recently gained prominence among these diet programs. Different methods of intermittent fasting have been reported in the literature, of which the following four have been widely accepted: alternate day fasting, modified fasting diet, time-restricted eating, and Ramadan fasting diet[8]. Even a single fasting interval (for example, overnight) can reduce basal concentrations of many metabolic biomarkers associated with chronic diseases, such as insulin and glucose, in humans[9]. The time-restricted eating model is one of the new dietary approaches in the treatment of obesity, and it focuses on when to eat rather than what to eat. The model refers briefly to cycles of starvation and satiety that include periods during which our body is actually exposed to starvation. This method is based on the principle of a diet with three variants in which food intake is limited to ≤8 hours each day (16:8, 18:6, and 20:4), and only calorie-free liquid foods can be consumed during the remaining part of the day[3,9,10]. The most commonly used method, the 16:8 method, consists of a fasting period of 16 hours followed by an eating session of 8 hours[10]. Considering an individual's chronotype is important while planning the timing in order to enhance adherence and ensure long-term health benefits[11].

It has been reported that the health effects of intermittent fasting are not limited to weight loss and that this approach may be beneficial in managing a wide range of diseases such as cardiovascular diseases, neurodegenerative diseases, inflammation, and cancer[12]. Currently, intermittent fasting methods are among the popular subjects of research, especially because of their effects on weight loss and metabolic health[13]. In a meta-analysis of studies investigating the effects of time-restricted eating on humans, it was concluded that this dietary model improved body weight; total cholesterol, triglyceride, glucose, insulin, IL-6, and TNF-α levels; and insulin sensitivity[14]. It has been found that intermittent fasting is associated with more favorable results than daily calorie-restricted diets in preserving lean mass and is more convenient than other diets for losing weight in obese individuals[15]. In a study by Volpe[16], it has been reported

that intermittent fasting is very effective in reducing the risk of metabolic diseases and ensuring weight loss and that more comprehensive studies on the combination of intermittent fasting and exercise are needed. Furthermore, most of the studies in the literature were performed in obese individuals and the chronotype factor was ignored. Hence, the effect of exercise performed together with intermittent fasting on weight control and certain physiological values in healthy individuals whose chronotypes were determined was investigated in our study.

MATERIAL & METHODS

A total of 36 healthy individuals between 20 and 24 years of age, including 18 in the experimental group (exercising) and 18 in the control group (non-exercising), who were assigned by the random selection method, participated in the study. All individuals followed an intermittent fasting diet for 30 days. Fasting lasted for 16 hours a day, during which none of the participants consumed any food other than calorie-free beverages. During the period other than the fasting period, the participants did not follow any specific diet plan and consumed a diet according to their own wishes. The individuals in the experimental group exercised 36 minutes a day, 5 days a week, along with intermittent fasting for 30 days. On the other hand, the control group did not exercise during this period. The experimental group exercised 2 hours after the first meal following the fasting period. The individuals participating in the study consumed food according to their wishes between 10:00 and 18:00 hours every day throughout the study period. The experimental group performed their 36-minute exercise session between 12:00 and 13:00 hours. The main purpose of food consumption before exercise is to provide the muscles with the necessary energy and to protect them from starvation and exhaustion that may occur during exercise[17]. The personal information of all participants was recorded, and their physiological characteristics (body weight, body mass index, body fat ratio (kg and percentage), lean body weight (kg), body fluid ratio, and required daily calorie intake) were collected using the Tanita brand physiological measuring device on the first and last days of intermittent fasting. Different forms of intermittent fasting exist, and the method used in this study was the time-restricted eating method in which food is consumed within the specified period and no calorie-containing nutrient is consumed outside of this period[18].

Chronotype Evaluation: All living beings have an endogenous circadian clock to ensure that physiological processes occur at optimal times and that the activities are limited either to the day or the night[18]. The self-assessment form used to determine morning and evening types in the human circadian rhythm, which was developed by Horne and Ostberg and was adapted to the Turkish population by Pünduk et al.[19], was used to evaluate the metabolic and physiological processes of healthy individuals who voluntarily participated in the study. In the evaluation, individuals were classified into evening type (score: 16–41), intermediate type (score: 42–58), and morning type (score: 59–86)[20]. All participants were determined as the "intermediate type" to eliminate the chronotype effect in our study. Since the individuals participating in the study generally showed "intermediate type" characteristics, the food consumption period was set as 10:00–18:00 hours.

Figure 1. Exercise Program

X4	Jumping Jack 30 Second	Squad 30 Second	Crunches 30 Second	Side Bends 30 Second	1 min. rest
	Running Man 30 Second	Kick Booty 30 Second	High Knee 30 Second	High Step 30 Second	1 min. rest
	Side High Knee 30 Second	Arm Circle 30 Second	Plunk 30 Second	Body Running 30 Second	1 min. rest

A program that does not contain high-intensity exercise and would not challenge the participants too much but would activate all body muscles and improve the cardiovascular system was designed for the experimental group. There were 12 movements in total in the exercise program, and each movement was performed for 30 seconds. A resting period of 1 minute followed a set of four movements, that is, a 120-second exercise routine. All movements were completed in 9 minutes and repeated four times. In this way, the exercise program lasted for 36 minutes.

Data Analysis: The statistical analysis of the data obtained in the research was carried out using the SPSS 21 package program. The study used the Shapiro–Wilk test and determined that the data showed normal distribution. Accordingly, a Paired t-Test was used in the analysis of the data. In addition, the researcher calculated the difference between the posttest and pretest values of the groups and used the Independent Samples t-Test to compare the differences between the means. The percentage change rate between the pretest and posttest was calculated.

The percentage change rate calculation: This rate was obtained by dividing the difference between the posttest and the pretest by the pretest value and multiplying the result by 100.

RESULTS

Table 1. Descriptive statistics

	Experimental (n=18)	**Control (n=18)**	**p**
	Mean±SD	**Mean±SD**	
Age	22.06±0.80	22.00±1.37	0.883
Height (cm)	170.39±9.18	171.06±9.12	0.828
Body Weight (kg)	71.47±10.93	69.73±8.52	0.598
BMI (kg/m²)	24.55±3.32	23.90±3.77	0.586

A comparison of descriptive information of the participants is given in Table 1. When the data of the experimental and control groups were compared, no statistical difference was found between their mean values ($p > 0.05$).

Table 2. Chronotype scores

Group	**N**	**Mean**	**SD**
Experimental	18	48,78	8,59
Control	18	50,65	6,37

Table 2 shows the mean chronotype scores of the individuals who participated in our study. The scores obtained were found to be 48.78 for the experimental group and 50.65 for the control group. It can also be understood from the table that the mean values of the two groups are within the intermediate type score range.

Table 3. Comparison of the pretest and posttest scores of the physiological parameters of the groups within and between groups

		Experimental (n=18)		Control (n=18)	
		Mean	SD	Mean	SD
Body Weight (kg)	Pre-test	71.47	10.93	69.73	8.52
	Post-test	68.21	11.48	68.93	8.23
	p	0.001		0.020	
BMI (kg/m^2)	Pre-test	24.55	3.32	23.90	3.77
	Post-test	23.19	3.39	23.69	3.55
	p	0.001		0.310	
Body Fat (kg)	Pre-test	16.38	6.87	14.84	7.80
	Post-test	15.16	6.54	14.48	7.47
	p	0.001		0.002	
Body Fat Ratio (%)	Pre-test	22.71	7.74	20.63	10.32
	Post-test	20.94	6.66	20.22	10.01
	p	0.018		0.003	
Lean Mass Value (kg)	Pre-test	49.55	8.09	49.87	7.48
	Post-test	48.37	8.06	49.39	7.73
	p	0.001		0.015	
Body Fluid Ratio	Pre-test	39.25	6.95	38.19	6.12
	Post-test	38.65	6.87	38.15	6.04
	p	0.004		0.581	
Daily Calorie Intake	Pre-test	1497.17	199.33	1488.83	167.96
	Post-test	1454.28	196.20	1480.56	170.05
	p	0.001		0.005	

Table 4. Comparison of pretest-posttest mean differences of physiological parameters between experimental and control groups

		Experimental (n=18)	Control (n=18)
Body Weight (kg)	Pre-test	71.47±10.93	69.73±8.52
	Post-test	68.21±11.48	68.93±8.23
	Differences	-3,27±1,98	-0,81±1,33
	Percentage Change (%)	4.57	1.16
	p	0.001	
BMI (kg/m^2)	Pre-test	24.55±3.32	23.90±3.77
	Post-test	23.19±3.39	23.69±3.55
	Differences	-1,36±1,19	-0,21±0,86
	Percentage Change (%)	5.54	0.88
	p	0.002	
Body Fat (kg)	Pre-test	16.38±6.87	14.84±7.80
	Post-test	15.16±6.54	14.48±7.47
	Differences	-1,22±0,72	-0,37±0,43
	Percentage Change (%)	7.45	2.49
	p	0.001	
Body Fat Ratio (%)	Pre-test	22.71±7.74	20.63±10.32
	Post-test	20.94±6.66	20.22±10.01
	Differences	-1,77±2,86	-0,42±0,56
	Percentage Change (%)	3.57	2.04
	p	0.057	
Lean Mass Value (kg)	Pre-test	49.55±8.09	49.87±7.48
	Post-test	48.37±8.06	49.39±7.73
	Differences	-1,18±0,77	-0,47±0,74
	Percentage Change (%)	2.38	0.94
	p	0.008	
Body Fluid Ratio	Pre-test	39.25±6.95	38.19±6.12
	Post-test	38.65±6.87	38.15±6.04
	Differences	-0,60±0,78	-0,04±0,33
	Percentage Change (%)	1.53	0.11
	p	0.009	
Daily Calorie Intake	Pre-test	1497.17±199.33	1488.83±167.96
	Post-test	1454.28±196.20	1480.56±170.05
	Differences	-42,89±29,64	-8,28±11,03
	Percentage Change (%)	2,87	0.56
	p	0.001	

In Table 3, the within-group preliminary test and final test physiological parameter values of the experimental and control groups were compared. A statistically significant difference was found in all physiological parameter values in the comparison between the preliminary test and final test values of the experimental group ($p < 0.05$). In the comparison of the preliminary test and final test values of the control group, there was no statistically significant difference in the physiological parameter values of body mass index (BMI) and body fluid ratio ($p > 0.05$), while there was a statistically significant difference in body weight, body fat mass, body fat ratio, lean mass value, and daily calorie intake ($p < 0.05$).

The statistics of the difference between the mean preliminary test and posttest physiological parameter values calculated within the experimental and control groups and the percentage change rates are given in Table 4. The differences between the mean values of the experimental and control groups were compared. A statistically significant difference was found between the preliminary test and the posttest physiological parameter values (body weight, BMI, body fat, lean mass value, body fluid ratio, and daily calorie intake) in the experimental and control groups ($p < 0.05$). However, there was no significant difference in body fat ratio ($p > 0.05$).

DISCUSSION

Currently, intermittent fasting methods are among the popular subjects of research, especially because of their effects on weight loss and metabolic health[13]. This study was designed to reveal the effect of low-intensity exercise performed in addition to the time-restricted eating model, which is one of the intermittent fasting methods, on key physiological parameters.

In our study, a statistically significant difference was found in the values of all physiological parameters (body weight, BMI, body fat, body fat ratio, lean mass value, body fluid ratio, and daily calorie intake) while comparing the preliminary test and final test values of the experimental group. In other words, there was a decrease in all final test values when compared with the preliminary test values in the experimental group. Particularly, the improvement in BMI values, which is a good indicator of body fat percentage, shows that the probability of an individual having a fitter and healthier life increases. Similarly, a statistically significant difference was noted in the physiological parameter values of the control group (body weight, body fat, body fat ratio, lean mass value, and daily calorie intake); however, no significant difference was perceived only for BMI and body fluid ratio. This study asserts that exercise in addition to intermittent fasting helps in weight loss and improves certain physiological parameters. There are many studies in the literature that support the results of our study[21,25]. In a study similar to ours, it was observed that energy restriction and exercise performed for the treatment of obesity and weight loss effectively reduced body weight, fat ratio, and abdominal fat. Other studies in the literature also support these findings[26,30]. Moreover, it has been emphasized in weight loss programs that it is important to exercise for a prolonged duration and also adhere to a diet program, especially for local fat loss[31]. Even without following any

diet program, moderate or high-intensity aerobic exercise reduces belly fat in overweight and obese individuals[29]. In addition, in cases where weight loss is not considered, physical activity has a favorable effect on cardiovascular health[32]. Another study emphasizing the importance of exercise reported that exercise performed together with energy restriction protects lean tissue and prevents decrease in the resting metabolic rate[33]. It can be understood from the literature that exercise has favorable effects on body composition and health, but exercising together with diet can provide maximum benefit in the prevention of obesity and obesity-related diseases[34,35].

In a study in which a time-restricted diet was followed, it was determined that 16/8 intermittent fasting could improve some health-related biomarkers, reduce fat mass, and preserve muscle mass[21]. In another study, it was reported that intermittent fasting combined with endurance exercises is an effective method that can be applied to reduce body weight and increase fat burning without causing muscle loss[22]. Aird et al.[26] examined different studies to reveal the effect of exercise performed on an empty and full stomach and reported that training on a full stomach would increase the performance while training on an empty stomach would increase the circulating free fatty acids, that is, fat burning. In yet another study combining the results of different investigations in which resistance training and intermittent fasting were simultaneously performed, it was revealed that muscle mass was preserved and the fat ratio was lowered[25]. Nahuriddin and Yusof[36] examined the effect of 10-day intermittent fasting on the performance of 20 male participants and found that it had a positive effect on triglyceride levels within a short time; hence, the approach could be effective in terms of short-term health benefits, but the individuals' performance decreased. Based on the results, they emphasized that a period of longer than 10 days is needed for the body's adaptation in terms of performance. Ganesan et al.[24] reported in a review examining the effects of intermittent fasting that it ensures weight control and is beneficial in regulating blood glucose and combating insulin resistance.

Epidemiological studies revealed that weight loss and mortality are closely related to each other[37]. Literature findings suggest that there should be a limit to weight loss and that rapid weight loss within a short time can lead to adverse consequences. For example, the analyses revealed that 30% weight loss increased mortality, while 15% fat loss reduced the risk of death[38]. Furthermore, it has been reported that excessive weight loss is an important risk factor for cardiovascular diseases[39]. Diet program and exercise should be implemented in moderation and excessiveness should be avoided.

In our study, when the differences between the mean preliminary test and the final test physiological parameter values calculated within the experimental and control groups were compared, a statistically significant difference was found in the physiological parameter values (body weight, BMI, body fat, lean mass value, body fluid ratio, and daily calorie intake). No significant difference was found only in the body fat ratio. In the literature, initial studies related to intermittent fasting found that rats that were fed such a diet lived twice as long as the control group that consumed as much as and whenever they wanted to[40,41]. It has been observed that when intermittent fasting is started at middle age, individuals live 30%–40% longer than the control group in the similar age range who consume food as much as and whenever they want to. In addition, it has been reported that this life span can be further increased with exercise[42]. In two different studies that obtained results similar to ours, Heilbronn et al.[43] and Horne et al.[44] documented that intermittent fasting caused significant weight loss. In another study, it was established that intermittent fasting for 3 weeks led to a weight loss of 2.5% in the participants[43]. Contrary to our results, in a study by Halberg et al.[45], it was noticed that intermittent fasting for 2 weeks did not make a significant difference in terms of body weight. In a randomized controlled study in which intermittent fasting was followed for 12 weeks, a mean weight loss of 6% was achieved, and it was demonstrated that intermittent fasting was an effective way to lose weight[46]. This result shows that long-term intermittent fasting may lead to favorable results.

In our study, the percentage change in physiological parameter values was also calculated to clearly reveal the changes between the preliminary and final test values in both groups for gaging the effect of exercise. The percentage changes in the experimental group were found to be 4.57% for body weight, 5.54% for BMI, 7.45% for body fat, 3.57% for body fat ratio, 2.38% for lean body mass, 1.53% for body fluid ratio, and 2.87% for daily calorie intake. The percentage changes in the control group were found to be 1.16% for body weight, 0.88% for BMI, 2.49% for body fat, 2.04% for body fat ratio, 0.94% for lean body mass, 0.11% for body fluid ratio, and 0.56% for daily calorie intake. Thus, the rates of change in the preliminary test and final test values of the group that exercised along with intermittent fasting (experimental group) were higher than those of the control group.

To lose weight and have a fit appearance, it has been suggested that moderate physical activity in addition to calorie restriction is an effective method; conversely, the weight loss effect of exercise performed without calorie restriction would be weak[47,]. Hagan et al.[48] found in a 12-week study that 5.5% of the body weight was lost with diet alone, 0.6% of it with exercise alone, and 7.5% of it with diet and exercise combined. In addition, Ross et al.[49] recorded a mean weight loss of 7.6 kg with diet and exercise. It is known that exercise performed together with a diet program preserves muscle mass and slightly increases the basal metabolic rate[50] In a study investigating the effect of diet and exercise on weight loss, it was found that the weight lost by dieting and creating a calorie deficit was regained after a while, while the weight loss achieved during the programs in which diet and exercise were applied together was permanent[51,52,53]. This observation supports the results of our study and demonstrates that these results are sustainable in the long run.

The International Association for the Study of Obesity recommends at least 30 minutes of moderate physical activity 7 days a week to prevent chronic diseases and support overall health in adults. However, this level may be insufficient for losing weight or for maintaining the body weight after reduction. As previously mentioned, this finding reestablishes the necessity of adopting an exercise regimen in combination with diet programs.

CONCLUSIONS

Based on the findings, it could be concluded that intermittent fasting is an effective method for losing weight and reducing body fat and that adding low-intensity exercise to this routine ensures more effective weight reduction. Hence, starving for a certain period of time has a favorable effect on the physiological parameters, and the practice of exercising in addition to dieting further improves these values.

REFERENCES

1. Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, Bouchard C. Physical activity and public health: a recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. JAMA. 1995; 273(5): 402-427.
2. Ball K, Owen N, Salmon J, Bauman A, Gore C. Associations of physical activity with body weight and fat in men and women. International Journal of Obesity. 2001; 25(6): 914.
3. Akpınar Ş, Akbulut G. Aralıklı açlık diyetlerinin ağırlık denetimi ve sağlık çıktıları üzerindeki etkisi. Süleyman Demirel Üniversitesi Sağlık Bilimleri Dergisi. 2019; 10(2): 177-83.
4. Slentz CA, Duscha BD, Johnson JL, Ketchum K, Aiken LB, Samsa GP, et al. Effects of the amount of exercise on body weight, body composition, and measures of central obesity: STRRIDE a randomized controlled study. Archives of Internal Medicine. 2004: 164(1):31-9.
5. Boulé NG, Haddad E, Kenny GP, Wells GA, Sigal RJ. Effects of exercise on glycemic control and body mass in type 2 diabetes mellitus: a meta-analysis of controlled clinical trials. JAMA. 2001: 286(10): 1218-27.
6. Church TS, Blair SN, Cocreham S, Johannsen N, Johnson W, Kramer K, et al. Effects of aerobic and resistance training on hemoglobin A1c levels in patients with type 2 diabetes: a randomized controlled trial. Jama. 2010: 304(20); 2253-62.
7. Lee CJ, Kim JY, Shim E, Hong SH, Lee M, Jeon JY, et al. The effects of diet alone or in combination with exercise in patients with prehypertension and hypertension: a randomized controlled trial. Korean Circulation Journal. 2018: 48(7); 637-51.
8. Patterson RE, Sears DD. Metabolic effects of intermittent fasting. Annual Review of Nutrition. 2017: 37; 371-93.
9. Upadhyay A, Anjum B, Godbole NM, Rajak S, Shukla P, Tiwari S, et al. Time-restricted feeding reduces highfat diet associated placental inflammation and limits adverse effects on fetal organ development. Biochem Biophys Res Commun. 2019: 514(2); 415-21.
10. Malinowski B, Zalewska K, Wesierska A, Sokolowska MM, Socha M, Liczner G, et al. Intermittent fasting in cardiovascular disorders An overview. Nutrients. 2019: 11(3); 673.
11. Qoeiroz JN, Macedo RCO, Tinsley GM, Oliveira AR. Timerestricted eating and circadian rhythms: the biological clock is ticking. Crit Rev Food Sci. 2020: 14; 1-13.
12. Mattson MP, Longo VD, Harvie M. Impact of intermittent fasting on health and disease processes. Ageing Res Rev. 2017: 39; 46-58.
13. Patterson RE, Laughlin GA., Sears DD, LaCroix AZ, Marinac C, Gallo LC, et al. Intermittent fasting and human metabolic health. Journal of the Academy of Nutrition and Dietetics. 2015: 115(8); 1203-1212.
14. Rothschild J, Hoddy KK, Jambazian P, Varady KA. Time restricted feeding and risk of metabolic disease: a review of human and animal studies. Nutr Rev. 2014: 72(5); 308-18.
15. Hesketh K, Wake M, Graham M. Stability of television viewing and electronic game/computer use in a prospective cohort study of Australian children: relationship with body mass index. Int J Behav Nutr Phys Act; 2007: 4; 60.
16. Volpe SL. Intermittent Fasting -What Is It and Does It Work? ACSM's Health & Fitness Journal. 2019: 23(1); 34-36.
17. Ersoy G. Futbolcular için beslenme ilkeleri. Hacettepe Üniversitesi Yayınları.1995: 2; 5-18.
18. Panda S, Hogenesch JB, Kay SA. Circadian rhythms from flies to human. Nature. 2002: 417; 329–35.
19. Pündük Z, Gür H, Ercan İ. Sabahçıl-Akşamcıl Anketi Türkçe uyarlamasında güvenilirlik çalışması. Türk Psikiyatri Dergisi. 2005: 16(1); 40-45
20. Mota C, Santos M, Mauro R, Samman N, Matos AS, Torres D, Castanheira I. Protein content and amino acids profile of pseudocereals. Food chemistry. 2016: 193; 55-61.
21. Moro T, Tinsley G, Bianco A, Marcolin G, Pacelli QF, Battaglia G, Paoli A. Effects of eight weeks of time-restricted feeding (16/8) on basal metabolism, maximal strength, body composition, inflammation, and cardiovascular risk factors in resistance-trained males. Journal of Translational Medicine. 2016: 14(1); 290.
22. Moraes RC, Portari GV, Ferraz ASM, Da Silva TEO, Marocolo M. Effects of intermittent fasting and chronic swimming exercise on body composition and lipid metabolism. Applied Physiology, Nutrition and Metabolism. 2017: 42(12); 1341-1346.
23. Aird TP, Davies RW, Carson BP. Effects of fasted vs fed-state exercise on performance and post-exercise metabolism: A systematic review and meta-analysis. Scand J Med Sci Sports. 2018: 28; 1476–1493.
24. Ganesan K, Habboush Y, Sultan S. Intermittent Fasting: The choice for a healthier lifestyle. Cureus. 2018: 10(7); e2947.
25. Keenan S, Cooke MB, Belski R. The Effects of intermittent fasting combined with resistance training on lean body mass: A systematic review of human studies. Nutrients. 2020: 12(8); 2349.
26. Miles L. Physical activity and health. Nutrition Bulletin. 2007: 32(4); 314-63.
27. Zemel MB. The role of dairy foods in weight management. Journal of the American College of Nutrition. 2005: 24(sup6); 537-546.
28. Westerterp KR. Physical activity, food intake, and body weight regulation: insights from doubly labeled water studies. Nutrition Reviews. 2010: 68(3); 148-154.
29. Vissers D, Hens W, Taeymans J, Baeyens JP, Poortmans J, Van Gaal L. The effect of exercise on visceral adipose tissue in overweight adults: a systematic review and meta-analysis. PloS One. 2013: 8(2); e56415.
30. Ho SS, Dhaliwal SS, Hills AP, Pal S. The effect of 12 weeks of aerobic, resistance or combination exercise training on cardiovascular risk factors in the overweight and obese in a randomized trial. BMC Public Health. 2012: 12(1); 704.
31. Chaston T, Dixon J. Factors associated with percent change in visceral versus subcutaneous abdominal fat during weight loss: findings from a systematic review. International Journal of Obesity. 2008: 32(4); 619.
32. Reiner Ž, Catapano AL, De Backer G, Graham I, Taskinen MR, Wiklund O, et al. ESC/EAS guidelines for the management of dyslipidaemias: the Task Force for the management of dyslipidaemias of the European Society of Cardiology (ESC) and the European Atherosclerosis Society (EAS). European Heart Journal. 2011: 32(14); 1769-818.
33. Byrne NM, Hills AP, Hunter GR, Weinsier RL, Schutz Y. Metabolic equivalent: one size does not fit all. J Appl Physiol. 2005: 99(3); 1112-9.
34. Janssen I, Fortier A, Hudson R, Ross R. Effects of an energy-restrictive diet with or without exercise on abdominal fat, intermuscular fat, and metabolic risk factors in obese women. Diabetes Care. 2002: 25(3); 431-8
35. Özenoğlu A, Uzdil Z, Sevde Y. Kadınlarda tek başına planlı egzersizin antropometrik ölçümler ve vücut kompozisyonu

üzerine etkisi. Samsun Sağlık Bilimleri Dergisi. 2016: 1(1); 1-10.
36. Naharudin MN. Yusof A. The effect of 10 days of intermittent fasting on Wingate anaerobic power and prolonged high-intensity time-to-exhaustion cycling performance. European Journal of Sport Science. 2018: 18(5); 667-676.
37. Andres R, Muller DC, Sorkin JD. Long-term effects of change in body weight on all-cause mortality. A review. Ann Intern Med. 1993: 119; 737-743.
38. Allison DB, Zannolli R, Faith MS. Weight loss increases and fat loss decreases all-cause mortality rate: results from two independent cohort studies. Int J Obes Relat Metab Disord. 1999: 23; 603-611.
39. Pi-Sunyer FX. A review of long-term studies evaluating the efficacy of weight loss in ameliorating disorders associated with obesity. Clin Ther. 1996: 18; 1006-1035.
40. Goodrick CL, Ingram DK, Reynolds MA, Freeman JR, Cider NL. Effects of intermittent feeding upon growth and life span in rats. Gerontology. 1982: 28(4); 233-241.
41. Goodrick CL, Ingram DK, Reynolds MA, Freeman JR, Cider NL. Differential effects of intermittent feeding and voluntary exercise on body weight and lifespan in adult rats. J. Gerontol. 1983: 38(1); 36-45.
42. Singh R, Manchanda S, Kaur T, Kumar S, Lakhanpal D, Lakhman SS, et al. Middle age onset short-term intermittent fasting dietary restriction prevents brain function impairments in male Wistar rats. Biogerontology 2015: 16(6); 775-788.
43. Heilbronn LK, Smith SR, Martin CK, Anton SD, Ravussin E. Alternate-day fasting in nonobese subjects: effects on body weight, body composition, and energy metabolism. Am J Clin Nutrv. 2005: 81(1): 69–73.
44. Horne BD, Muhlestein JB, Lappe DL, May HT, Carlquist JF, Galenko O, et al. Randomized cross-over trial of shortterm water-only fasting: Metabolic and cardiovascular consequences. Nutr Metab Cardiovasc Dis. 2013: 23(11); 1050-7.
45. Halberg N, Henriksen M, Soderhamn N, Stallknecht B, Ploug T, Schjerling P, et al. Effect of intermittent fasting and refeeding on insulin action in healthy men. J Appl Physiol. 2005: 99(6); 2128-36. Doi: 10.1152/japplphysiol.00683.2005
46. Varady KA, Bhutani S, Klempel CM, Kroeger MC, Trepanowski FJ, Haus MJ, et al. Alternate day fasting for weight loss in normal weight and overweight subjects: a randomized controlled trial. Nutrition Journal. 2013: 12(1); 146.
47. Katzel LI, Bleecker ER, Colman EG, Rogus EM, Sorkin JD, Goldberg AP. Effects of weight loss vs aerobic exercise training on risk factors for coronary disease in healthy, obese, middle-aged and older men. A randomize controlled trial. JAMA. 1995: 274; 1915-21.
48. Hagan, R.D., Upton, S.J., Wong, L., James, W. The effects of aerobic conditioning and/or caloric restriction in overweight men and women. Med Sci Sports Exerc. 1986: 18; 87-94.
49. Ross R, Dagnone D, Jones PJ, Smith H, Paddags A, et al. Reduction in obesity and related comorbid conditions after diet-induced weight loss or exercise-induced weight loss in men. Ann Intern Med. 2000: 133; 92-103.
50. Sparti A, DeLany JP, de la Bretonne JA. Sander GE, Bray GA. Relationship between resting metabolic rate and the composition of the fat-free mass. Metabolism. 1997: 46; 1225-30.
51. Fogelholm M, Kukkonen-Harjula K, Nenonen A, Pasanen M. Effect of walking training on weight maintenance after a very low energy diet in premenopausal obese women. Arch Intern Med 2000: 160; 2177-84.
52. Ozdemir, M., Tanir, H., Ilkim, M., & Ozmaden, M. (2017). The effects of 8 week exercise program on reaction time performance of hearing impaired students at 11-14 years of age.
53. Ilkim, M., Ozdemir, M., & Tanir, H. (2017). Evaluation of some physical and motoric characteristics of athletes with down syndrome.