Effect of Ketogenic Diets and Intermittent Fasting on Obese patients

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Abstract

The present study aims to investigate the effect of ketogenic diets and intermittent fasting on 140 females' obese, their age ranged between 20-40 years with body mass index (BMI) greater than 30 kg/m^2, for four months. Height, weight, BMI, waist, hip circumference and total fat % were measured before, middle and after the experiment. Blood samples were collected for estimated total cholesterol (TC), high density lipoprotein (HDL), low density lipprotein (LDL), triglyceride (TG), hemoglobin A_{1c} (Hb A_{1c}), white blood cells (WBC) and red blood cells (RBC) before and after the experiment. The results showed that a significant ($P< 0.001$) decrease in body weight followed by BMI, waist, hip circumference and total fat %. The blood analysis results showed that high significant ($P< 0.001$) decrease in TC, TG and Hb A_{1c}, and significant increase in HDL and RBC, it also recorded a slight increase in LDL and WBC. Therefore, it is recommended to influence applying ketogenic diets with intermittent fasting for positive and clear impact on anthropometric measurements and improving blood measurements.

keywords: Low carbohydrate ketogenic diet – Total cholesterol – Weight loss – BMI- Hemoglobin A_{1c}.

INTRODUCTION

In recent decades, the global prevalence of obesity has increased significantly leading to a global epidemic. Despite continuous advances in the medical world, obesity continues to remain a major worldwide health hazard ***(Masood et al., 2020).*** Obesity has become a serious chronic disease in both developing and developed countries. Furthermore, it is associated with a variety of chronic diseases ***(Bray, 2004).*** Most chronic diseases like diabetes, hypertension, and cardiovascular disease are largely related to obesity which is usually a product of an unhealthy lifestyle and poor dietary habits ***(Zhang et al.,2016 and Castellana et al., 2020).***

The 21st century has seen the emergence of many diet programs aimed at promoting weight loss ***(Mozaffarian et al.,2011).*** The ketogenic diet (KD) has obtained immense popularity that stretches beyond its myriad of clinical applications. KD provides a practical solution to attain body recompositing and meet the weight loss target within a short interval. During this COVID-19 period, the ketogenic diet has become a popular and practical solution for rapid weight loss in lieu of the constraints for physical exercise amidst the quarantine ***(Arnold et al., 2020).***

High-fat, low-carbohydrate ketogenic diets (KDs) have been used for almost a century for the treatment of epilepsy. Used traditionally for the treatment of refractory pediatric epilepsies, in recent years the use of KDs has experienced a revival to include the treatment of adulthood epilepsies as well as conditions ranging from autism to chronic pain and cancer ***(Boison, 2017 and Saraceni, 2018)***.

The ketogenic diet (KD) is a diet rich in healthy dietary fats and enough in high-quality dietary protein and low in carbohydrates ***(Urbain and Bertz 2016 and Boison, 2017)***. This reduction in carbohydrate intake helps the body switch toward a state that promotes the breakdown of fats (from the diet and the body) to produce ketone bodies and enter a state known as "ketosis." ***(Mawer, 2016)***. In the ketogenic diet that is very high in healthy fat and low in carbohydrates, the body uses fats as the primary source of energy. The purpose of restricting

carbohydrates is to convert the body's dependency from glucose to ketone bodies ***(Murphy et al., 2019)***.

High intakes of carbohydrates have recently been associated with a higher risk of total mortality, although lower overall mortality has been correlated with total fat and different forms of fat ***(Dehghan et al., 2017)***. It is generally believed that high-fat diets may lead to the development of obesity and several other diseases such as coronary heart disease, diabetes, and cancer. This view is based on studies carried out in animals that were given a high-fat diet rich in polyunsaturated fatty acids ***(Dashti et al.,2003).***

"Intermittent fasting" refers to time restricted eating. Fasting has been practiced for thousands of years and is a staple across many different religions and cultures around the globe. Prior to being referenced as fasting, this occurrence was termed as starvation. Being done only due to the lack of accessible food. Several religious groups partake in rituals that involve periods of fasting, such as Muslims who fast during Ramadan from sunrise until sunset ***(Longo and Mattson, 2014).***

This study was conducted to investigate the effect of Ketogenic Diets and Intermittent Fasting on obese patients.

MATERIALS AND METHODS

MATERIALS

Non-stretch digital tape from local market, Electronic digital scale with a capacity of 200 kg and precision of 50g (Beurer Diagnostic Scale - BF105-Germany)**.** Total cholesterol, high density lipoprotein, low density lipprotein, triglyceride, hemoglobin A_{1c}, white blood cells and red blood cells kits were obtained from Bio Diagnostic Company, Giza, Egypt.

METHODS

Experimental design

A total of 140 adult obese females, selected from Assiut city, Dairout and El Qosya center. Ages ranged from 20 - 40 years, with body mass index (BMI) greater than 30 kg/m^2, for four

months. The sample subjects were informed of study requirements prior to initiation. They were informed ten days before the start of the experiment, to reduce the intake of sugars and starches (carbohydrates), with the cessation of drinking soft water, chips and fast food, while reducing eating at night. Both the intermittent fasting and the ketogenic diet were explained and clarified for the research sample during the week before the start of the experiment and introduced to the permitted and restricted foods in the ketogenic diet**.**

Ethics research

All subjects included in this study provided written informed consent, and the protocol of this study was approved by the Ethics Committee of the Medicine faculty of Assiut University.

Blood samples

Fasting blood samples were collected before and after the experiment, from the obese females into clean and labeled tubes contained EDTA tubes from all subjects after a 12-hour overnight fast at the beginning of the study and at the end of each dietary period. Plasma was obtained by low-speed centrifugation for 15 minutes for 1 hour of venipuncture, which was stored aliquot in sealed tightly tubes at – 20 °C until biochemical assays *(Perez and Serrano, 2011).*

Biochemical analysis

Total cholesterol (TC), triglycerides (TG), high-density lipoproteins (HDL), low-density lipoproteins (LDL), hemoglobin A_{1c} (Hb A_{1c}), white and red blood cells were determined according to the method of ***Allian et al., (1974), Wahlefeld (1974), Warnick et al., (1983), Friedewald et al., (1971), Liu et al., (2008) and Dashe et al., (2014)***, respectively.

Height

Height was measured to the nearest 0.5 cm while the subjects advised to stand up straight with the head, their feet

together, shoulder, in the horizontal plane and the backs rest on the wall ***(Sanchez et al.,2018).***

Weight

Weight was measured before and after application the dietary using an electronic digital scale with a capacity of 200 kg and precision of 50g (Beurer Diagnostic Scale - BF105-Germany) ***(Feliciano et al.,2014)***. Body weight was measured in the fasted state. Subjects wore light clothing and without shoes prior to the measurements. Weight was assessed to the nearest 0.1kg ***(Zhang et al., 2016)***. For calculating the ideal weight for women according to the following equation:

Ideal weight = $\boldsymbol{Height - 100}$ ***(Sanchez et al.,2018)***

Body mass index (BMI)

BMI was calculated according to the following equation:

$$\text{BMI} = \frac{weight\ (kg)}{heigh\ (m)^{\ 2}}$$ ***(Cicekli, 2019)***

Waist circumference (WC)

Waist circumferences was measured to the nearest 0.5 cm using a stretch resistant tape at the end of normal expiration. Waist circumference was measured at the midpoint between the lower margin of the least palpable rib and top of the iliac crest ***(Youssef, 2019)***. The World Health Organization (WHO) classifies adults have abdominal obesity when waist circumference (WC) > 94 cm for men and >80 cm for women ***(Alberti and Zimmet, 1998)***.

Hip circumference

Hip circumferences are measured to the nearest 0.1 cm using a flexible narrow non stretch tape in adults wearing minimal clothing, standing straight but not pulling in their stomachs ***(Youssef, 2019)***.

Waist-to-Hip Ratio (WHR)

The WHR is obtained by dividing the WC by the hip circumference (HC) using the same units of measurements for both ***(Youssef, 2019)***. The World Health Organization (WHO) classifies adults have abdominal obesity when Waist-to-Hip Ratio

(WHR) of > 0.90 in men and > 0.85 in women ***(Alberti and Zimmet 1998)***.

Total Body Fat Percentage (BF%)

Body Fat Percentage (BF%) was measured before and after application the dietary by using an electronic digital scale (Beurer Diagnostic Scale - BF105-Germany) by bioelectrical impedance analysis (BIA) ***(Kurniawan et al.,2018).***

Diet Composition

The ketogenic diet consists of 20g - 50g of healthy carbohydrates in the form of leafy greens, without starchy vegetables such as bell pepper, zucchini, spinach, cauliflower, green beans, lettuce, garlic, cabbage, cucumber, tomatoes, onions, eggplant and parsley. ~ 70% of calories come from high-quality fats like butter, animal fat, sesame, sesame oil, ghee, coconut, coconut oil, flax seed, nuts except for walnuts, almond flour (small amount), sesame tahini, peanut butter and olive oil. 20% of the calories come from proteins such as fish rich in omega-3 , grass-fed animal protein like beef, chicken meat, fish, shrimp, salmon, tuna, turkey, duck breasts, duck's thigh, geese, mutton and goat meat ***(****Dashti et al., 2006 and 2007;* ***Paoli et al.,2014;*** *Muscogiuri et al., 2019; Fenton et al., 2019; Alharbil and AlSowayan, 2020)*

Supplements

Micronutrients (vitamins and minerals) were given daily to each subject in the form of one tablet of a poly vitamins– minerals supplement ***(Dashti et al.,2006).***

Statistical Analysis

Data were analyzed using Statistical Package for social science (SPSS) according to the method of ***(Ota et al., 2016).***

RESULTS AND DISCUSSION

Dietary intake

Each participant was prescribed a diet suited to personal energy requirements according to ***Dudek, (1997)*** by 1398 kcal for the activity level of the study. Protein was prescribed as 20%,

carbohydrates were prescribed as 20 - 50 g (about 10%), and fats were prescribed as 70% for all participants according to ***Paoli et al.,(2014)*** as shown in Table (6).

Results in Table (1) and Table (2) showed the dietary intake means of macronutrients, water, ash, fiber, some minerals and some vitamins for a week**.**

Table (1): The mean of dietary intake composition by ketogenic diet for a week

Macronutrient						
Water g	**Energy** kcal	**Protein** g	**Fat** g	**Carbohydrate** g	**Fiber** g	**Ash** g
835.9±6.3	1398.5±16.2	65.96±3.2	101.1±4.5	49.41±1.89	8.21±0.65	9.55±0.95

- Mean three replicates

The data in Table (1) showed that the mean of dietary intake from carbohydrates recorded 49.41 g, while the mean of dietary intake from protein recorded 65.96 g and fat recorded 101.05 g. The mean of dietary intake from energy, fiber and ash recorded 8.21 g and 9.55 g., respectively.

Table (2): The mean of composition of dietary intake from minerals and vitamins by ketogenic diet for week

Micronutrient								
Sodium mg	**Potassium** mg	**Calcium** mg	**Phosphor** mg	**Iron** mg	**Thiamine** mg	**Riboflavin mg**	**Niacin** mg	**Vitamin C** mg
727.6 ±15. 4	955.6±14. 6	884.2±5. 4	911.3±7. 9	20.66±1 . 4	1.59±0.0 5	65.74±1.2 4	16.18±0 . 9	71.14 ±2.4

- Mean three replicates - Values are presented as mean ± Standard Error (SE)

The data in Table (2) showed that the mean of dietary intake from calcium recorded 84.24 mg, iron recorded 20.66 mg. while

sodium, potassium, phosphor recorded 727.59 mg, 955.61 mg and 911.34 mg., respectively.

The same Table showed that the mean of dietary intake from vitamin C recorded 71.142 mg, riboflavin recorded 65.74 mg, thiamine and niacin recorded 1.59 mg and 16.18 mg., respectively. During the period feeding total calorie consumption decreased and carbohydrate consumption decreased.

The effect of ketogenic diets and intermittent fasting on anthropometric measurements

Results in Table (3) showed the effect of ketogenic diets and intermittent fasting on body weight, BMI, waist, hip circumference and total body fat %.

Table (3): Effect of ketogenic diets and intermittent fasting on anthropometric measurements

Parameters	Beginning	Middle	End	P- value
Body weight (kg)	1.04^{a}±7.99	94.03^{b}±6.97	85.16^{c}±6.51	0.01
Body mass index (kg/m^2)	40.98^{a}±2.96	36.81^{b}±2.58	33.31^{c}±2.39	0.02
Waist circumference (cm)	136^{a}.5±6.2	119.3^{b}±7.3	86.4^{c} ±4.6	0.001
Hip circumference (cm)	145.3^{a}±7.6	121.4^{b}±4.1	105.7^{c}±6.4	0.01
Waist-to-Hip Ratio (%)	93.94^{b}±4.3	98.27^{a}±3.2	81.74^{c}±3.2	0.02
Total Body Fat Percentage (%)	41.65^{a}±1.65	37.05^{b}±1.32	33.37^{c}±1.24	0.001

- Values are presented as mean ± Standard Error (SE)
- Values followed by the same superscript letter within the same column were not significantly different.

The data in Table (3) showed that the differences in body weight, the highest value was recorded for the beginning of the experiment and the lowest value was recorded at the end. The mean values of body weight in the beginning and end study were recorded 1.04 kg and 85.16 kg., respectively. BMI recorded a significant reduction from 40.98 kg/m^2 in the beginning of the experiment to 33.31 kg/m^2 at the end of the experiment. Waist and hip circumference recorded the highest value 136.5cm and 145.3cm. in the beginning., respectively, but at the end of the

experiment they decreased to 86.4cm. and 105.7cm, respectively. Finally, the changes that occurred in body weight, waist and hip circumference decreased total body fat from 41.65 to 33.37 %.

Such data agree with ***Harvie et al.,(2013) and Ministrini et al., (2019)*** who reported that after very low carbohydrate ketogenic diet and intermittent fasting, body weight and BMI were significantly reduced ($p<0.001$ for both). Similarly, waist, hip circumference and fat mass were significantly reduced as well.

Our data also agree with ***yancy et al., (2005) and Vargas et al, (2018)*** who told that Ketogenic deit achieved a positive change in body composition, due to a decrease in body weight with a reduction in body fat mass.

The body weight, BMI, WC, percentage of body fat, significantly improved from baseline to 4 weeks and from 4 to 12 weeks while no changes were observed from 12 weeks to 12 months. Therefore, after 1 year the subjects experienced a mean total body weight loss of 14 ± 10 kg after using ketogenic diets and intermittent fasting ***(Cicero et al., 2015 and Chae, 2018)***.

On another hand ***Honors, (2009)*** showed the body weight and percentage of body fat increased during endocrine a low carbohydrate high fat ketogenic diet on rats.

The effect of ketogenic diets and intermittent fasting on lipid profile

Results in Table (4) showed the effect of ketogenic diets and intermittent fasting on lipid profile (TC, HDL, LDL, TG) before and after the experiment.

Table (4): Effect of ketogenic diets and intermittent fasting on lipid profile

Parameters	Beginning	End	P-value
Total cholesterol (TC) mg/dl	185.10±10.2	150.20±8.62	0.001**
HDL-c mg/dl	55.60±4.69	75.62±4.93	0.001**
LDL-c mg/dl	92.00±4.13	94.50±3.13	0.022*
Triglycerides (TG) mg/dl	123.00±16.4	64.43±1.42	0.002**

- Values are presented as mean ± Standard Error (SE)
- * significant ($P<0.05$), ** High significant ($P< 0.01$)

The data in Table (4) showed that the mean value of total cholesterol decreased significantly (P< 0.001) at the end of the study as compared to this parameter in the beginning study 150.20±8.62 Vs 185.10±10.2 mg/dl, respectively. Triglycerides recorded a high significant reduction after the end of experiment, decreased from 123.00 mg/dl to 64.43 mg/dl. The low density lipprotein (LDL) recorded a slight increase from 92.00 mg/dl to 94.50 mg/dl. While, the high density lipprotein (HDL) increased significantly (P< 0.001) at the end of experiment from 55.60 mg/dl to 75.62 mg/dl.

Our data agree with *Santosa & Macedob* ***(2018) and Ministrini et al., (2019)*** who reported that the lipid profile parameters were significantly reduced: a 23% reduction in triglycerides, and a 17% reduction in total cholesterol by using ketogenic diet and intermittent fasting. But disagree with the last in a result of HDL and LDL, who told that HDL decreased to 10% and a 22% reduction in LDL-cholesterol. ***Krauss et al. (2006)*** showed that high fat intake, combined with carbohydrate restriction, raises the levels of larger-sized LDL-C, which are known to be less atherogenic than the small, dense LDL-C.

Increases occurred in both high-density lipoprotein (HDL) cholesterol (8%) and low-density lipoprotein (LDL) cholesterol (10%) but these changes were of borderline statistical significance ***(Yancy et al., 2005 and*** *Perez, 2017)*. The beneficial effects of ketogenic diet following its long-term administration. It significantly reduces the body weight and body mass index. Furthermore, it decreases the level of triglycerides ***(Dashti et al., 2006 and*** *Perez, 2017)*.

On another hand ***Cicero et al., (2015)*** found that lipid parameters, LDL improved significantly from baseline to 3 months and noticed no change after 1 year of observation. A similar trend has been observed for TG, while HDL improved from baseline to 4 weeks

The effect of ketogenic diets and intermittent fasting on Hemoglobin A_{1c} and blood cells

Results in Table (5) showed that the effect of ketogenic diets and intermittent fasting on hemoglobin A_{1c}, white and red blood cells before and after the experiment.

Table (5): Effect of ketogenic diets and intermittent fasting on hemoglobin A_{1c} and blood cells

Parameters	Beginning	End	P-value
Hemoglobin A_{1c} (Hb A_{1c})	5.490±0.47	4.260±0.29	0.007**
White blood cells (WBC)	6.030±0.41	6.980±0.59	0.001**
Red blood cells (RBC)	4.000±0.61	4.730±0.57	0.001**

- Values are presented as mean ± Standard Error (SE)
- * significant (P<0.05), ** High significant (P< 0.01)

The data in Table (5) showed that the result of hemoglobin A_{1c} recorded decrease at the end of the experiment from 5.490 % to 4.260 %. The result of red blood cells recorded 4.730 × 10^6/cm from 4.000 × 10^6/cm. Finally, the white blood cells recorded a slight increase from 6.030 × 10^3/cm to 6.980 × 10^3/cm.

Such data agree with ***Lichtash et al., (2020)*** who found that therapeutic use of intermittent fasting and ketogenic diet as an alternative treatment for type 2 diabetes in a normal weight woman, HbA1c reached 5.8%, and body mass index was minimally changed.

The hemoglobin A1c, decreased from 7.5 ± 1.4% at baseline to 6.3 ± 1.0% at week 16 ($p < 0.001$) and (8.8 ± 1.8% to 7.3 ± 1.5%, $p = 0.009$), respectively ***(yancy et al., 2005 and Westman et al., 2008)***. The effects of ketogenic diet on CBC or blood cells morphology no changes were observed, as well as white blood cell count (WBC) and red blood cell count (RBC) ***(Nazarewicz et al., 2007)***.

In conclusion

Administering ketogenic diets and intermittent fasting for obese patients occurred significant decreased in body weight,

body mass index, body fat percentage, waist and hip circumference. Also occurred significant improved in the lipid profile, cumulative sugar and blood cells. Therefore, this study suggests that it is useful to use ketogenic diet and intermittent fasting for obese patients.

Table (6): Dietary intake for a week

No.	Breakfast	lunch	Dinner
(1)	- 2 eggs fried in 2 tablespoons butter. - Leafy salad (a bunch of arugulas + a bundle of parsley + 1 small bell pepper + 1 very small tomato).	A piece of boiled meat fried in 1 tablespoon of butter. - A medium-sized vegetable okra plate, its ingredients are (1 small tomato + half a small onion + 1 teaspoon butter + 2 cups okra) - 2 Arugula Packets.	Fried egg in 1 tablespoon butter. - Leafy salad (bunch of arugulas + bundle of parsley + 1 small bell pepper) without tomatoes
(2)	- 2 hard-boiled eggs, chopped in 1 tablespoon butter. - Leafy green salad. 1cup of coffee without sugar.	4/1 chicken (preferably hip) boiled and fried in 1 tablespoon butter. - A medium-sized Molokhia dish with its ingredients (1 teaspoon butter or animal fat + a little garlic + green Molokhia + 2 cups of liquid). - Leafy salad	1 boiled and mashed egg in 1 tablespoon butter. Leafy salad without tomatoes.
(3)	- 2 eggs fried in 1 tablespoon butter and add half a small grated onion. - 2 bunch of arugulas + 3 pickled olives. -1cup of coffee without sugar.	- A medium-sized plate of liver with its ingredients (200 grams of liver + one half of a small grated onion + one small bell pepper + a tablespoon of animal fat or butter + a teaspoon of fried garlic). - Leafy salad.	Fried egg in 1 tablespoon butter. - Leafy salad (bunch of arugulas + bundle of parsley + 1 small bell pepper) without tomatoes
(4)	- 2 eggs fried in 1 tablespoon butter. A quarter cup of grated zucchini is added to it. - 3 olives + 1 bunch of arugulas. 1cup of coffee without sugar.	Tilapia fish (about 300 grams spiced with a little garlic, to which 1 tablespoon of olive oil is added) grilled in the oven + 1 tablespoon of raw tahini + a slice of lemon. Salad and ketchups.	A piece of cottage cheese, to which add 1 tablespoon of olive oil. Leafy salad without tomatoes
(5)	- A piece of Quraish cheese about 100 grams (about 2 tablespoons). 1 fried egg in one tablespoon of butter. 1 small cucumber 1cup of coffee without sugar. -	- 7 sticks of medium-sized kofta, its ingredients (150 grams of minced meat with a percentage of fat + egg + very little spice + a little parsley + a little onion to taste), fry in 1 spoon and a half of butter or grill in the oven with the same amount of butter. - A plate of medium-sized zucchini vegetables (1 small tomato + half a small onion + 1 teaspoon butter + 2 cup zucchini) Lettuce or 2 bunch of arugula	1 boiled and mashed egg in 1 tablespoon butter. Leafy salad without tomatoes.
(6)	2 fried eggs in one tablespoon of butter, to which a cup of spinach is added + 1 tablespoon of grated cheider cheese (cheese as desired and can be replaced with mozzarella cheese or Quraish). 2 bunches of arugula or any other leafy vegetables. 1cup of coffee without sugar.	- A cup of beef soup with pieces of zucchini + a piece of boiled meat smothered in a tablespoon of butter. - Leafy salad.	Fried egg in 1 tablespoon butter. - Leafy salad (bunch of arugulas + bundle of parsley + 1 small bell pepper) without tomatoes
(7)	- a cup of steamed cauliflower +1 egg + 1 teaspoon of fried parsley + 1.5 tablespoon of butter. 1 small cucumber - 1 cup of coffee without sugar	a can of tuna 200 grams + 2 tablespoons of olive oil. Salad and ketchups	A piece of cottage cheese, to which add 1 tablespoon of olive oil. Leafy salad without tomatoes

REFERENCES

Alberti, K.G. and Zimmet, P.Z.(1998). Definition, Di-Agnosis and Classification of Diabetes Mellitus and Its Complications. Part 1: Diagnosis and Classification of Diabetes Mellitus. Provisional Report of a who Consultation. *Diabetic medicine*, 15(7):539-553.

Alharbi1, A. and Al-Sowayan, N. (2020). The Effect of Ketogenic-Diet on Health. Food and Nutrition Sciences, (11): 301-313.

Allian, C.C.; Poon, L.S.; Chan, C.S.G.; Richmond, W. and Fu, P.C. (1974). Enzymatic Determination of Total Serum Cholesterol. *J. Clin.Chem.*, (20):470–473.

Arnold, A.; Ali, A.; Kaka, N.; and Kakodkar, P. (2020). Ketogenic Diet: Biochemistry, Weight Loss and Clinical Applications. *Nutri Food Sci. Int J.*, (1): 10.

Boison, D. (2017). New Insights into the Mechanisms of the Ketogenic Diet. *Curr. Opin. Neurol.*, 30(2): 187–192.

Bray, G. A. (2004). Medical Consequences of Obesity. *J. Clin. Endocrinol Metab.,* (89):2583-9.

Castellana, M.;Conte, E.;Cignarelli, A. ; Perrini,S. ; Giustina, A. ; Giovanella, L. ; Giorgino, F. and Trimboli, P. (2020). Efficacy and Safety of Very Low Calorie Ketogenic Diet (Vlckd) in Patients with Overweight and Obesity: a Systematic Review and Meta-Analysis. *J. Endocrine and Metabolic Disorders*, (21):5–16.

Chae, K. (2018). Effect of Intermittent Fasting on Resting Metabolic Rate During Weight Loss. A Thesis, the Degree of Master of Science in Health Science, Cornell University**,** 110-123.

Cicekli, İ. (2019). Maternal Obesity and Nutrition. Nutrition and Obesity (First Edition). *İstanbul, Güven Plus*, 107-112.

Cicero, A. F.; Benelli, M.; Brancaleoni, M.; Dainelli, G.; Merlini, D. and Negri, R. (2015). Middle and Long-Term Impact of a Very Low-Carbohydrate Ketogenic

Diet on Cardiometabolic Factors: A Multi-Center, Cross-Sectional, Clinical Study. *High Blood Pressure and Cardiovascular Prevention*, 22(4), 389–394.

Dashe , T. M. ; Osawe, S. ; Tokdung, M. ; Daniel, N. ; Choji, R. P. ; Mamman, I. ;Deme, K. ; Damulak, D. and Abimiku, A. (2014). Comprehensive Reference Ranges for Haematology and Clinical Chemistry Laboratory Parameters Derived from Normal Nigerian Adults, *Plos One. Org*., (9):15-28.

Dashti, H. M.; Al-Zaid, N. S.; Mathew, T. C.; Al-Mousawi, M.; Talib, H.; Asfar, S. K. and Abdulla, I. (2006). Long Term Effects of Ketogenic Diet in Obese Subjects with High Cholesterol Level. *Molecular and Cellular Biochemistry*, (286): 1–9.

Dashti, H. M.; Al-Zaid, N.S.; Mathew,T.C. ; **Al-Mousawi,M. ; Talib, H. ; Asfar, A. K. and Behbahani, A. I. (2007).** Beneficial Effects of Ketogenic Diet in Obese Diabetic Subjects. *Molecular and Cellular Biochemistry*, (302):19, 249–256.

Dashti, H. M.; Bo-Abbas, Y. Y. and Asfar, S. K. (2003). Ketogenic Diet Modifies the Risk Factors of Heart Disease in Obese Patients. *J. Nutrition*, (19):901–2.

Dehghan M.; Mente, A.; Zhang, X.; Swaminathan, S.; Li, W.; Mohan, V.; Iqbal, R.; Kumar, R.; Viljoen, E.; Rosengren, A.; Amma, L.; Avezum, A.; Chifamba, J.; Diaz, R. and Khatib, R. (2017). Associations of Fats and Carbohydrate Intake with Cardiovascular Disease and Mortality in 18 Countries from Five Continents (Pure): A Prospective Cohort Study. *Lancet Public Health*, (4):2050-2062.

Dudek, S. G. (1997). Nutrition Handbook for Nursing Practice. New York, *Third Edition*.

Feliciano P. P. ; Miguel, H. S.; Queiroz, G. C.; Machado, S. R. ; Carmo, M. G. and Peluzio, S.C. (2014). Measurements of Body Fat Distribution: Assessment of Collinearity with Body Mass, Adiposity and Height in Female Adolescents. *Rev. Paul. Pediatr*, 33(1):63–71.

Fenton,C. ; Groveman,S. ; Claire M. and Christina, A.G.(2019). Benefits of a Ketogenic Teaching Kitchen., *Journal of Child Neurology*, (14): 34, 886-890.

Friedewald, W.T.; Levy, R.I. and Fredrickson, D.S. (1971). Estimation of the Concentration of Low-Density Lipoprotein Cholesterol in Plasma, Without Use of the Preparative Ultracentrifuge. *Clin Chem*., (18):499-502.

Harvie, M. : Wright, C.; Pegington, M. ; McMullan, D. ; Mitchell, E. and Martin, B. (2013). The Effect of Intermittent Energy and Carbohydrate Restriction Daily Energy Restriction on Weight Loss and Metabolic Disease Risk Markers in Overweight Women. British *Journal of Nutrition*, (110): 8, 177- 184.

Honors, M. A.; Davenport, B.M. and Kinzig, K.P (2009). Effects of Consuming a High Carbohydrate Diet After Eight Weeks of Exposure to a Ketogenic Diet. *Nutrition & Metabolism*, (6): 46, 48-51.

Krauss, R. M.; Blanche, P.J. and Rawlings, R. S. (2006). Separate Effects of Reduced Carbohydrate Intake and Weight Loss on Atherogenic Dyslipidemia. *Am. J. Clin. Nutr.*, (83):1025–1031.

Kurniawan, L. B. ; Bahrun, U. ; Hatta, M. and Arif, M. (2018). Body Mass, Total Body Fat Percentage, and Visceral Fat Level Predict Insulin Resistance Better Than Waist Circumference and Body Mass Index in Healthy Young Male Adults in Indonesia. *J. Clin. Med.*, *7*(5): 96.

Lichtash, C.; Fung, J.; Ostoich, K. and Ramos, M. (2020). Therapeutic Use of Intermittent Fasting and Ketogenic

Diet as an Alternative Treatment for Type 2 Diabetes in a Normal Weight Woman: A 14-Month. *B.M.J. Case Rep.*, (7): 13, 76-91.

Liu, L. ; Hood, S. ; Wang, Y. ; Bezverkov, R. ; Dou, C. ; Datta, A. and Yuan, C. (2008) : Direct Enzymatic Assay for %Hba1c in Human Whole Blood Samples. Science direct; Clinical Biochemistry; (41) 576–583.

Longo, V. and Mattson, M. (2014). Fasting**:** Molecular Mechanisms and Clinical Applications. *Cell Metabolism*, 19(2): 181–92.

Masood, W.; Annamaraju, P; and Uppaluri, K. R. (2020). Ketogenic Diet. Stat Pearls Publishing, Treasure Island, FL.

Mawer, R. (2016). The Ketogenic Diet: A Detailed Beginner's Guide. Retrieved from https://authoritynutrition.com/ketogenic-diet-101/

Ministrini, S.; Calzini, L.; Nulli, E.; Anastasia,M.; Roscini,A.; Siepi,D.; Tozzi, G. and Daviddi,G. (2019). Lysosomal Acid Lipase as a Molecular Target of the Very Low Carbohydrate Ketogenic Diet in Morbidly Obese Patients: The Potential Effects on Liver Steatosis and Cardiovascular Risk Factors. *Journal of Clinical Medicine*, (8): 621, 383-397.

Mozaffarian, M. D.; Tao, M. H.; Rimm, E. B.D. and Willett, M. D. C. (2011). Changes in Diet and Lifestyle and Long-Term Weight Gain in Women and Men. *The New England Journal of Medicine*, (364):25, 439- 434.

Murphy, E.; Angelaa, b. and Jenkins, J. (2019). A Ketogenic Diet for Reducing Obesity and Maintaining Capacity for Physical Activity Hype or Hope. *Clinical Nutrition and Metabolic Care*,(22): 4, 314-319.

Nazarewicz, R.; Ziolkowski, W.; Vaccaro, P. and Ghafourifar, P. (2007). Effect of Short-Term Ketogenic

Diet on Redox Status of Human Blood. *Rejuvenation Research*, (10):4, 17-22.

Ota, M.; Matsuo, J ; Ishida, I. ; Hattori, K. ; Teraishi, T.; Tonouchi, H. and Ashida, K. (2016). Effect of a Ketogenic Meal on Cognitive Function in Elderly Adults: Potential for Cognitive Enhancement. Original Investigation, (233): 3797–3802.

Paoli, A. ; Rubini, A. ; Volek, J. S. and Grimaldi, K.A. (2014). Beyond weight loss: A Review of the Therapeutic Uses of Very-Low-Carbohydrate (Ketogenic) Diets. *US National Library of Medicine National Institutes of Health*, (5): 68, 641.

Perez, J.G. (2017). Medium Chain Triglycerides, Agents for Weight Loss, Induce the Ketosis and Improve the Health. *Revista Espanola de Obesidad*.

Perez, L. and Serrano, A. (2011). A Pilot Study of the Spanish Ketogenic Mediterranean Diet: An Effective Therapy for the Metabolic Syndrome**.** *Journal of Medicinal Food***,** 14 (7): 681–687**.**

Sanchez, W. A.; Ortega, V. S. and Álvarez,W. P. (2018). Validation of the Broca Index as the Most Practical Method to Calculate the Ideal Body Weight. *Journal of Clinical Investigation and Studies.* 1(1): 1-4.

Santosa, O. H. and Macedob, C.O. (2018). Impact of Intermittent Fasting on the Lipid Profile: Assessment Associated with Diet and Weight Loss. *Clinical Nutrition ESPEN*, (24): 14-21.

Saraceni, J. A. (2018). The Perceived Benefits of Consuming a Ketogenic Diet, a thesis, *Master of Science***.**

Urbain, P. and Bertz, H. (2016). Monitoring for Compliance with a Ketogenic Diet: What is the Best Time of Day to

Test for Urinary Ketosis. *Nutrition and Metabolism*, (13):77, 830-835.

Vargas, S.; Romance, R.; Jorge, L.; Diego, A. and Galancho, I. (2018). Efficacy of Ketogenic Diet on Body Composition During Resistance Training in Trained Men: A Randomized Controlled Trial. *Journal of the International Society of Sports Nutrition*, (15):31, 754-761.

Wahlefeld, A. W. (1974). Triglycerides. Determination After Enzymatic Hydrolysis. In Bergemeyer, H. U. (ed.) Methods of Enzymatic Analysis, *Academic Press Inc.*, New York and London. 1831-1834.

Warnick, G. R. ; Benderson, M. J. and Albers, J. J. (1983). Interlaboratory Proficiency Survey of High-Density Lipoprotein Cholesterol Measurement. *Clinical Chemistry*, (29): 3, 516–519.

Westman, E.; Yancy, W.; Mavropoulos, J.; Marquart, M. and Duffie, J. (2008). The Effect of a Low-Carbohydrate, Ketogenic Diet Versus a Low-Glycemic Index Diet on Glycemic Control in Type 2 Diabetes Mellitus. *Nutrition & Metabolism*, (5): 36, 657-661.

Yancy, W.; Foy, M.; Chalecki, A.; Vernon, M. and Westman, E. (2005). A Low-Carbohydrate, Ketogenic Diet to Treat Type 2 Diabetes. *Nutrition & Metabolism*, (2):34.

Youssef A. A.B. (2019). Comparing Measures of Obesity: Waist Circumference, Waist-Hip, and Waist-Height Ratios. Nutrition in the Prevention and Treatment of Abdominal Obesity. *Second Edition*, 29-40.

Zhang, P.; Wang, R.; Gao, C.; Song, Y.; Lv, X.; Jiang, L.; Yu, Y.; Wang, Y. and Bo, L. (2016). Types of Obesity and its Association with the Clustering of Cardiovascular Disease Risk Factors in Jilin Province of China. *Int. J. Environ. Res. Public Health*, (13): 685.

تأثير نظام الكيتوجينيك والصيام المتقطع على مرضى السمنة

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الملخص العربي

يهدف البحث الحالي الى دراسة تأثير بعض الوجبات الغذائية بنظام الكيتوجينيك مع اتباع الصيام المتقطع على 140 سيدة تعانين من السمنة المفرطة، تتراوح أعمارهن ما بين 20–40 عام، ومؤشر كتلة الجسم لديهن أكبر من 30 كم/م^2، تم تغذيتهن لمدة أربعة شهور. تم قياس وزن الجسم لهن وحساب مؤشر كتلة الجسم ومحيطي الخصر والأرداف ونسبة محيط الخصر الى الأرداف ونسبة الدهون في الجسم قبل وأثناء وبعد انتهاء التجربة. كما تم سحب عينات دم من السيدات اللواتي اتبعن النظام الغذائي في الدراسة قبل وبعد التجربة وذلك لقياس الكوليسترول الكلي والدهون الثلاثية والبروتينات الدهنية المرتفعة والمنخفضة الكثافة وكذلك قياس مستوى السكر التراكمي (HbA_{1c}) وكرات الدم الحمراء والبيضاء. وقد أظهرت النتائج انخفاض ملحوظ في وزن الجسم ومعه انخفاض في مؤشر كتلة الجسم، ومحيطي الخصر والأرداف ونسبة الدهون في الجسم. كما أظهرت نتائج تحليل الدم انخفاض معنوي في كل من الكوليسترول الكلي والدهون الثلاثية، وزيادة ملحوظة في البروتينات الدهنية مرتفعة الكثافة وكرات الدم الحمراء. كما سجلت زيادة طفيفة في كل من البروتينات الدهنية منخفضة الكثافة وكريات الدم البيضاء. ولذا توصي الدراسة بفاعلية تطبيق نظام الكيتوجينك مع الصيام المتقطع لما لهما من تأثير إيجابي واضح على القياسات الجسمية وتحسين قياسات الدم.

الكلمات المفتاحية: نظام الكيتوجينيك منخفض الكربوهيدرات – الكوليسترول الكلي – فقدان الوزن – مؤشر كتلة الجسم – الهيموجلوبين السكري.