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Original Article

Anthropometrics and Mental Health Among People with and Without Type 2 Diabetes

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Abstract

Objectives: To investigate the relationships between anthropometric variables and the mental health of older people with type 2 diabetes compared to those without diabetes.

Design: A case-control study.

Setting(s): The study was conducted in Yazd, the capital city of the Yazd province in Iran.

Participants: This study comprised 501 diabetic and 555 non-diabetic individuals recruited from the Yazd Health Study (YaHS).

Outcome measures: The Depression Anxiety Stress Scales (DASS-21) questionnaire was used to assess mental health. The scale measured anthropometric indicators, including blood pressure, waist circumference, hip circumference, neck circumference, body fat, body muscle percentage, visceral fat, and body mass index (BMI).

Results: The non-diabetic group exhibited better mental health ($P \leq 0.01$) compared to the diabetic group. Linear regression analysis indicated that, among demographic variables, gender in diabetic elderly was associated with mental health ($P \leq 0.01$), while gender, level of education, and marital status ($P \leq 0.01$) in non-diabetics were associated with mental health. Furthermore, among anthropometric factors, BMI and visceral fat ($P \leq 0.01$) in diabetics and visceral fat ($P \leq 0.01$) in non-diabetics were associated with mental health. The model obtained from liner regression based on demographic and anthropometric variables explained 6 to 13.3% and 8.8 to 15.4% of variance in mental health among diabetic ($R^2 = 0.086$, $P \leq 0.01$) and non-diabetic ($R^2 = 0.162$, $P \leq 0.01$) individuals, respectively.

Conclusions: Gender, higher BMI, and visceral fat were associated with poor mental health among diabetic patients. The results of the present study can be used for designing appropriate interventions through different programs such as physical fitness programs.

Keywords: Diabetes, Anthropometric, Mental health, DASS-21, Yazd health study

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Introduction

People with diabetes experience poor mental health and quality of life compared to those without diabetes, and they are more likely to develop mental disorders. [1] Hopefully, identifying risk factors associated with mental health problems and performing the necessary interventions in diabetic patients can promote their mental health. Changes in the normal ranges of anthropometric indicators have been reported as one of the factors contributing to the occurrence of mental disorders in diabetic patients.[2] The findings of previous studies examining the relationships between anthropometric variables and mental health are still controversial. For example, some studies have found that overweight or increased visceral fat is significantly associated with a higher rate of mental disorders,[3,4] while other studies indicated that mental disorders are significantly associated with lower weight (rather than overweight).[5,6] Previous studies have demonstrated that increasing adipose tissue and body fat percentage, which are integral parts of the endocrine system, leads to the production of various adipokines and inflammatory proteins that can cause mental disorders with negative

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effects on brain function.[7,8] The results also indicated a significant relationship between mental health and hip and waist circumference, which is consistent with some previous research findings.[9,10] Cho et al conducted a study to investigate the relationship between visceral fat accumulation and suffering from mental disorders such as depression, concluding that an increase in each unit of visceral fat in square centimeters increases the likelihood of having mental disorders by 1.006 times.[11] However, another study investigating the relationship between visceral fat and the mental health of the elderly found no significant relationship between visceral fat and mental health in the elderly population.[10] In general, the results concerning the relationships between anthropometric factors and mental health in diabetic patients are inconsistent, and to the best of our knowledge, no study has yet compared the relationship between these variables and mental health in the elderly with and without diabetes. Hence, this study aimed to investigate the relationships between anthropometric factors and mental health among older people with type 2 diabetes and compare them to the non-diabetic ones.

Methods

Study Participants and Procedures

We used data obtained during the recruitment phase of the Yazd Health Study (YaHS).[12] In the present study, data gathered from 1056 older people (aged over 60 years) were analyzed. Participants were divided into two groups (501 with diabetes and 555 without diabetes), and their respective data were compared. Criteria for considering a person as having type 2 diabetes included a history of diagnosis with diabetes recorded by a healthcare practitioner over a lifetime period according to the interview with the patient, doctor's diagnosis, and fasting plasma glucose levels ≥ 126 mg/dl in blood tests. Exclusion criteria included not suffering from mental disorders such as depression and anxiety and having FBS levels ≤ 125 (see Reference 12 for further details).

Data Collection Tools

Depression, Anxiety, and Stress Scale

The Depression, Anxiety, and Stress Scale (DASS-21) is a self-report questionnaire developed by Lovibond and Lovibond[13] to measure three negative emotional states: depression, anxiety, and stress. Items related to depression assess dysphoric mood (e.g., sadness or worthlessness), items related to anxiety primarily evaluate symptoms of physical arousal, panic attacks, and fear (e.g., trembling or faintness), and items related to stress measure the existence of symptoms such as tension, irritability, and a tendency to overreact to stressful events. It takes 5 to 10 minutes to complete.[14] This inventory has already been validated in Iran.[14] The scoring of the scale is in Likert form ranging from 0 (did not apply to me at all) to 3 (applied to me very much), with higher scores indicating poorer mental health status.

Anthropometric Indicators

A. Blood pressure was measured after completing two-thirds of the questionnaire, while the subjects were sated and relaxed. Reichter electronic sphygmomanometers were used to measure blood pressure with the average of the second and third measurements determining the participants' blood pressure.
B. The body mass index (BMI) of individuals was obtained as weight (using a digital balance with 0.1 kg accuracy) divided by height squared (using a tape stuck to the wall).
C. Waist circumference was gauged to the nearest 0.5 cm using non-stretch tape placed midway between the iliac crest and lowest rib while participants were in the standing position.
D. Hip circumference was also measured, similar to the WC, with a tape meter at the widest part of the buttocks.
E. The neck circumference was measured using a tape measure around the base of the neck below the thyroid, holding it slightly loose and not restrictive on the neck.
F. Body fat and body muscle percentage were also measured using a Tanita body scan (Model 494, Tanita Corp, Tokyo, Japan).

Data Analysis

Statistical analysis was performed using SPSS version 24. Data were presented as numbers, percentages, means, and standard deviations. An independent sample t-test was used to compare quantitative variables between groups. Moreover, a P value ≤ 0.05 was considered statistically significant. Furthermore, analysis of Variance (ANOVA) was used to compare the mean of each parameter. Finally, multiple linear regression analysis was conducted to adjust for the relationship of various confounding variables.

Results

A total of 501 elderly people with diabetes and 555 people without diabetes participated in this study (Table 1). The results showed that non-diabetic elderly have better mental health compared to diabetic ones ($P \leq 0.01$), as depicted in Table 2. Additionally, a comparison of mental health between the two genders showed that non-diabetic men had better mental health compared to men with diabetes, and non-diabetic women had better mental health compared to women with diabetes (≤ 0.01).

Our findings showed a statistically significant difference between marital status and mental health in diabetic ($P \leq 0.01$) and non-diabetic ($P \leq 0.01$) groups. Based on the results of the post hoc test, married people had better mental health compared to widowed/divorced individuals and experienced less depression, anxiety, and stress in both groups. Married people in the non-diabetic group had better mental health than those with diabetes,

Table 1. Socio-demographic Characteristics of Participants With and Without Diabetes

Variables		Diabetic (n = 501)		Non-diabetic (n = 555)	
Gender	Female	276	55.1	243	43.8
	Male	225	44.9	312	56.2
Educational level	Primary school and less	322	64.3	323	58.2
	Secondary	97	19.4	123	22.2
	Diploma	63	12.6	84	15.1
	Masters and Ph. D	19	3.8	25	4.5
Marital status	Single	6	1.2	4	0.7
	Married	423	84.4	495	89.2
	Widow/ Divorced	72	14.4	56	10.1

Table 2. Mental Health Status in Individuals With and Without Diabetes

DASS-21	Groups		*P*
	Diabetic	Non-diabetic	
	Mean ± SD	Mean ± SD	
Total score	15.65 ± 9.67	14.1 ± 8.69	0.06
Stress	6.82 ± 4.33	6.69 ± 4.11	0.61
Anxiety	4.49 ± 3.6	3.54 ± 3.3	0.01
Depression	4.34 ± 3.63	3.87 ± 3.33	0.03

Note. DASS: Depression, anxiety, and stress scale.

and widowed/divorced people in the non-diabetic group had better mental health than those with diabetes.

Comparison of the mental health of the elderly based on educational status in two diabetic and non-diabetic groups indicated a significant relationship between mental health and educational status in diabetic ($P \leq 0.05$) and non-diabetic ($P \leq 0.01$) elderly. The post hoc test results displayed a statistically significant difference between the total mental health scores of individuals with lower educational levels (primary school and less) compared to those with higher educational levels (high school and more). Moreover, diabetic individuals with primary school and lower literacy levels experienced greater mental disorders compared to individuals without diabetes ($P \leq 0.01$).

The relationship between anthropometric variables and total mental health scores indicated that BMI, visceral fat, body fat percent ($P \leq 0.01$), and hip circumference (in diabetics $P \leq 0.05$ and non-diabetics $P \leq 0.01$) had a positive and significant relationship, while body muscle percentage had an inverse and significant relationship with mental health scores in the elderly with and without diabetes ($P \leq 0.01$). In addition, in non-diabetic elderly, waist circumference had a positive and significant relationship with mental health ($P \leq 0.01$), as illustrated in Table 3.

In the first step, among socio-demographic factors, gender (*beta* = 0.182, $P \leq 0.01$) was related to the mental health of the elderly with diabetes. In the second stage, among anthropometric factors, BMI (beta = 0.232, $P \leq 0.05$) and visceral fat (beta = 0.195, $P \leq 0.01$) were related to the mental health of diabetic elderly. The model explained 6 to 13.3 % of the variance in mental health ($R^2 = 0.133$, $P \leq 0.01$). In non-diabetic elderly, in the first step, among socio-demographic factors, gender (*beta* = 0.177, $P \leq 0.01$), level of education (beta = -0.125, $P \leq 0.05$), and marital status (beta = 0.112, $P \leq 0.01$) were correlated with mental health. In the second step, among anthropometric factors, visceral fat (beta = 0.269, $P \leq 0.01$) was related to the mental health of non-diabetic elderly. The model explained 8.8 to 15.4% of the variance in mental health ($R^2 = 0.154$, $P \leq 0.01$), as depicted in Table 4.

Discussion

The present study found that mental health in non-diabetic elderly is more favorable than in the elderly with diabetes. Mirzaei et al conducted a study to evaluate depression, anxiety, and stress in diabetic and non-diabetic patients and concluded that the odds of developing mental disorders such as anxiety, stress, and depression in people with diabetes are 1.84, 1.34, and 1.46 times higher, respectively, than in individuals without diabetes.[15] Previous studies have also reported that adults with diabetes are twice as likely to experience mental disorders or a mental health decline compared to adults without diabetes.[16-18] People with diabetes face many problems such as the need for insulin injection, following strict diets, increased healthcare expenditures, recurrent infections, the possibility of frequent hospitalizations due to disease complications, and restrictions on reproduction and employment.[19] These patients often experience feelings of failure and hopelessness due to difficulties in coping with and planning for treatment, which adversely affects their mental and social well-being. As a result, many report feelings of fear, anger, and guilt associated with diabetes.[20] These factors may hinder individuals' ability to effectively engage in social or work activities, develop their potential abilities, and maintain a sense of psychological well-being.

Anderson et al conducted a study to assess mental disorders such as depression in people with diabetes using meta-analysis and concluded that there is no statistical difference in the mental health of these people based on their gender.[16] However, other studies showed a significant relationship between gender and mental health in elderly people with diabetes, indicating that older men with diabetes exhibit a higher incidence of mental disorders such as depression, while women in the diabetic group have better mental health than their male counterparts.[21,22]

In the non-diabetic elderly, the results showed a statistically significant relationship between mental health and gender, with women exhibiting poorer mental health compared to men. These findings regarding gender differences in mental health in both diabetic and non-

Table 3. Pearson Correlation Matrix Between Anthropometric Variables and Mental Health in the Individuals With and Without Diabetes

Anthropometric Variables		Diabetic	Non-diabetic
		Mental Health (Total Score)	Mental Health (Total Score)
BMI	*r*	0.21**	0.253**
	P	0.01	0.01
Visceral fat	*r*	0.172**	0.252**
	P	0.01	0.01
Systolic blood pressure	*r*	-0.01	0.09
	P	0.07	0.2
Diastolic blood pressure	*r*	-0.02	0.05
	P	0.06	0.23
Pulse	*r*	0.0056	0.06
	P	0.02	0.08
Body fat percent	*r*	0.0208**	0.0245**
	P	0.01	0.01
Body muscles percent	*r*	-.0231**	-.0272**
	P	0.01	0.01
Waist circumference	*r*	0.006	0.0220**
	P	0.01	0.01
Hip circumference	*r*	0.11*	0.0217**
	P	0.03	0.01
Neck circumference	*r*	-0.06	0.06
	P	0.01	0.1

Note. BMI: Body mass index; *$P \leq 0.05$; **$P \leq 0.01$.

Table 4. Comparison of the Effect of Each Variable on Mental Health of Diabetic and Non-diabetic Elderly

Step/Variables	Diabetic		Non-diabetic	
	Model I β	Model II β	Model I β	Model II β
Gender	0.182**	0.135**	0.177***	0.213**
Marital status	0.052	0.054	0.112**	0.095**
Level of education	-0.021	-0.002	-0.125*	-0.103**
BMI		0.232*		0.045
Visceral fat		0.195**		0.269***
Systolic blood pressure		-0.021		0.012
Diastolic blood pressure		-0.035		0.009
Pulse		-0.001		-0.037
Body fat percent		-0.086		-0.027
Body muscles percent		-0.011		-0.033
Waist circumference		-0.124		0.018
Hip circumference		-0.095		0.033
Neck circumference		-0.029		0.049
F	12.2	5.60	17.82	7.34
R	0.262	0.364	0.297	0.392
$R^2$0.06		0.133	0.088	0.154

Note. BMI: Body mass index. *$P \leq 0.05$; **$P \leq 0.01$; ***$P \leq 0.001$. Demographic variables (gender, marital status, and education level) were adjusted in both models.

diabetic groups can be justified in the sense that older women in societies with more gender discrimination become more vulnerable as they age and are less likely to have the same social capital and resources as men, which puts them at greater risk of mental disorders. On the other hand, older men with diabetes may experience more psychosocial problems and have lower mental health compared to their non-diabetic counterparts due to the disease and its associated limitations in personal and social life.

Moreover, the results demonstrated that married elderly in the diabetic and non- diabetic groups have better mental health than their single and widowed counterparts. This finding is in line with some studies,[23] but contradicts others.[21,24] Azadi et al aimed to evaluate anxiety and depression among elderly diabetic patients and concluded that marital status has no significant relationship with anxiety and depression.[21] The discrepancies between our study and the previously mentioned one can be attributed to differences in sample size (s 1056 individuals in our study versus 102 in the previous study),[21] target groups (younger older population in our study and versus general population in the other study),[24] and the instruments or methodologies used in the prementioned study compared to ours.[21,24] The present study used DASS-21 to assess mental disorders, including depression, anxiety, and stress, but the previous study employed the geriatric depression scale (GDS)[21] and Hospital Anxiety and Depression Scale (HADS)[24] to assess mental disorders.

It is noteworthy to mention that marriage and having a family of her own are accompanied by more perceived social support, especially from a spouse, which can help the patient to maintain better morale and experience less psychological tension.

In the present study, the mean total mental health score in the diabetic group showed a significant relationship with education levels, which is in line with studies by Kau et al and Azadi et al,[21,25] but contradicts others.[15,26,27] In non-diabetics, both the overall mental health score and its subscales had a statistically significant relationship with education levels. In non- diabetics, illiteracy and lower literacy levels were related to more mental health problems, but this relationship was not observed with higher levels of education. The similar findings have been observed in some other studies.[28,29] As reported, lower literacy is generally linked to worse socioeconomic status and lower health literacy. Therefore, people with lower literacy levels, unlike literate people, have fewer resources to participate in social activities and enjoyable leisure activities that can promote their mental health.[30]

Furthermore, the findings indicated that BMI in the elderly with and without diabetes is significantly associated with mental health, and the correlation coefficients of this relationship in both groups are almost the same. This finding contradicts the findings of some previous studies[31,32] but aligns with others.[2,33-35] Obesity or an increase in BMI is associated with chronic inflammation in peripheral tissues and blood circulation,[36] which affects brain physiology, mood, and behavior, thereby

leading to lower mental health, depression, and anxiety.[37] Additionally, BMI and obesity are associated with mental health through social mechanisms such as stigma (people with higher BMI are considered unsuccessful, lazy, and unintelligent), behavioral mechanisms (e.g., functional impairment and withdrawal from the community), and cognitive mechanisms (e.g., dissatisfaction with body shape).[38]

In old age, muscle tissue gradually degrades and transforms to adipose tissue, leading to increased body fat as one of the most important risk factors for mental disorders such as depression.[39] Studies have found that an increase in adipose tissue, along with an increase in body fat percentage, which is part of the endocrine glands, produces a wide range of adipokines and inflammatory proteins, which have adverse effects on the brain and can cause mental disorders.[7,39]

The findings also indicated significant relationships between mental health and visceral fat, hip circumference, and waist circumference, which are consistent with the results of some previous studies[8,11] but contradict others.[10,40] These variables, known as central obesity indices, increase steadily with age until around 70 years. The age-related increase in obesity may be due to hormonal changes, decreased physical activity, and altered Basal Metabolic Rate (BMR).[41] The distribution of fat in the body significantly impacts health. In central obesity, fat accumulates primarily in internal and visceral areas than external and subcutaneous areas. People with this type of obesity are at a higher risk for metabolic disorders such as diabetes, premature atherosclerosis, and mental disorders.[42] The results suggested that with increase in body muscles, mental health score decreased, which indicates better mental health. Engaging in daily activities and regular physical exercises can help prevent muscle wasting and its conversion to fat tissue, thereby improving mental health and ultimately promoting the quality of life for the elderly.[43]

Regression analysis results showed that in the diabetic elderly, only gender among the demographic variables and BMI and visceral fat among anthropometric indicators are related to mental health. The results of other studies also indicated that increasing BMI in people with diabetes and the general population decreases their mental health, leading to experiencing more mental problems due to a negative self-perception. [44-46] Conversely, in the non-diabetic elderly, gender, education level, and marriage among demographic factors and visceral fat among anthropometric indicators were associated with mental health. The increase in visceral fat was associated with a decrease in the mean score of mental health, indicating that higher visceral fat may deteriorate mental health of individuals.

Limitations

The variables of this study only explained a limited part of mental health variance among older adults. Moreover, caution is suggested in generalizing the results because our sample consisted only of younger elderly.

Strengths

The present study is the first study to investigate the relationship between anthropometric indices and mental health in the elderly with diabetes and compare them with the elderly without diabetes. A large sample size in both groups can be one of the strengths of the present study.

Conclusions

Socio-demographic (gender in diabetics and gender, level of education, and marital status in non-diabetics) and anthropometric (BMI and visceral fat in diabetics and visceral fat in non-diabetics) factors affect the mental health of people with and without diabetes. The results of the present study can be used for designing appropriate interventions operating at multiple levels, including the broad policy level, the family structure, and the individual level to promote the mental health of older adults with diabetes through different programs such as physical fitness programs.

Author contributions

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Data availability statement

The data that support the findings of this study are available from the first author, (shamsadinnamjoo@yahoo.com), upon reasonable request.

Ethical approval

This study was approved by the Ethics Committee of the University of Social Welfare and Rehabilitation Sciences (IR.USWR.REC.1398.006), and YaHS was approved by Shahid Sadoughi

University of Medical Sciences.

Consent for publication
Not applicable.

Conflict of interests
The authors reported no potential conflict of interests.

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