



Eight Weeks of Aerobic Exercise and Prescribed Diet (Low in Carbohydrate and High Protein) Improve Mental Health in Obese Women

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Abstract

Objectives: Although, the association between mental health and obesity has been reported in different studies, the relationship between dietary carbohydrate intake and mental health is not well understood. The aim of this study was to investigate the association of a diet (low in carbohydrate and high protein) along with aerobic exercise on mental health in obese individuals.

Methods: In this quasi-experimental study, 30 obese women (20 - 35 years; 80 - 100 kg, 160 ± 5.1 cm and body mass index (above 30) who lived in Qazvin, Iran were selected voluntarily. Dietary intakes during the past one-month was assessed using a quantitative questionnaire on food frequency. Additionally, Beck Anxiety Inventory was used to monitor the rate of depression. Subjects were then randomly divided into experimental and control groups. The experimental group received a balanced diet that was low in carbohydrates and high in protein based on the calculation of their metabolism, while at the same time engaging in aerobic exercise (walking) for 8 weeks with 75% of the maximum heart rate. Control group did not receive any intervention during the study period. The aerobic program was performed for eight weeks (4 sessions per week and 50 minutes per session).

Results: The results showed that the rate of depression was significantly improved in experimental group ($P = 0.001$), however, no significant change was found for control group ($P = 0.17$)

Conclusions: The present study showed that a low carb and high protein diet is positively associated with mental health improvement (anxiety, stress and depression).

Keywords: Low Carb Diet, High Protein Diet, Mental Health, Obesity, Overweight

1. Background

Over the past decades, the prevalence of obesity has gradually increased in all parts of the world and has become a major public health concern (1, 2). At least 2.8 million obesity and overweight deaths occur worldwide each year (3). The growing trend of obesity is due to several factors including genetics, lifestyle, unhealthy diet patterns and lack of physical activity (4). A positive energy balance, usually due to high food intake, is a key risk factor in weight gain (5). Although reducing energy intake plays an important role in prevention and treatment of obesity, the role of dietary ingredients in weight loss is not fully understood. Traditional treatments for obesity include a combination of a low-calorie diet with increased physical activity and nutritional strategies (6). It has been reported that low fat diet is highly recommended for weight loss

of obese persons (7). Hence, Low carb and high protein diets has become tremendously popular (8). Although, previous studies have suggested that changing the ratio of protein and carbohydrate intake in a diet would probably affect psychological status, the results are contradictory. A study showed that a high-protein diet can lead to faster satiety signals, which can help control appetite. On the other hand, it has been shown that eating foods that are high in carbohydrates can bring more pleasant feelings to humans (9). However, some evidence has shown that high carbohydrate intake may cause mood swings and lethargy, so that 90 minutes after eating high-carbohydrate foods, people's arousal reaches its lowest possible level and their mood is disturbed (10). In this context, Marcus et al. Found that a high-carbohydrate, low-protein diet increased depression as well as uncontrollable stress (11).

2. Objectives

In this study, researchers sought to investigate the effects of consumption of low-carbohydrate and protein diets along with physical activity on the mental health (anxiety, depression, stress) of obese women.

3. Methods

3.1. Subjects

A quasi-experimental pretest-posttest design was used in this study. 30 obese women (20 - 35 years; 80 - 100 kg, 160 ± 5.1 cm and body mass index (above 30) who lived in Qazvin-Iran, were selected voluntarily. Those who were pregnant or breastfeeding, or had a history of chronic disease, thyroid disorders, or any diet or obesity diet were not included in the study.

3.2. Assessment

Dietary intakes during the past one-month was assessed using a quantitative questionnaire on food frequency. Additionally, Beck Anxiety Inventory was used to monitor the rate of depression. All information was collected in the form of web-based questionnaires.

3.3. Procedure

Subjects were then randomly divided into experimental and control groups. The experimental group received a balanced diet that was low in carbohydrates and high in protein based on the calculation of their metabolism, while at the same time engaging in aerobic exercise (walking) for 8 weeks with 75% of the maximum heart rate. Control group did not receive any intervention during the study period. The aerobic program was performed for eight weeks (4 sessions per week and 50 minutes per session). Measurements of food consumption was done based on defined units such as spoons, palms, and plates, and then the researchers converted this information into grams based on the household scale, and finally calculations related to calories consumed and the percentage of macro-nutrients was calculated. Prior to the study, all subjects were asked to complete a consent form, and the procedure was fully explained to them, and participants were assured that the study had no potential harm or side effects.

3.4. Data Analysis

After performing and obtaining the findings, independent t-test was used to analyze the data and a significance level was set at $P \leq 0.05$. The statistical analysis was performed using the SPSS v21.0 software (SPSS Inc., Chicago, IL). Data are presented as mean \pm SD in the table and the text.

4. Results

Table 1 shows the general characteristics of participants.

The used food of participants during the past six months are listed in Table 2 for both control and experimental groups.

As it can be seen in Table 3, the rate of depression was significantly improved in experimental group ($P = 0.001$), however, no significant change was found for control group ($P = 0.17$).

5. Discussion

Research has shown that there is a direct link between obesity and psychological disorders such as depression, stress and anxiety (12, 13). Since the effect of nutrition on body health is well understood, in this study, the aim of the researchers was to investigate the effect of a low-carbohydrate and protein diet along with aerobic physical activity on the health status of obese women. The rationale for selecting female subjects for this study is also due to the fact, it seems that the number of women suffering from depression is higher than that of men due to vitamin D deficiency caused by less exposure to sun due to Hijab. In the present study, a significant inverse relationship was observed between consuming a low-carbohydrate and high-protein diet and aerobic exercise (walking) with the risk of depression in obese individuals. It was shown that a low-carbohydrate and high-protein intake had a significant effect on rate of depression among study participants.

According to global statistics, cognitive impairment is the fifth leading cause of disability in the world, which directly affects the quality of human life and has dire social consequences (14). Among the environmental factors affecting these disorders, we can mention the nutritional factor. The effect of nutrition on physical and mental health has been proven many times in various studies (15, 16).

Although numerous studies have been conducted on the effects of dietary programs on mental health in different populations, less attention has been paid between specific diets such as low carb and protein diets on the mental health index. Although the exact mechanism is unknown, various mechanisms have been proposed to identify the association between low-carbohydrate and high-protein diets and mental health indicators. The observed association may be due to the low glycemic index of a low-carbohydrate diet, as consuming a diet with a low glycemic index is associated with a reduced risk of insulin resistance, which in turn is

Table 1. The General Characteristics of Participants

Groups	N	Minimum	Maximum	Mean	Std. Deviation
Control					
Age	15	27	40	33.60	4.579
Height	15	156	167	161.87	3.907
BMI	15	30	36	32.47	4.99
Weight	15	81	105	92.1	12.3
Experimental					
Age	15	20	35	28.07	8.6
Height	15	158	170	161.67	4.3
BMI	15	31	37	34.3	3.9
Weight	15	80	83	93.6	6.8

Table 2. Used Food of Participants in Control and Experimental Groups

Groups	Rice Spaghetti	Potato	Meat	Chicken	Fish	Egg	Oil	Fast Food	dairy	Vegetables	Nuts	Grain	Fruit	Water
Control														
Mean	16.93	1.79	4.93	1.93	1.64	2.93	1.64	1.36	3.64	1.93	1.64	4.71	3.14	9.86
N	14	14	14	14	14	14	14	14	14	14	14	14	14	14
SD	8.01	1.31	1.97	1.38	0.929	1.26	1.447	1.008	0.842	1.07	1.008	2.26	1.09	3.20
Experimental														
Mean	17.20	2.07	3.27	1.80	1.07	2.20	1.73	1.47	2.93	1.13	2.13	3.80	2.73	8.27
N	15	15	15	15	15	15	15	15	15	15	15	15	15	15
SD	4.17	0.799	2.40	0.941	0.961	1.01	1.100	0.915	1.387	0.915	1.76	1.474	1.223	3.08
Total														
Mean	17.07	1.93	4.07	1.86	1.34	2.55	1.69	1.41	3.28	1.52	1.90	4.24	2.93	9.03
N	29	29	29	29	29	29	29	29	29	29	29	29	29	29
SD	6.210	1.067	2.329	1.156	0.974	1.183	1.257	0.946	1.192	1.05	1.44	1.921	1.163	3.19

Table 3. Paired Samples Test

Group	Paired Differences					t	df	Sig
	Mean	Std. Deviation	Std. Error Mean	95% CI of the Difference				
				Lower	Upper			
Control								
Pretest - posttest depression	-1.867	2.295	0.593	-3.138	-0.596	-3.150	14	0.17
Experimental								
Pretest - posttest depression	11.000	7.728	1.995	6.721	15.279	5.513	14	0.001

associated with a reduction in neurological deficits and mental disorders. On the other hand, a low carb and high protein diet is associated with an increase in unsaturated fatty acids. Unsaturated fatty acids are associated with reduced oxidative stress damage to neurons and decreased concentrations of monoamines and catecholamines, and can improve the function and proper secretion of neurotransmitters and reduce psychological symptoms such as anxiety and depression (17, 18).

Consistent with the results of the present study, Galletly et al, In a clinical trial showed that consuming high-protein and low-carbohydrate diets improved depressive symptoms compared to low-protein and high-carbohydrate diets (19). The difference between the present study and the Galletly study was that they did not use physical activity in their study. Marcus, et al. Also showed that limiting the percentage of carbohydrates consumed in the diet by combining 35% protein, 64% fat and 1% carbohydrate compared to a high-carbohydrate diet (29% carbohydrate) had a significant effect on improving depression in women (11). Therefore, it seems that finding the right percentage of carbohydrates and proteins based on research conducted in a laboratory and closely monitored and controlled can clarify these ambiguities. In a prospective study with a large sample size, Yarizadeh, et al showed that increasing glycemic index in the diet increases the risk of depression, while the more fiber and vegetables in the diet, the more improvement, and depression status can be (20). On the other hand, Whiteford, et al. Showed that the higher the intake of unsaturated fatty acids in the diet compared to saturated fatty acids, the lower the risk of depression (21). Although the exact mechanism is unknown, various mechanisms have been proposed to identify the association between low-carbohydrate and high-protein diets and mental health indicators. The observed association may be due to the low glycemic index of a low-carbohydrate diet, as consuming a diet with a low glycemic index is associated with a reduced risk of insulin resistance, which in turn is associated with a reduction in neurological deficits and mental disorders. On the other hand, a low carb and high protein diet is associated with an increase in unsaturated fatty acids. Unsaturated fatty acids are associated with reduced oxidative stress damage to neurons and decreased concentrations of monoamines and catecholamines, and can improve the function and proper secretion of neurotransmitters and reduce psychological symptoms such as anxiety and depression. As a result, although, it was shown that there may be a significant effect of a low carb and high protein pattern with aerobic exercise on improving mental disorders such as depression, anxiety and stress, further study, especially

with larger samples and prospective design is needed to confirm the results.

Footnotes

Authors' Contribution: Study concept and design, F. Y.; Analysis and interpretation of data, F. Y.; Drafting of the manuscript, F. Y.; Critical revision of the manuscript for important intellectual content, F. Y.; Statistical analysis, F. Y.

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References

1. Seghatoleslami A, Hemmati Afif A, Irandoust K, Taheri M. Effect of Pilates Exercises on Motor Performance and Low Back Pain in Elderly Women With Abdominal Obesity. *Iran J Ageing*. 2018;**13**(3):396-405. <https://doi.org/10.32598/sija.13.3.396>.
2. Taheri M, Irandoust K. The effect of balance exercises and computerized cognitive training on psychomotor performance in elderly. *J Phys Ther Sci*. 2017;**29**(12):2097-9. [PubMed ID: 29643582]. [PubMed Central ID: PMC5890208]. <https://doi.org/10.1589/jpts.29.2097>.
3. Irandoust K, Taheri M, Mirmoezzi M, H'Mida C, Chtourou H, Trabelsi K, et al. The Effect of Aquatic Exercise on Postural Mobility of Healthy Older Adults with Endomorphic Somatotype. *Int J Environ Res Public Health*. 2019;**16**(22). [PubMed ID: 31717625]. [PubMed Central ID: PMC6888232]. <https://doi.org/10.3390/ijerph16224387>.
4. Taheri F, Kazemi T, Chahkandi T, Namakin K, Zardast M, Bijari B. Prevalence of overweight, obesity and central obesity among elementary school children in Birjand, east of Iran, 2012. *J Res Health Sci*. 2013;**13**(2):157-61. [PubMed ID: 24077473].
5. Chaput JP. Sleep patterns, diet quality and energy balance. *Physiol Behav*. 2014;**134**:86-91. [PubMed ID: 24051052]. <https://doi.org/10.1016/j.physbeh.2013.09.006>.
6. Wadden TA, Webb VL, Moran CH, Bailer BA. Lifestyle modification for obesity: new developments in diet, physical activity, and behavior therapy. *Circulation*. 2012;**125**(9):1157-70. [PubMed ID: 22392863]. [PubMed Central ID: PMC3313649]. <https://doi.org/10.1161/CIRCULATIONAHA.111.039453>.
7. Bueno NB, de Melo IS, de Oliveira SL, da Rocha Ataide T. Very-low-carbohydrate ketogenic diet v. low-fat diet for long-term weight loss: a meta-analysis of randomised controlled trials. *Br J Nutr*. 2013;**110**(7):1178-87. [PubMed ID: 23651522]. <https://doi.org/10.1017/S0007114513000548>.
8. Volpe SL. Popular weight reduction diets. *J Cardiovasc Nurs*. 2006;**21**(1):34-9. [PubMed ID: 16407735]. <https://doi.org/10.1097/00005082-200601000-00008>.
9. Gibson EL. Emotional influences on food choice: sensory, physiological and psychological pathways. *Physiol Behav*. 2006;**89**(1):53-61. [PubMed ID: 16545403]. <https://doi.org/10.1016/j.physbeh.2006.01.024>.

10. Lloyd HM, Rogers PJ, Hedderley DI, Walker AF. Acute effects on mood and cognitive performance of breakfasts differing in fat and carbohydrate content. *Appetite*. 1996;**27**(2):151-64. [PubMed ID: 8937619]. <https://doi.org/10.1006/appe.1996.0042>.
11. Markus CR, Panhuysen G, Tuiten A, Koppeschaar H, Fekkes D, Peters ML. Does carbohydrate-rich, protein-poor food prevent a deterioration of mood and cognitive performance of stress-prone subjects when subjected to a stressful task? *Appetite*. 1998;**31**(1):49-65. [PubMed ID: 9716435]. <https://doi.org/10.1006/appe.1997.0155>.
12. Irandoost K, Taheri M, Seghatoleslami A. [The effects of weight loss by physical activity and diet on depression levels of highly depressed elderly females]. *Iran J Ageing*. 2015;**10**(1):48-53. Persian.
13. Irandoust K, Taheri M, Chtourou H, Nikolaidis PT, Rosemann T, Knechtle B. Effect of Time-of-Day-Exercise in Group Settings on Level of Mood and Depression of Former Elite Male Athletes. *Int J Environ Res Public Health*. 2019;**16**(19). [PubMed ID: 31546685]. [PubMed Central ID: PMC6801561]. <https://doi.org/10.3390/ijerph16193541>.
14. Brown I, Hatton C, Emerson E. Quality of life indicators for individuals with intellectual disabilities: extending current practice. *Intellect Dev Disabil*. 2013;**51**(5):316-32. [PubMed ID: 24303820]. <https://doi.org/10.1352/1934-9556-51.5.316>.
15. Himmerich H, Kan C, Au K, Treasure J. Pharmacological treatment of eating disorders, comorbid mental health problems, malnutrition and physical health consequences. *Pharmacol Ther*. 2021;**217**:107667. [PubMed ID: 32858054]. <https://doi.org/10.1016/j.pharmthera.2020.107667>.
16. Stevens AJ, Rucklidge JJ, Kennedy MA. Epigenetics, nutrition and mental health. Is there a relationship? *Nutr Neurosci*. 2018;**21**(9):602-13. [PubMed ID: 28553986]. <https://doi.org/10.1080/1028415X.2017.1331524>.
17. Hibbeln JR, Salem NJ. Dietary polyunsaturated fatty acids and depression: when cholesterol does not satisfy. *Am J Clin Nutr*. 1995;**62**(1):1-9. [PubMed ID: 7598049]. <https://doi.org/10.1093/ajcn/62.1.1>.
18. Charney DS. Monoamine dysfunction and the pathophysiology and treatment of depression. *J Clin Psychiatry*. 1998;**59 Suppl 14**:11-4. [PubMed ID: 9818625].
19. Galletly C, Moran L, Noakes M, Clifton P, Tomlinson L, Norman R. Psychological benefits of a high-protein, low-carbohydrate diet in obese women with polycystic ovary syndrome—a pilot study. *Appetite*. 2007;**49**(3):590-3. [PubMed ID: 17509728]. <https://doi.org/10.1016/j.appet.2007.03.222>.
20. Yarizadeh H, Setayesh L, Askarpour M, Keshavarz SA, Mirzaei K. The Relationship between Low Carbohydrate Diet Score and Mental Health in Overweight and Obese Women. *Qom Univ Med Sci J*. 2020;**14**(2):47-54. <https://doi.org/10.29252/qums.14.2.47>.
21. Whiteford HA, Degenhardt L, Rehm J, Baxter AJ, Ferrari AJ, Erskine HE, et al. Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. *Lancet*. 2013;**382**(9904):1575-86. [PubMed ID: 23993280]. [https://doi.org/10.1016/S0140-6736\(13\)61611-6](https://doi.org/10.1016/S0140-6736(13)61611-6).