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The Effect of Intermittent Fasting on Body Weight, BMI, Waist Circumference, and Fat Mass Percentage in Adults with Overweight or Obesity

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ABSTRACT

Introduction: Fasting is a state of negative energy balance. Different fasting regimens have been used to achieve weight loss and other health benefits. To evaluate the effects of intermittent fasting on body weight, body mass index (BMI), waist circumference and fat mass percentage in people with overweight or obesity.

Methods: This experimental study was conducted on 22 adults of both genders aged 18-60 years, who were overweight or obese. A gradual intermittent fasting intervention was performed for 4 weeks with 10 hours of fasting in the first week and 16 hours of fasting in the last week. Variables such as body weight, BMI, waist circumference, and fat mass percentage were evaluated before and after the intervention in two groups, with and without dietary recommendations (ad libitum).

Results: At the end of the intervention, body weight, BMI, and waist circumference were significantly reduced in both groups, except for fat mass percentage. On the contrary, no statistically significant differences were found for all the parameters between groups ($p>0.05$).

Conclusion: According to results, body weight, BMI, and waist circumference decreased significantly in the two groups after four weeks of intermittent fasting.

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Introduction

Obesity and a poor diet are essential and modifiable factors contributing the development of chronic non-communicable diseases, such as cardiovascular diseases, with an estimated risk attributable to cardiovascular mortality as much as 13%. Several dietary interventions have improved obesity, including calorie restriction (CR) and limiting calories (1).

Given that adherence to CR in humans is low (2), other alternative feeding methods were developed with the same benefits as CR. Intermittent fasting (IF) can be mentioned as one of these methods, which is also known as periodic energy restriction (3) and comprises eating patterns in which fasting (negligible energy intake without deprivation of essential nutrients) is followed for hours.

The best-known forms of IF include periodic fasting (PF) (4) and 5:2 intermittent fasting (fasting two days per week), time-restricted feeding (TRF) (5), in which the daily feeding is reduced, and alternate-day fasting (ADF) (6), in which the fasting day can be altered (7).

The health benefits of IF have been demonstrated through several clinical trials, especially weight loss in obese people, diabetes, and cardiovascular diseases, as well as improving cardiometabolic parameters (3). Several systematic reviews and meta-analyses of randomized clinical trials (RCTs) (8-11) have supported the IF benefits. However, the overall strength and quality of the evidence are low because the existing RCTs focused on FI subtypes or particular health outcomes.

Patirkon et al. (12) concluded that the IF can have positive results in terms of anthropometric and cardiometabolic parameters, even in overweight adults. This review included meta-analyses of RCTs investigating the effects of FI in adults.

This umbrella review included 11 meta-analyses with 130 RCTs. Participants followed three

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months of IF (13-15) and evaluated 104 relationships of different FI types and its effects on health, specifically in people with excess weight (3,14,15).

Beneficial results were observed on anthropometric parameters, such as lipids, glucose, and pressure of blood, and 28 statistically significant relationships were obtained. six relationships of moderate quality evidence were found from these studies. Study evidence was low in the other studies analyzed with significant results (12).

This study selected time-restricted feeding (TRF), restricting eating times to less than 10 hours per day without reducing daily calories during permitted eating times (13).

The novelty of this study is the use of TRF interventions gradually in two groups, with and without dietary recommendations (ad libitum). The results showed that the gradual TRF-type IF in both intervention groups benefits anthropometric parameters and body composition (fat mass).

No clinical trials have been conducted so far to evaluate this type of fasting and the effect of this type of feeding during the hours on the mentioned parameters.

Materials and Methods

Study design

This experimental study was conducted on a randomized clinical trial in both genders with overweight or obesity from Asunción – Paraguay, aged 18-60 years without underlying diseases in June 2021.

The study was carried out for a month (starting in June 2021) by researchers from the Multidisciplinary Center for Technological Research - National University of Asunción and Universidad del Norte - Paraguay in three base, follow-up, and final visits after the intervention. The researchers explained the nature, objective, and methodology in choosing the participants, and obtained informed consent from each volunteer, who wished to participate in the study. The assessments were not invasive and performed according to the corresponding clinical practice with no risk for the participants.

Clinical Endpoints

The primary endpoint of this study was evaluating nutritional status by IMC and assessing the abdominal circumference and body fat before and after the intervention. The secondary endpoint after the intervention was to show the efficacy of the intermittent fast in anthropometric parameters in people with excess weight.

Study Participants

The inclusion criteria were being adults aged 18-60 years who are overweight or obese and reside in Asunción or the Metropolitan Area and give their informed consent. The exclusion criteria were pregnant or lactating women, people with comorbidities, such as hypertension and diabetes, and who carry out programmed physical activities.

Each researcher included the first five consecutive participants who met the inclusion criteria to avoid selection bias. No sample size calculation was performed due to the exploratory nature of this study.

Intervention and Evaluation

The non-probabilistic convenient sampling was performed after taking their informed consent. A total of 30 people were enrolled to participate in the study, who were divided into two groups of 15; the first with ad libitum intermittent fasting (IFA) and the second with intermittent fasting with dietary recommendations (IFD).

Sociodemographic variables such as gender, age, origin, occupation, marital status, and academic level were evaluated. On the other hand, anthropometric variables, including (body mass index) BMI, waist circumference and percentage of fat mass (electrical bioimpedance) were evaluated before and after the intervention.

The IFA group was subjected to intermittent fasting, but they were allowed to consume the foods without restrictions. The IFD group was subjected to intermittent fasting with recommendations for a healthy diet in the hours allowed for food consumption. This group had to avoid fried foods, junk food, excess salt, carbonated and sugary drinks, alcohol, processed foods, increase the intake of fruits, raw and cooked vegetables, at least two liters of water per day and choose healthy menus.

The intermittent fasting was prescribed in the form of time-restricted feeding and gradually for four weeks. The first week fast was 10 hours with 14 hours permission to eat, and the second week fast was 12 hours with 12 hours permission to eat. The third week fast and eat was 14 and 12 hours, and the last week was 16 and 8 hours, respectively. The fast began in the

afternoon/night in the hours of sleep to prevent their excessive hunger and match circadian changes in the body during the day. The volunteers were evaluated every week and given continuous advice during the intervention. Compliance with the dietary recommendations was carried out through an adherence survey. The student's t-test was used to determine significant differences before and after intermittent fasting of the study variables with p-value <0.05 using SPSS© software version 21.0. The research was carried out according to the ethical principles of the Declaration of Helsinki (16) and approved by the Ethics Committee of the Universidad del Norte.

Statistical Analysis

Statistical analyzes were performed based on the available data, and no substitution was performed for missing values. The student's t-test was used to analyze differences between the study variables before and after supplementation with p-value <0.05 using SPSS© software version 21.0.

Table 1. Sociodemographic characteristics

VARIABLE		n (%)
Gender	Female	14 (63.6)
	Male	8 (36.4)
Total		**22 (100)**
Education Level	Elementary	0 (0)
	High school	7 (31.9)
	College education	15 (68.1)
Total		**22 (100)**
Marital Status	Single	11 (50)
	Married	9 (41)
	Separated	2 (9)
Total		**22 (100)**
Job Occupation	Student	4 (18.1)
	Employee	7 (31.8)
	Businessman	2 (9)
	Professional	8 (36.3)
	Housekeeper	1 (4.8)
TOTAL	**22 (100)**	
AGE (AVERAGE ±SD)		
38.8±10,0		

Results and Discussion

In the study, 30 volunteers signed up, of whom eight people were dropped out due to force majeure. The rest received the intermittent fasting group with (13 people) and without (9 people) recommendations.

The majority of the sample (63.6%) was female, 68.1% had a university education, 50% were single, 36.3% had a profession as a work occupation, and the mean age was 38.8±10.0 (Table 1). This study was similar to the Wegman et al. (17) in terms of gender percentage, which examined the effect of intermittent fasting on oxidative stress (17), but this percentage was less than Trepanowski et al. (18) (86%) for intermittent fasting in weight loss and maintenance (18). The average age was lower than Trepanowski et al. (18), who found an average of 44 years in their study population (18).

The educational level exceeds the 50.2% observed by Machado et al. (19) on sociodemographic characteristics concerning cardiovascular health (19). In this study, 50% were single, a percentage exceeding the Savas (20) study (14.7%) on the effect of sociodemographic factors on fasting in diabetic patients (20).

Significant differences were found between the initial body weight, BMI, and waist circumference at the end of the intervention regarding the anthropometric variables of the group subjected to intermittent fasting with recommendations and the ad libitum group. No significant differences were found between the fat mass percentage before and after the intervention (Table 2).

The decrease in body weight was due to the restriction in food consumption. Few studies have so far shown the effects of IF on weight and the reduction of developing cardiovascular diseases. Almost all of these studies were conducted on obese people with a BMI of 30 to 39.9 kg/m^2) (21-23). Furthermore, Sundfor (24) reported comparable results for weight loss in

the intermittent and continuous energy restriction groups.

Klempel et al. (25) conducted a study on intermittent fasting and weight loss and found that BMI loss was statistically significant at 1.3 points out of 35 kg/m2 in obese volunteers, showing that intermittent fasting effectively reduces this parameter (25). On the other hand, practicing this type of lifestyle beyond a year can have a rebound effect when people go hungry or are not adequately accompanied. Fawzi et al. (26) studied people who fasted for a month as Ramadan style with and without Metabolic Syndrome. Those with Metabolic Sx had a BMI as much as 27.6 kg/m^2 one week before starting and 28.7 kg/m^2 at the end, and those without Metabolic Sx had a BMI as much as 26.2 kg/m^2 one week before starting and 26.9 kg/m^2 at the end. These results showed that the follow-up of each person who performs a specific type of immediate needs professional support to improve their health.

Table 2. Anthropometric parameters before and after fasting

IFD Group	Initial Weight (Kg)	Final Weight (Kg)	Initial Imc (Kg/M^2)	Final Imc (Kg/M^2)	Initial Waist Circum (Cm)	Final Waist Circum (Cm)	Initial% Of Fat Mass	Final % Of Fat Mass
AVERAGE	90.52	89.12	32.63	31.50	104.54	99.69	41.56	39.32
SD	15.38	15.65	5.08	5.12	9.84	9.33	10.42	10.63
IFA Group	**Initial Weight (Kg)**	**Final Weight (Kg)**	**Initial Imc (Kg/M^2)**	**Final Imc (Kg/M^2)**	**Initial Waist Circum (Cm)**	**Final Waist Circum (Cm)**	**Initial% Of Fat Mass**	**Final % Of Fat Mass**
AVERAGE	91.78	90.39	31.24	30.66	100.72	96.83	40.10	38.06
SD	20.01	19.95	5.79	5.45	19.13	17.66	4.45	5.52

IFD GROUP:
*Initial weight – Final weight **p=0.001**
*Initial IMC – Final IMC **p=0.012**
*Initial waist circum – Final waist circum **p=0.001**
* Initial % off at mass – Final % of fat mass p= 0.101
+ Student's t-analysis for related samples

IFA GROUP:
*Initial weight – Final weight **p=0.002**
*Initial IMC – Final IMC **p=0.019**
*Initial waist circum – Final waist circum **p=0.001**
* Initial % off at mass – Final % of fat mass p= 0.90
+ Student's t-analysis for related samples

Waist circumference was one of the anthropometric measurements with most reduction rate in this study. The meta-analysis by Arguin et al. (27) showed significant differences between the control and experimental group in terms of intermittent fasting on the reduction of waist circumference (27). This latter study showed a more significant reduction in waist circumference in the experimental group after one year of follow-up but not during the intervention period. Therefore, prolonged intermittent fasting effectively reduces this anthropometric measure.

Table 3. Anthropometric parameters after fasting between groups

	Final Weight (Kg) IFD	Final Wieght (Kg) IFA	Final IMC (Kg/M^2) IFD	Final IMC (Kg/M^2) IFA	Final Waist Circum (Cm) IFD	Final Waist Circum (Cm) IFA	Final % Of Fat Mass IFD	Final % Of Fat Mass IFA
Average	89.12	90.39	31.50	30.66	99.69	96.83	39.32	38.06
SD	15.65	19.95	5.12	5.45	9.33	17.66	10.63	5.52

*Final weight **p=0.72**
*Final IMC **p=0.65**
*Final waist circum **p=0.052**
*Final % of fat mass **p= 0.75**
+ Student's t-analysis for related samples

No statistically significant differences were found when comparing the results after the intervention between the two groups for all the anthropometric parameters (Table 3). Therefore, both ad libitum and dietary recommendations fasting significantly reduce weight, BMI and waist circumference in the same way.

Intermittent fasting in conjunction with healthy dietary recommendations includes several nutrients, considering the components of these foods, which has more positive effects than

including foods individually. For example, fiber is a food component that cannot be missing and is found mainly in fruits and vegetables. In addition to fiber, these foods contain optimal amounts of vitamins, minerals, and polyphenols, which are low in calories, provide satiety and have a high antioxidant capacity and a low glycemic index to control blood sugar. The Mediterranean diet is recommended in the IF since its components are healthier than other diets and includes fruits and vegetables, grains and olive oil, less meat, dairy, and solid fats. However, this diet has many variations to suit the study population from non-Mediterranean countries, and the results of randomized controlled trials provides inconsistent results (28).

On the other hand, intermittent fasting, which allows the patient to eat what they want ad libitum any time, leaves a gap in consuming foods with high fat, sugar, and calories. This diet would not lead to a severe problem in the case of consuming in short meal times. There are studies of alternate-day fasting without eating for one to two days. On eating days, they consumed high fat, sugar, and calories foods and lose weight with improved biochemical parameters (29). The prolonged fasting in the morning does not produce a compensatory intake during eating at lunch in ad libitum. Furthermore, this type of fasting does not increase appetite in the afternoon. In addition, morning IF reduces the appetite-stimulating hormone (ghrelin) levels in the afternoon. Thus, intermittent daily fasting can be safe because of the effectiveness of these mechanisms compared not eating for days (30).

One of the limitations of this study was that several participants withdrew during the study, and the sample size was reduced. In addition, biochemical parameters such as cholesterol, glycemia, and triglycerides could not be evaluated.

One of the strengths of the study is its uniqueness because it is one of the first studies on intermittent fasting intervention with two groups, one ad libitum (participant allow to eat what they want in the allowed hours) and another with healthy dietary recommendations.

Conclusion

According to results, the benefits of intermittent fasting were based on less food intake due to the restriction of eating hours without discriminating the types of food, as long as the fasting hours are respected.

Conflicts of Interest

The authors declared no conflicts of interest.

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