Original Article

Comparative analysis of big five personality traits in obese and normal weight type 2 diabetes mellitus patients

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Abstract

Background and Objectives: Type 2 diabetes has multifactorial causation, with obesity and metabolic dysregulation being two of them. Personality traits are also known to influence many metabolic processes and have been associated with the pathogenesis of diabetes as well as obesity. The objective of the study was to analyze the differences in the big five personality traits of normal-weight type 2 diabetes mellitus, obese type 2 diabetes mellitus patients, and healthy controls. **Methods:** A total of 70 subjects were included in the study after outpatient-based screening, of which 40 were type 2 diabetes patients (20 obese and 20 normal weight) and 30 were healthy controls. After the anthropometric screening, the personality assessment of the subjects was done using the Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness-Five Factor Inventory (NEO-FFI). The differences in the scores of each trait for every group were analyzed by analysis of variance (ANOVA) with Tukey's honest significant difference (HSD) *post hoc* corrections. The difference in the scores between controls and diabetes patients was also compared by independent samples *t*-test. **Results:** The neuroticism score was significantly higher in both the normal-weight diabetes group ($P = 0.01$) and obese diabetes group ($P = 0.02$) as compared to the control group. All diabetes patients when compared with healthy controls had a significantly higher neuroticism score ($P = 0.00$) while their score of openness was significantly lower ($P = 0.035$) than healthy controls. **Interpretation and Conclusion:** This study identifies the association of personality with type 2 diabetes mellitus. The diabetes patients have higher neuroticism and lesser openness to experience as traits of personality. Importantly, this association is present irrespective of the obesity status of the patients.

Keywords: Big five personality factors, NEO-FFI, Neuroticism, obesity, openness, personality, type 2 diabetes

Introduction

Type 2 diabetes mellitus is a disease of multifactorial causation, with obesity being one of the significant causes.[1,2] Obesity causes insulin resistance, impairment in glucose metabolism, and fatty acid oxidation.[3] Obesity may lead to higher hepatic glucose production, impaired glucose metabolism (both oxidative and non-oxidative), and increased levels of blood glycerol and non-esterified fatty acids.[4] Obesity-induced inflammation is another important cause of metabolic dysregulation and pathogenesis of diabetes and related complications.[5] Personality has a significant impact on the causation and progression of any disease.[6] According to a study, age and gender have a significant effect on the big five personality traits of an individual namely neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness.[7] Age and gender along with some other factors are part of the unmodifiable group of factors affecting personality. Similarly, there are some modifiable factors to personality as well. These include health conditions like obesity, hypertension,[8] and diabetes. Such chronic health conditions affect a person's lifestyle and might lead to changes in his or her personality and the converse is also true. The personality of a person also affects his or her health condition as mentioned above.[9] As per a study conducted on a heterogeneous group of individuals, it was found that high neuroticism and low agreeableness had a high association with metabolic syndrome.[10] Similar results

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were seen in another study in which it was found that there was a positive relationship between neuroticism and extraversion with body mass index (BMI), body fat, waist and hip circumference. This relationship was negative in the case of conscientiousness.[11] Higher extraversion and conscientiousness reportedly corresponded to better glycemic control with lesser Haemoglobin A1c/Glycated haemoglobin (HbA1c) levels in type 2 diabetes patients. However, higher scores of neuroticism corresponded to poorer glycemic control with higher HbA1c levels.[12] Hence, one of the major factors affecting the development and progression of diabetes is lifestyle and personality traits. Certain personality traits can lead to the development of obesity and type 2 diabetes mellitus or can alter their course. Conversely, the presence of a disease can also bring changes into one's personality traits and so is the case with obesity and diabetes. The personality traits can be assessed by NEO-Five Factor Inventory (NEO-FFI). The NEO-FFI is a personality model that evaluates a person's big five personality traits (openness to experience, conscientiousness, extraversion, agreeableness, and neuroticism).[13] It is a reliable inventory with high internal consistency. There is a paucity of information dealing with the association between personality and metabolic dysregulations and the studies available are quite inconclusive. Furthermore, there are no studies which evaluate the correlation between personality traits and diabetes separately with obese and normal-weight individuals. However, if there are adequate studies on the modifiable factors of an individual's personality and if proper methods of modulating such personality traits are devised, numerous metabolic diseases might be better controlled. For the primary health care physicians, the study becomes relevant as screening of personality may be an important adjunct in the early diagnosis and related preventive measures of type 2 diabetes and related complications. Similarly, in cases of newly diagnosed type 2 diabetes, personality workup may prove beneficial. So, in this study, we compared the personality traits of normal-weight type 2 diabetes mellitus patients, obese type 2 diabetes mellitus patients, and healthy controls (having neither diabetes nor obesity) using NEO-FFI.

Materials and Methods

A total of 70 male subjects of age 30–60 years were recruited in the study after obtaining informed written consent. Forty out of the 70 participants were type 2 diabetes mellitus patients. Thirty age-matched healthy male subjects were recruited as controls. The type 1 diabetes mellitus patients or those suffering from other systemic diseases or with co-morbidities were excluded from the study. Out of 40 participants, 20 were obese/overweight and 20 were lean type 2 diabetes patients.

The assessment of obesity was performed by the BMI, waist circumference (WC), and waist-hip ratio (WHR). The weight was measured by a digital weighing machine. The subject wore light clothing and no footwear. The subject was made to stand straight on the foot bar with legs positioned on each side of the digital scale. The height was measured using a standardized wall-mounted stadiometer. The subject stood straight on a flat surface with feet flat, heels almost together, legs straight, and knees almost together, arms at the side, and looking straight ahead. The heels, hips, shoulder blades, and occiput were pressed against the vertical bar. Then, the slider was brought down to rest on the top of the head pressing the hair. It has an arrow which accurately measures height. The BMI was calculated as BMI = Weight (in kg)/[Height (in m)]^2. The obesity cutoffs were taken as BMI > 23 kg/m^2. The waist circumference (WC) was measured at the midpoint between the lower rib margin and the iliac crest, during the end of expiration. The measurements were taken by using a calibrated measuring tape in the subjects standing straight with the back facing a mirror so that the horizontal placement of the measuring tape could be assured.[14] The hip circumference was measured as the maximum circumference in the buttock region using the measuring tape. The grid lines on the mirror were used to verify the horizontal position of the tape. The waist hip ratio (WHR) was calculated by dividing WC by HC. All the subjects were required to fill up a questionnaire based on the NEO-FFI. The big five personality traits, that is, neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness were evaluated for each individual. The differences in the scores of each trait for each of the three groups were analyzed by one-way analysis of variance (ANOVA) with Tukey's HSD *post hoc* corrections. The difference in post hoc scores between 30 controls and all the diabetes patients combined (aggregate of the other two groups, i.e., 20 + 20 = 40) was compared using the independent samples t-test. All the data were analyzed by SPSS 23. A $P < 0.05$ was considered statistically significant. The study was approved by the ethical committee of the institute and recommendations of the Helsinki Declaration were followed while recording data.

Results

The comparison groups and scores of the corresponding personality traits are depicted in Table 1. The neuroticism score was significantly higher in both the normal-weight diabetes group ($P = 0.01$) and the obese diabetes group ($P = 0.02$) as compared to the control group, Table 2. When all the diabetes patients were considered as one group, irrespective of BMI, their neuroticism score was significantly higher than the controls ($P = 0.00$), Table 3. However, there was no significant difference ($P = 0.997$) in the neuroticism score between normal-weight and obese diabetes patients.

There were no significant differences in extraversion, openness to experience, agreeableness, and conscientiousness scores between

Table 1: Scores of personality traits of non-obese, obese type 2 diabetes patients, and healthy controls

Personality Trait	Control	Non-Obese Diabetes	Obese Diabetes
Neuroticism	21.50±8.87	30.50±9.48	30.30±6.42
Extraversion	29.67±6.86	27.90±5.54	25.75±5.88
Openness	23.50±5.67	21.50±4.80	20.25±4.31
Agreeableness	28.90±7.45	29.55±6.13	25.55±6.90
Conscientiousness	35.93±6.61	34.90±3.68	32.10±8.87

Table 2: Comparison of scores of personality factors among obese type 2 diabetes mellitus patients, normal-weight type 2 diabetes mellitus patients, and healthy controls

Dependent Variable	(I) Group no	(J) Group no	Mean difference (I-J)	Std. error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Neuroticism	1	2	-9.0	2.44	0.001	-14.842	-3.158
		3	-8.8	2.44	0.002	-14.842	-2.958
	2	1	9	2.44	0.001	3.158	14.842
		3	0.2	2.67	0.997	-6.20	6.600
	3	1	8.8	2.44	0.002	2.958	14.642
		2	-0.2	2.67	0.997	-6.60	-6.20
Extraversion	1	2	1.76	1.8	0.591	-2.55	6.084
		3	3.91	1.8	0.083	-0.40	8.234
	2	1	-1.76	1.8	0.591	-6.084	2.550
		3	2.15	1.97	0.524	-2.579	6.879
	3	1	-3.91	1.8	0.083	-8.234	0.400
		2	-2.15	1.97	0.524	-6.879	2.579
Openness	1	2	2	1.46	0.365	-1.510	5.510
		3	3.25	1.46	0.075	-0.260	6.760
	2	1	-2	1.46	0.365	-5.510	1.510
		3	1.25	1.60	0.717	-2.595	5.095
	3	1	-3.25	1.46	0.075	-6.760	0.260
		2	-1.25	1.60	0.717	-5.095	2.595
Agreeableness	1	2	-0.65	2.00	0.944	-5.453	4.153
		3	3.35	2.00	0.224	-1.453	8.153
	2	1	0.65	2.00	0.944	-4.153	5.453
		3	4	2.12	0.170	-1.262	9.262
	3	1	-3.35	2.00	0.224	-8.153	1.453
		2	-4	2.12	0.170	-9.262	1.262
Conscientiousness	1	2	1.03	1.94	0.855	-3.612	5.678
		3	3.83	1.94	0.126	-0.812	8.478
	2	1	-1.03	1.94	0.855	-5.678	3.612
		3	2.8	2.12	0.390	-2.288	7.888
	3	1	-3.8	1.94	0.126	-8.478	0.812
		2	-2.8	2.12	0.390	-7.888	2.288

1=control, 2=normal-weight type 2 diabetes mellitus patients, 3=obese type 2 diabetes mellitus patients. Values are represented as mean±SD

Table 3: Comparison of scores of personality traits between type 2 diabetes patients and healthy controls

Big five personality traits	Non-diabetic subjects	Diabetic subjects	*P*	95% confidence interval of the difference	
				Lower	Upper
Neuroticism	21.50±8.87	30.40±7.99	0.00	-12.94	-4.86
Extraversion	29.66±6.86	26.82±5.74	0.064	-0.17	5.85
Openness	23.50±5.67	20.87±4.54	0.035	0.18	5.06
Agreeableness	28.90±7.44	27.55±6.75	0.431	-2.05	4.75
Conscientiousness	35.93±6.61	33.50±6.85	0.140	-0.82	5.68

Values are represented as mean±SD

the obese and normal-weight diabetes patients. These personality scores of normal-weight and obese diabetes patients were also not significantly different when compared with controls. However, when the diabetes patients (obese and normal-weight combined) were compared with healthy controls, their score of openness to experience was comparatively low ($P = 0.035$), Table 3.

Discussion

This study was started with the assumption that certain personality characteristics might be definite risk factors for the development of type 2 diabetes in susceptible individuals. At the same time, we also assumed that diabetes being a disease of multifactorial causation and having manifold effects on the body, can cause certain changes in an individual's personality. Obesity being a confounding factor may alter the course of diabetes and/or have a significant effect on the personality too. For testing these assumptions, the big five personality trait scores were compared among three groups consisting of healthy controls, normal-weight type 2 diabetes mellitus patients, and obese type 2 diabetes mellitus patients, respectively.

Neuroticism describes the tendency to experience negative emotions and related processes in response to perceived

threat and punishment. These include anxiety, depression, anger, self-consciousness, and emotional liability.[15] A higher neuroticism score has been found to be associated with poorer glycemic control in diabetes patients.[12] In our study, the neuroticism scores were found to be significantly higher in both obese and normal-weight type 2 diabetes patients as compared to the healthy controls who did not have diabetes. Neuroticism is a trait which fuels negative emotions such as anxiety, depression, anger, etc., which are invariably harmful to the body. This leads to destructive behavioral changes which make the person less health conscious and ultimately leads to the development of metabolic diseases like diabetes.[10]

There are many probable explanations for the link between personality and diabetes. One of them is the 'psychological burden hypothesis' which says that the stress of knowing that a person has diabetes, any other chronic illness, or some complications, can lead to him or her developing depression or other negative psychological states. A person with diabetes, who has knowledge of his/her disease, is likely to be more stressed than the one who does not know that he/she has diabetes. Moreover, regular medications and functional limitations lead to a reduced quality of life.[16] This explains why a person with type 2 diabetes can have a higher neuroticism score as compared to the healthy controls. This can also explain why all the diabetes patients, irrespective of their obesity status, have lower scores of openness as compared to the controls.

Several biological mechanisms like cerebral blood vessel lesions leading to negative mood disorders in diabetes, systemic inflammation leading to diabetes and also affecting personality, and high blood glucose levels affecting mood might be the reason behind the association between neuroticism and type 2 diabetes.[16]

However, we could not find any significant effect of obesity on neuroticism or its relation with diabetes. This could be either because there is no significant impact of obesity on the personality-based aspect of diabetes causation or it may be because the sample size is not large enough for its effect to manifest to a significant extent.

Although the other personality traits, namely extraversion (reflects sociability, assertiveness, and positive emotionality, all of which have been linked to sensitivity to rewards),[15] openness to experience (imagination, creativity, intellectual curiosity, and appreciation of aesthetic experiences),[15] agreeableness (tendency toward cooperation, maintenance of social harmony, and consideration of the concern of the others),[15] conscientiousness (traits related to self-discipline, organization, and control of impulses and appears to reflect the ability to exert self-control to follow rules or maintain goal pursuits)[15] did show certain numerical differences in the mean value between the subject groups (as mentioned under 'Observations and Results'), none of these differences were statistically significant. This suggests that there might be no actual association between these traits, diabetes, and obesity or that the sample size is not big enough for these associations to manifest. However, it is found that if the factor of obesity is done away with and the diabetes patients in the two groups of obese and normal weight are combined as a whole and compared with the controls, a significantly lower value of openness to experience is seen in the diabetes group. This might suggest that lower openness, that is, fewer attributes of creativity and imagination in one's personality might be a cause of predisposition to type 2 diabetes or an effect of it. A novel finding of this study has been that diabetes may be associated with personality factors irrespective of obesity status.

Thus, this study opens up a vast avenue for future research as it is seen here that there is a definite and significant association between neuroticism, openness to experience, and diabetes. The association between the other traits, obesity, and diabetes might also be established if the sample size is increased. If a cohort study is done on this topic and patients with diabetes and healthy patients with high neuroticism and low openness scores are followed up regularly, a definite cause-effect relationship can be established between neuroticism, openness, and type 2 diabetes mellitus.

One of the modern approaches in primary care medicine is the holistic approach. Addressing the patient's mental health along with his/her physical health has been shown to be highly beneficial in improving the overall health condition of the patient. This study aims to improve upon the existing literature linking physical health conditions, like diabetes in this case, to mental health aspects like personality traits. This study will help spread awareness among the primary care physicians that there might be a possibility that diabetes might be causing changes in a patient's personality (e.g., making them more neurotic and less open to experience, as found in this study) or development of such personality traits might be playing a role in diabetes causation. So, the primary care physicians might keep an eye out in the future, for changes in personality, suspect a diagnosis, monitor the progression of diabetes, or help improve the overall health of a person.

Conclusion

It can be concluded that personality does have a definite association with type 2 diabetes mellitus. Patients with type 2 diabetes mellitus are found to have significantly higher neuroticism scores and lower scores of openness as compared to the healthy controls. This association is present irrespective of whether the patient is obese or not. Thus, obesity is not playing any confounding role in the aforesaid associations. The results of this study open up a somewhat unique aspect of the management of type 2 diabetes mellitus. Changes in habits and behavior in a person susceptible to diabetes leading to a healthier personality with a low neuroticism score can contribute to the prevention of diabetes in the said individual. However, further research on this topic, especially a cohort study, is necessary to determine the cause-effect relationship, that is, whether high neuroticism

is leading to the development of diabetes or the presence of diabetes is leading to a high neuroticism score and also to find out whether obesity has any role to play in all of this.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Key message

- There is a definite and significant association with higher neuroticism, and lower openness to experience among type 2 diabetes patients.
- Diabetes is associated with personality traits irrespective of the obesity status of the individuals.
- Personality assessment using NEO-FFI may be useful for primary health care physicians involved in the management of obesity and diabetes as a holistic approach.

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Conflicts of interest

There are no conflicts of interest.

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