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Comparative analysis of intermittent and continuous energy restriction in obesity management

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ABSTRACT

An alternative to continuous energy restriction in the medical nutrition treatment of obesity, which has come to the fore in recent times, is called intermittent fasting. The aim of this study is to compare the effects of intermittent energy restriction (IER) and continuous energy restriction (CER) practices on body composition and anthropometric measurements in overweight and first-degree obese individuals. The comparison study was conducted on 34 people aged 19-64 between April and September 2022. They had no health problems, and applied to a private institution providing nutrition consultancy. In the study, the participants were divided into two groups and were asked to maintain the IER or CER diet type for six weeks. When the participants in the two diet types were compared in terms of parameters of anthropometric measurements, body compositions, blood pressure measurements, and initial and final measurements of abdominal fat analysis, no statistically significant difference was found ($p\alpha$, $p\beta>0.05$). The mean weight loss of the participants in the IER and CER groups was 3.95±1.94 kg and 4.09±1.48 kg, respectively. The weight loss of the participants in the two diet groups was similar. The long-term efficacy and safety of time-restricted feeding in weight loss is still unclear. More comprehensive research is needed on this subject.

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1. INTRODUCTION

Obesity is a complex and multifactorial disease characterized by excessive adiposity and increased risk of non-communicable chronic diseases. In the fight against obesity, which has become a global public health problem, weight loss through lifestyle change has been proven to be the basis of weight management. Although the success with lifestyle intervention is limited, it is the first-line therapy to treat obesity and prevent associated comorbidity [1], [2].

Energy-restricted diet intervention and consequent weight loss is the main method in the treatment of obesity [3]. There are different multivariate diet models with different macronutrient content. Reducing daily energy intake is the most common strategy for stimulating weight loss [4]. Although 5 to 10% weight loss can be achieved with an average energy restriction, adherence to this dietary method decreases within 1-4 months [3]. Due to this limitation, alternative weight loss diet strategies are being researched [5].

An alternative to continuous energy restriction in the medical nutrition treatment of obesity, which has come to the fore in recent times, is called intermittent fasting or intermittent energy restriction [6]. In fact, it is known that this feeding method has been practiced for many years and has a place in religious beliefs [7]. The main point that distinguishes intermittent energy restriction from continuous energy restriction (CER) is

that there are certain periods of time spent with hunger. Furthermore, unlike the CER method, there is no or minimal energy restriction during feeding periods [6]. There are multiple methods of applying intermittent energy restriction [8]. Although there is no standard application of intermittent energy restriction (IER), it is a method in which energy and nutrient intake are alternated, no restriction is applied in daily energy intake, or a low level restriction is applied [6]. For many people, it is considered less restrictive than methods in which energy intake is restricted [9]. The most frequently applied methods of IER application are periodic long fasting, time-restricted feeding and alternate day fasting. Fasting period, application method and feeding times are different from each other in each method [8]. There are three different methods of time-restricted diet: 16:8, 18:6 and 20:4. The 16:8 method defines fasting for 16 hours and eating for 8 hours. With more detailed planning, the eating interval can be reduced to 4 hours and the fasting period can be increased to 20 hours [10]. In time-restricted nutrition, there is no restriction on the consumption of energy-free beverages during fasting [11].

Studies have shown that time-restricted feeding causes weight loss in healthy adults, and it has an effect in the short-term treatment of various chronic diseases, including diabetes and cardiovascular disease [12], [13]. However, the long-term effect of weight loss still remains unclear [1], [14]. The aim of this study is to compare the effects of intermittent energy restriction and continuous energy restriction on body composition and anthropometric measurements in overweight and 1st degree obese individuals.

2. METHOD

The method of this research was a comparative analysis of two dietary interventions. This study was carried out with 51 volunteers, aged 19-64 years, who are overweight and have 1st degree obesity, who applied to a private institution providing nutrition counseling services in Ankara between April 2022 and September 2022 for weight loss purposes and agreed to participate in the study for six weeks. Considering the effect size in weight values in a study; according to 95% power of test (1-β), 95% confidence (1-α), d=0.95 effect size and one-way hypothesis, the total number of cases that should be included in the study was determined as 50 [15]. During the data collection, seven participants of the IER diet group; 10 participants of the CER diet group left the study because they did not follow the study plan. The sample of the study consisted of 34 individuals. This study was approved by Baskent University Institutional Review Board and Ethics Committee (Project no: KA22/197).

2.1. Participants

An IER diet or a CER diet applied to the individuals participating in the study. The sample of the study consisted of 34 individuals (IER=19 individuals; CER=15 individuals) who filled out the questionnaire completely and without mistakes, completed three diet records after the study started, and had body analyzes done both at the beginning and at the six week. Those who have chronic diseases (diabetes, coronary artery disease, hypertension, cancer, and kidney disease), those who have lost more than 5% weight in the last three months, those who have a moderate level of physical activity, those who have endocrine dysfunction, those who are pregnant and breastfeeding Individuals who have a special dietary preference or follow a special diet plan (food allergy and vegan), those who are taking medication for psychological problems, and those who use drugs that are known to affect body weight significantly were not included in the study. In order to determine the demographic and general characteristics and eating habits of the participants, a questionnaire consisting of multiple-choice and open-ended questions was applied by face-to-face interview method.

2.2. Anthropometric measurements

Height measurements, body weight measurements, body composition analyzes, neck, waist and hip circumference measurements, abdominal fat analysis and blood pressure measurements were made and recorded. These measurements were taken at the beginning of the study and repeated six weeks later. Body weight, lean body mass (kg), lean body mass ratio (%), body fat mass (kg), body fat mass ratio (%), body fluid mass (kg), body fluid mass ratio (%) of individuals were measured by the researcher by using bioelectrical impedance analysis with TANITA MC780 MA brand body analyzer. On the days when the measurements will be taken, the individuals were informed that the measurement should be made at least three hours after the consumption of food and beverage. The analysis was repeated by calling the participants for a control session on the same day every week, under the same measurement conditions. If the participants did not participate in the control session, they were asked to repeat the measurement on the first day of the next week. The beginning and six week results were included in the study.

Height was measured with a 0.1 cm sensitive stadiometer at the beginning of the study. During the measurement, the individuals were measured without shoes, their heels together, their hips and heels touching the stadiometer, and their head in the Frankfurt plane (eye triangle and auricle are at the same level, parallel to

the ground). Body mass index (BMI) calculated as weight in kilograms divided by the square of height in meters. Waist circumference was measured by the researcher, it was parallel to the ground, located between the lowest rib bone and the cristailiac and passing through the midpoint of the individuals. The data obtained were evaluated according to the WHO classification.

Hip circumference was measured at the widest circumference of the hip with a non-stretchable tape measure, parallel to the ground. During the measurement, the individuals were in an upright position, their arms were at their sides, and their feet were close to each other. The waist-to-height ratio is calculated by dividing the waist circumference by height, and the waist-to-hip ratio is calculated by dividing the waist circumference by the hip circumference. Neck circumference was measured with a non-flexible tape measure perpendicular to the neck axis, just below the cricoid cartilage, with the head in an upright position. The ≥34 cm value in female individuals; A value of ≥37 cm in male individuals is considered a risk factor for obesity.

Adiposity around the internal organs and adiposity in the abdominal area measurements were made with the TANITA Viscan AB 101 abdominal analyzer. All the criteria considered during body composition analysis were applied to the individuals. Systolic blood pressures (SBP) and diastolic blood pressures (DBP) of individuals were measured at the beginning and end of the study with the automatic blood pressure monitor OMRON (HEM-7121). The measurement was made on the left arm after 20 minutes of rest.

2.3. Diet plan

The diet plans of the individuals, individuals who were randomly assigned to the groups according to the order of arrival for the first interview, were planned in the form of IER and CER, according to the group by the dietitian who conducted the research. Basal metabolic rate (BMR) is the energy that the body needs enough to maintain its vital functions at rest. The basal metabolic rates of individuals were calculated using the Harris-Benedict formula [16]. Then, the daily energy requirements were calculated by multiplying the physical activity factor (1-1.2) according to the physical activity status. Thermal energy from food is ignored. Energy, macro and micronutrient intake levels were calculated from the data obtained with the "Computer aided nutrition program, nutrition information systems package program (BEBİS)" software program.

2.3.1. Intermittent energy restriction

It was reported that individuals in the IER group were planned to take food for eight hours or less a day for six weeks. Participants could only consume water, tea, coffee, mineral water, unsweetened herbal tea during the remaining at least 16 hours of fasting period of the day. Participants practiced intermittent fasting for six weeks.

2.3.2. Continious energy restriction

It was prepared by determining the meal time and number suitable for the lifestyles of the individuals according to the energy and macronutrient values calculated for the individuals included in the CER group. Weekly interviews were planned with all participants during the six-week weight loss diet period. In the interviews, individualized recommendations were given to encourage additional lifestyle changes and increase compliance with the nutrition programs. All participants were asked to maintain their current physical activity level throughout the study. Before the beginning of the study, the participants were asked to record a three-day food consumption record for a total of three times, in the 3rd week and the 6th week. Food consumption records were recorded two days on weekdays; one day at the weekend. A photographic food catalog was used to determine the amounts of food and beverages consumed by the participants [17]. In order to evaluate the accuracy of the applied diet, the participants were asked to keep a three-day food consumption record in the third week of the study. At the end of the study (six week), a three-day food consumption record was taken again to compare with the initial nutritional status.

2.4. Statistical analysis

During the statistical analysis of the data obtained in the study, the IBM-SPSS (statistical package for the social sciences) 23 statistical package program was used. In the study, categorical variables were summarized with frequency distributions, and quantitative variables were summarized with mean and standard deviation. The normality of the variables in the quantitative structure was examined by Kolmogorov Smirnov and Shapiro-Wilk goodness-of-fit tests. Although the distribution of the majority of the variables in the study was in accordance with the normal distribution, appropriate transformation methods were used for the variables that did not show normal distribution and adaptation to the normal distribution was achieved. Fisher's exact test was used to control the difference between the two diet types related to qualitative demographic variables, lifestyle habits, health status and nutritional habits of individuals. In cases where the number of categorical variable levels was more than 2, the Chi-square test was applied. Independent samples t-test was used to control the statistical significance of the difference between the two diet types and men and women in terms of quantitative variables. Paired samples t-test was used to compare the measurements of individuals at the first

and last interview. The McNemar test was used to compare the classifications for the first and last measurements. The inter-subject effects of factors and the within-subject effect of time as well as the significance of interactions between factors were analyzed under multiple repeated measures ANOVA. In the process of revealing the relationship between two quantitative variables, the Pearson correlation coefficient was used, and the significance, magnitude and direction of the relationships were interpreted through the correlation coefficients. The upper limit for the statistical significance level in the tests was taken as 0.05.

3. RESULTS AND DISCUSSION

Data on demographic characteristics and health status of individuals are shown in Table 1. The mean age of the individuals in the IER group was 37.8±10.24 years, and the mean age of the individuals in the CER group was 36.0±6.36 years (p=0.540). When the results were examined, a statistically significant difference was found between two different diet types in terms of skipping meals (p=0.029). While all of the IER group participants skipped meals, 73.3% of the CER group participants skipped meals.

Table 1. Demographic characteristics and health status of individuals

Demographic characteristics/Health status	IER (n=19)		CER (n=15)		Total (n=34)		p
	n	%	n	%	n	%	
Age groups (years)							
19-27	2	10.5	-	-	2	5.9	0.269[c]
28-37	7	36.8	10	66.7	17	50.0	
38-47	7	36.8	4	26.7	11	32.4	
48-57	3	15.8	1	6.7	4	11.8	
58-64	-		-		-		
Age (years) (X ± SS)	37.8±10.24		36.0±6.36		37.1±8.67		0.540[b]
Gender							
Female	15	78.9	10	66.7	25	73.5	0.338[a]
Male	4	21.1	5	33.3	9	26.5	
Educational status							
Primary education	1	5.3	-	-	1	2.9	0.809[c]
Highschool	3	15.8	1	6.7	4	11.8	
Bachelor degree/Associate degree	12	63.2	11	73.3	23	67.6	
Postgraduate degree	3	15.8	3	20.0	6	17.6	
Occupation							
Student	1	5.3	-	-	1	2.9	0.580[c]
Insured employee	6	31.6	3	20.0	9	26.5	
Pensioner	1	5.3	-	-	1	2.9	
Civil servant	7	36.8	8	53.3	15	44.1	
Self-employement	3	15.8	4	26.7	7	20.6	
(Unemployed)	1	5.3	-	-	1	2.9	
Marital status							
Single	7	36.8	5	33.3	12	35.3	0.520[c]
Married	12	63.2	10	66.7	22	64.7	
Living place							
Dorm	-		-		-		0.220[a]
Home (with family)	17	89.5	11	73.3	28	82.4	
Home (with a friend)	-		-		-		
Home (alone)	2	10.5	4	26.7	6	17.6	
Chronical disease in family							
Yes	9	50.0	5	33.3	14	42.4	0.271[a]
No	9	50.0	10	66.7	19	57.6	
Skipping meal							
Yes	19	100.0	11	73.3	30	88.2	0.029[a]*
No	-	-	4	26.7	4	11.8	
If yes, which meal							
Breakfast	5	26.3	5	45.5	10	33.3	0.623[c]
Lunch	10	52.6	4	36.4	14	46.7	
Dinner	1	5.3	-	-	1	3.3	
Snacks	3	15.8	2	18.1	5	16.7	
Reason of skipping meal							
Weight loss	7	36.8	1	9.1	8	26.7	0.108[a]
I don't have a habit	3	15.8	4	36.4	7	23.3	0.200[a]
I don't want to	3	15.8	4	36.4	7	23.3	0.200[a]
I don't have time	10	52.6	4	36.4	14	46.7	0.317[a]
I forget	1	5.3	1	9.1	2	6.7	0.607[a]
Meal doesn't get prepared	1	5.3	1	9.1	2	6.7	0.607[a]

IER: Intermittent energy restriction group, CER: Continuous energy restriction group, a: Fisher's exact test, b: Independent samples t-test, c: Chi-square test *Significant p-value at p<0.05

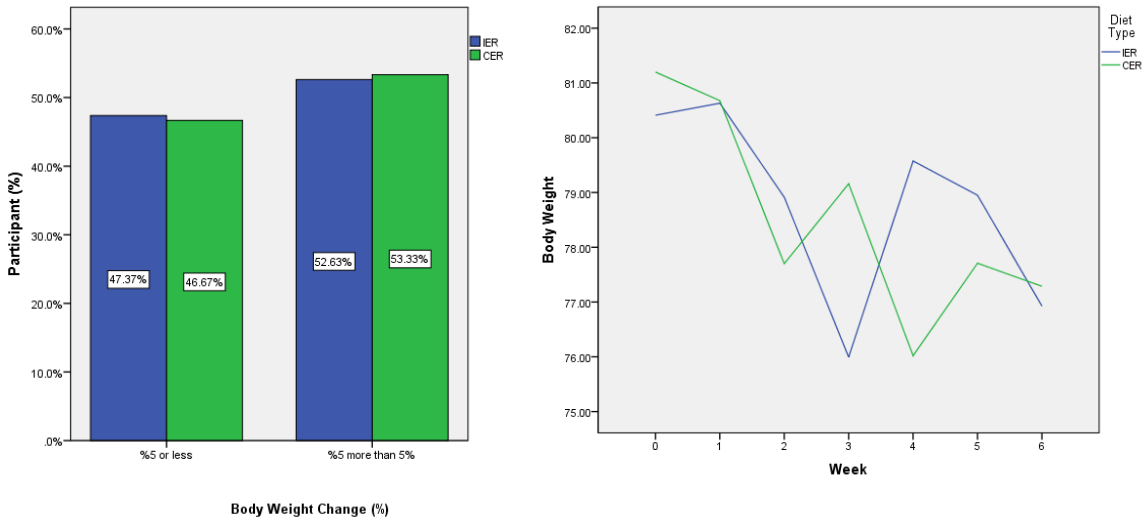
Information on anthropometric measurements, body composition analyzes, blood pressure measurements, and abdominal fat analyzes of individuals at the beginning and at the end of sixweeks are given in Table 2. The participants in the two diet groups were compared in terms of parameters of anthropometric measurements, body compositions, blood pressure measurements and abdominal fat analysis, no statistically significant difference was found ($p>0.05$). A statistically significant difference was found between the first and last measurements of all parameters except waist/hip ratio ($p=0.056$) and DBP ($p=0.128$) in women who followed the IER diet type ($p^1<0.05$). A statistically significant difference was found between the first and last measurements of all parameters except waist/hip ratio ($p=0.388$) in women who followed the CER diet type ($p^3<0.05$).

Table 2. Evaluation of anthropometric measurements, body compositions, blood pressure measurements, abdominal fat analyzes of individuals at the beginning and after six weeks

	IER (n=19)				p^1	p^2	CER (n=15)				p^3	p^4	p^α	p^β	p^γ
	First measurement		Last measurement				First measurement		Last measurement						
Variables	Femal e (15) $\bar{X}$ ± SS	Male (4) $\bar{X}$ ± SS	Femal e (15) $\bar{X}$ ± SS	Male (4) $\bar{X}$ ± SS			Femal e (10) $\bar{X}$ ± SS	Male (5) $\bar{X}$ ± SS	Femal e (10) $\bar{X}$ ± SS	Male (5) $\bar{X}$ ± SS					
Anthropometric measurements															
Body weight (kg)	76.9±6 .89	93.4±5 .51	73.3± 6.88	88.2±4 .22	0.0 00*	0.0 11*	74.9 ± 5.08	93.8± 9.05	71.3±4 .35	88.7± 8.74	0.0 00*	0.0 01*	0.9 31	0.9 86	0.8 27
Height (cm)	161.9± 4.11	176.8± 5.74	-	-			164.7 ±5.27	176.8 ±5.17	-	-			0.1 21		
BMI (kg/m^2)	29.4± 2.48	29.9± 2.74	27.9±2 .49	28.3±2 .52	0.0 00*	0.0 10*	27.7± 2.77	30.1± 3.56	26.4± 2.41	28.4± 3.62	0.0 00*	0.0 01*	0.2 06	0.1 71	0.0 79
Waist circumference (cm)	97.1±5 .76	110.3± 9.50	93.1± 4.82	105.6± 10.72	0.0 00*	0.0 16*	94.4± 6.20	108.0 ±6.44	90.9± 5.68	103.6 ±6.19	0.0 00*	0.0 22*	0.7 41	0.8 89	0.6 80
Hip circumference (cm)	112.4± 5.58	112.0± 2.83	109.1± 6.11	108.3± 2.36	0.0 00*	0.0 01*	112.2 ±4.52	113.1 ±4.31	108.8± 3.48	109.9 ±4.85	0.0 00*	0.0 19*	0.9 86	0.8 62	0.8 76
Waist/ hip ratio	0.86± 0.05	0.98± 0.07	0.85± 0.05	0.97± 0.08	0.0 56	0.4 55	0.84± 0.04	0.95± 0.03	0.83± 0.03	0.94± 0.02	0.3 88	0.2 36	0.9 86	0.8 76	0.3 54
Neck circumference(cm)	35.3±1 .65	41.8±2 .53	34.7±1 .78	40.4±1 .70	0.0 00*	0.0 69	35.3± 0.89	41.7± 1.30	34.8±0 .97	40.8± 1.60	0.0 08*	0.0 09*	0.5 42	0.4 14	0.5 49
Waist/ height ratio	0.60± 0.04	0.63± 0.07	0.57± 0.03	0.59± 0.07	0.0 00*	0.0 14*	0.57± 0.05	0.61± 0.04	0.55± 0.04	0.58± 0.04	0.0 00*	0.0 22*	0.2 45	0.2 31	0.3 87
Body composition															
Lean body mass (kg)	52.4± 4.34	69.3± 3.59	51.2±4 .36	67.7± 3.60	0.0 10*	0.1 02	51.8± 2.60	70.3± 5.20	50.7± 2.61	67.5± 4.84	0.0 27*	0.0 47*	0.7 16	0.7 68	0.5 01
Lean body mass (%)	68.4± 4.49	74.3± 1.7	70.01± 4.29	76.8± 2.83	0.0 01*	0.0 30*	69.5± 5.19	75.2± 3.46	71.3± 5.18	76.3± 3.39	0.0 00*	0.2 76	0.3 40	0.5 10	0.5 97
Fat mass (kg)	24.5±4 .85	24.0±2 .69	22.1±4 .54	20.5± 2.99	0.0 00*	0.0 13*	23.1± 5.08	23.5± 4.97	20.7± 4.59	21.2± 4.72	0.0 00*	0.0 72	0.5 10	0.6 27	0.5 78
Fat mass (%)	31.6± 4.48	25.7± 1.77	29.9± 4.29	23.2± 2.84	0.0 01*	0.0 30*	30.5± 5.18	24.8± 3.46	28.7± 5.16	23.6± 3.39	0.0 00*	0.2 76	0.3 40	0.5 21	0.5 67
Body fluid mass (kg)	34.3± 1.81	49.2± 2.18	33.5± 2.03	47.4± 1.80	0.0 16*	0.0 13*	33.8± 1.21	49.5± 3.65	33.1± 1.01	47.8± 3.76	0.0 00*	0.0 22*	0.8 35	0.6 65	0.9 72
Body fluid mass (%)	44.7± 2.23	52.7± 0.85	46.1± 2.43	53.8± 0.59	0.0 00*	0.0 06*	45.3± 1.96	52.9± 1.79	46.5± 1.78	54.1± 1.48	0.0 00*	0.0 89	0.2 67	0.4 66	0.7 71
Blood pressure measurements															
SBP (mmHg)	120.6± 10.80	124.2± 17.85	109.1± 10.57	120.8± 11.14	0.0 00*	0.4 74	108.2 ±6.86	123.8 ±8.07	100.9± 11.60	116.6 ±6.23	0.0 43*	0.0 04*	0.0 68	0.4 45	0.3 73
DBP (mmHg)	77.6±8 .91	74.7±3 .20	73.9±7 .93	75.0±1 .41	0.1 28	0.8 61	73.3± 7.10	77.2± 8.13	67.6±7 .70	75.2± 11.82	0.0 43*	0.4 08	0.2 24	0.0 68	0.5 72
Abdominal fat analysis															
Adiposity around the internal organs	11.3± 3.08	22.3± 5.39	10.0± 2.69	18.1±4 .62	0.0 00*	0.0 89	9.9± 2.95	22.5± 4.56	8.6± 2.89	19.6± 2.53	0.0 02*	0.0 66	0.7 55	0.8 35	0.9 58
Adiposity in the abdominal area (%)	44.0± 5.42	40.7± 6.17	42.2± 4.77	35.5± 5.22	0.0 00*	0.0 76	42.0± 4.30	40.3± 4.58	39.6± 4.46	37.3± 2.63	0.0 03*	0.0 86	0.2 98	0.2 12	0.9 11

IER : Intermittent energy restriction group, CER: Continuous energy restriction group, BMI: Body Mass Index, SBP: Systolic Blood Pressure, DBP: Diastolic Blood Pressure, *p-value significant at the level of 0.05 p^1 IER-Significance test of difference between first and last measurement (female), p^2 IER: Significance test of difference between first and last measurement (male), p^3 CER: Significance test of difference between first and last measurement (female), p^4 CER: First and last measurement Significance test of the last measurement difference (male), p^α : Significance test of the mean of the first measurement between groups, p^β: Significance test of the mean of the last measurement between groups p^γ Significance test of the intergroup difference

The distribution of body weight change rates according to diet type and the variation of weight averages according to diet type during the six-week follow-up are shown in Figure 1. Participants were divided into two categories as 5% and less than 5% and more than 5% in terms of the ratio of body weight changes over the course of the study to their total weight. While body weight change was 5% or less in 47.4% of those who followed the IER diet, it was more than 5% in the remaining 53.6%. Similarly, 46.7% of those following the CER diet, while the change in body weight was 5% or less, for the remaining 53.3% it was more than 5% as shown in Figure 1(a). While the average weight loss is 3.95 kgs in the IER diet type, the average weight loss in the CER diet type is 4.09 kgs as shown in Figure 1(b).



(a) (b)

Figure 1. Participants' body weight assessments, (a) Distribution of body weight change rates by diet type and (b) comparison of the weekly variation of the participants' body weight

Obesity is an important global public health problem that affects the society at every financial level and it is a disease that needs to be treated because of the diseases it causes and it is negative effects on quality of life [18], [19]. The most effective method for the prevention of obesity and healthy weight control is the combined treatment method, which includes a lifelong healthy and balanced diet, increased physical activity and behavioral treatments. Energy-restricted dieting is the basis of nutritional therapy for weight loss. Continuous application of this nutrition method, also known as continuous energy restriction, to ensure weight loss is not easily applicable for everyone [20]. Although 5-10% weight loss can be achieved with an average energy restriction, adherence to this diet method lasts for several months, and the longer this period, the lower the compliance [3]. Due to this limitation, alternative weight loss diet strategies are being researched [21]. IER, on the other hand, is an alternative nutritional method for weight loss in which energy and nutrient intake are alternated, no restriction is applied in daily energy intake, or a low level of restriction is applied [9]. This study was planned to compare the effects of intermittent energy restriction and continuous energy restriction practices on body composition in overweight and 1st degree obese individuals. The effect of meal frequency and timing on health has been a subject of interest for many years [22].

In a study, it was found that those who always ate breakfast had a lower risk of weight gain than those who skipped breakfast. In the same study, those who consumed the largest meal of the day at lunch and dinner time were found to have a higher risk of increase in BMI values [23]. In a meta-analysis study, researching the relationship between skipping breakfast and heart diseases, it was found that skipping breakfast increased the risk of heart diseases [24]. In a study conducted on 23,488 individuals selected from the National Health and Nutrition Examination Survey (NHANES) participants, the effect of skipping meals on daily energy intake and diet quality was examined. As a result of the study, it was found that skipping meals led to more energy intake at the next meal [25]. Among the individuals who participated in our study, 88.2% reported skipping meals. According to the results of the Turkey Nutrition and Health Survey (TBSA) 2017, the rate of skipping the evening meal was found to be 3.7% in individuals aged 15 years and older. Furthermore, dinner is the least skipped meal among all meals [26]. Looking at the consumption and skipping of main and intermediate meals in Turkey, it was found that most of the participants had breakfast, similar to our study. It is thought that

individuals with the habit of skipping meals have a negative effect on their compliance with long-lasting energy-restricted diets. Therefore, it is thought that intermittent energy restriction, which has fewer meals in body weight management, is considered as an option for individuals with a tendency to skip meals.

In an 8-week follow-up study conducted by Maroofi and Nasrollahzadeh [20] with 88 overweight and obese participants, the participants were divided into 2 groups. One group received the CER diet plan (70% of daily energy requirement), while the other group received the IER diet plan. Participants in the IER group were given a very low energy diet plan (30% of daily energy requirement) for three days of the week and were asked to eat as they wished on the remaining days. At the end of eight weeks, body weight, waist circumference, body fat mass and lean body mass of all participants decreased significantly, but there was no significant difference between the groups. At the end of the study, it was found that participants in the CER group lost 4.07±1.83 kgs and participants in the IER group lost 4.57±2.21 kgs [20]. In a study conducted by Lowe *et al.* [27] with 116 obese adults, the effect of optional feeding at feeding times was researched in the application of time-restricted feeding for 12 weeks. Of the participants, 57 were included in the diet plan group that included 3 main meals and 59 were included in the time-restricted feeding group in which they were fed as they wished for eight hours of the day (16:8). At the end of the study, a statistically significant weight loss was observed only in the time-restricted feeding group. Furthermore, no significant difference was observed between the two groups in terms of weight loss [27]. In this study, at the end of six weeks, the mean weight loss was found to be 3.95±1.94 kgs in the IER diet type and 4.09±1.48 kgs in the CER diet type. Although the studies on intermittent fasting in the literature differ in terms of sample size, gender groups, general health status of the participants, types of intermittent fasting and study duration, it is seen that IER and CER have similar results in body weight management.

Some short-term studies show that IER and CER diet types have similar effects in reducing body fat mass and visceral fat mass compared to baseline [2], [28]. However, there are also studies in the literature showing that the effects of these diets on fat mass are different [29], [30]. In the present study, no statistically significant difference was found when the participants in the two diet groups were compared in terms of anthropometric measurements, body composition, blood pressure measurements and abdominal fat analysis parameters of both initial and final measurements (p^{α}, $p^{\beta}>0.05$). In the literature, body composition analysis was performed with different methods in studies comparing IER and CER diet types. In this study, bioelectrical impedance analysis (BIA) method was preferred due to its reliability, effect on the person applied, cost, application time and ease of application. Furthermore, among the studies comparing IER and CER diet types, studies using abdominal fat analyzer are limited.

This study has some limitations. These limitations include the presence of participants in different age groups and gender, the limited sample size and study duration, the application of time-limited nutrition for different periods of time, and the lack of biochemical parameters. The small sample size made it difficult to interpret the results. Furthermore, the long timing of the study and the fact that this period coincided with the holiday/annual leave periods caused some participants to drop out of the study. The fact that the food consumption records of the participants were routinely taken before and during the study, the control interviews were conducted at frequent intervals, the dietary patterns of both groups were prepared by the dietitian and the use of the abdominal fat analyzer can be considered as the strengths of the study.

4. CONCLUSION

In conclusion, the weight loss of the participants in both diet groups was similar in this study. Although the intermittent fasting method has become more popular because it is considered less restrictive than the continuous energy restriction method, in which energy restriction is done throughout the day, every day of the week, the appropriateness of the diet plan and risk factors should be evaluated individually. Weight loss diets should maintain physical function, prevent weight regain, increase body fat loss and minimize loss of lean body mass, and be sustainable. Although time-restricted feeding reduces body weight and fat mass, it is not sufficient to support evidence-based clinical guidelines for obesity. On the other hand, the long-term efficacy and safety of time-restricted feeding as a weight loss strategy is still unclear. There is a need to increase the number of randomized controlled trials with larger samples and to emphasize the importance of this issue.

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