ORIGINAL ARTICLE

The Big-Five Personality Traits and Quality of Life in Elderly Malaysian Patients with Diabetes Mellitus: A Cross-Sectional Study

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ABSTRAK

Walaupun penyakit kencing manis sering dijumpai dalam kalangan warga emas serta memberi kesan yang ketara terhadap kualiti hidup (QOL) seseorang, kita masih tidak mengetahui secara jelas cara trait personaliti mempengaruhi QOL. Kajian keratan rentas ini yang dijalankan di Pusat Perubatan Universiti Kebangsaan Malaysia adalah bertujuan untuk menentukan hubung kait di antara trait personaliti dan QOL dalam kalangan warga emas (berumur ≥60 tahun) yang mengalami penyakit kencing manis. Maklumat sosio-demografik dan klinikal telah dikumpulkan. QOL diukur dengan soal sedilik WHO Quality of Life-BREF (WHOQOL-BREF) sementara trait personaliti pula dinilai dengan Big Five Inventory (BFI). Kemurungan dan keresahan diukur dengan pengujian soal selidik Beck Depression Inventory-II (BDI-II) dan Generalized Anxiety Disorder 7-item (GAD-7) masing-masing dan diambil dalam analisa statistik. Terdapat sebanyak 170 peserta kajian yang melibatkan diri (umur median = 69.0 tahun; IQR: 65.0-73.0; dengan 51.2% lelaki). Menggunakan model 'stepwise linear regression', didapati skor kehematan (β=0.156; P=0.044) dan skor neurotisisme yang negatif (β=-0.176; P=0.028) amat berkait dengan QOL yang baik di dalam domain kesihatan fizikal. Sementara nilai skor ekstraversi (β=0.209; P=0.001) dan skor kehematan yang tinggi (β=0.248; P<0.001) pula amat berkait dengan QOL yang baik di dalam domain kesihatan psikologi. Ketinggian skor kepersetujuan (β=0.286; P<0.001) amat berkait rapat dengan QOL yang baik di dalam domain perhubungan sosial. Akhirnya, skor kepersetujuan yang tinggi (β=0.327; P<0.001) dan darjah neurotisme (β=-0.223; P=0.001) didapati amat

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berkait dengan QOL yang baik di dalam domain persekitaran. Trait personaliti berkait rapat dengan semua domain QOL di kalangan pesakit warga emas yang mengalami penyakit kencing manis. Personaliti sebelum jatuh sakit (premorbid personality) mungkin mempunyai peranan penting di dalam mempengaruhi kesan penyakit kencing manis terhadap kehidupan pesakit warga emas.

Kata-kunci: diabetes mellitus, kesihatan mental, kualiti hidup, personaliti, warga tua

ABSTRACT

While diabetes mellitus is highly prevalent in the elderly population with significant impact on quality of life (QOL), we yet to know much about how personality traits affect QOL in this patient population. A cross-sectional study was conducted at Universiti Kebangsaan Malaysia Medical Centre with the aim to determine the relationship between personality traits and QOL among the elderly (aged ≥60 years) with diabetes mellitus. Sociodemographic and clinical information were obtained. QOL was assessed using the WHO Quality of Life-BREF (WHOQOL-BREF) questionnaire and personality traits were assessed using the Big Five Inventory (BFI) questionnaire. Depression and anxiety were measured with Beck Depression Inventory-II (BDI-II) and Generalized Anxiety Disorder 7-item (GAD-7) scale, respectively, and controlled for in all analyses. There were in total 170 study participants (median age=69.0 years; IQR: 65.0-73.0; 51.2% male). In stepwise linear regression models, higher conscientiousness scores (β=0.156; *P*=0.044) and lower neuroticism scores (β=-0.176; *P*=0.028) were associated with greater QOL in the physical health domain. Higher extraversion scores (β=0.209; *P*=0.001) and higher conscientiousness scores (β=0.248; *P*<0.001) were associated with greater QOL in the psychological health domain. Higher agreeableness scores (β=0.286; *P*<0.001) were associated with greater QOL in the social relationship domain. Finally, higher agreeableness scores (β=0.327; *P*<0.001) and lower neuroticism scores (β=-0.223; *P*=0.001) were associated with greater QOL in the environment domain. Personality traits were closely associated with all domains of QOL among elderly patients with diabetes mellitus. Premorbid personality may have important role in moderating the impact of diabetes mellitus on the lives of elderly patients.

Keywords: diabetes mellitus, elderly, mental health, personality, quality of life

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INTRODUCTION

Diabetes mellitus (DM) is a common disease associated with significant microvascular and macrovascular complications (Fowler 2008). As optimal glycaemic control is crucial in preventing these complications, maintaining glycaemic control is essential. This can only be achieved

through the combination of rigorous lifestyle modifications and pharmacotherapy. In this respect, elderly patients with diabetes require different management approaches than their younger counterparts. Geriatric populations face specific challenges related to health, including frailty, functional limitation, changes in cognitive ability and mental health, as well as increased dependency on others for care (Gregg et al. 2002). With this complexity of care comes a need to better understand the psychosocial factors that influence the health of this population.

While certain social, clinical, and psychological factors that impact DM management have been highlighted in previous studies, the influence of personality traits on the quality of life (QOL) in elderly patients with diabetes has not been adequately explored. The Big Five Model of personality includes the following domains i.e., extraversion, agreeableness, neuroticism, conscientiousness, and openness to experience (Costa & McCrae 1990). These traits are believed to remain stable across time. In a large nationally representative sample of adults in Australia, personality, as measured according to the Big Five Model, changed minimally across four years (Cobb-Clark & Schurer 2012). Another study followed individuals over 45-years and found stability in the domains of neuroticism, conscientiousness, and openness to experience across time (Soldz & Vaillant 1999). As diabetes is a chronic condition, it is important to consider the impact of stable factors such as

personality on long-term disease management in these individuals.

Personality may impact disease perception and QOL in individuals with diabetes. One study conducted in Israel among older adults with type 2 DM examined the effect of personality traits on the relationship between subjective health (a patient's perception of their health) and objective health (measured by various health outcomes). They found that participants with higher neuroticism scores had stronger associations between subjective and objective health, suggesting that this trait impacts how a patient views their illness (Elran-Barak et al. 2019). A review by Schimmack et al. (2004) explored the relationship between QOL (defined as Health-Related Quality of Life and Life Satisfaction) and personality traits (defined by the five-factor model). They found a significant positive association between extraversion and life satisfaction. The World Health Organization has further developed the general concept of QOL into four different aspects: physical health, psychological health, social relationships, and environment (WHOQOL Group 1998). A study by Yamaoka et al. (1998) found that extraversion correlated positively with health related QOL in both healthy and cancer populations. All four of these domains may be impacted by the disease burden associated with DM as well as the personality traits of the individual.

Malaysia is a middle-income country with a unique socio-cultural landscape and a high incidence rate of DM reported to be at 20.8% in

2011 (Hussein et al. 2015). In addition, the country has a rapidly ageing population; by 2040, it is estimated that 15% of the population will be above the age of 65 (Department of Statistics Malaysia 2016). As the incidence of DM continues to rise with the average age of the population continues to increase, so will the related costs to the Malaysian healthcare system. Thus, there is a great need in expanding our understanding of psychosocial factors affecting treatment outcomes among the elderly with DM in this country. In this current study, we explored the relationships between personality traits and QOL in elderly patients with DM in Malaysia, with the aim of contributing to the optimisation of disease management in this specific population.

MATERIALS AND METHODS

Study Design and Participants

This was a cross-sectional study conducted at the Universiti Kebangsaan Malaysia Medical Centre (UKMMC), a tertiary referral centre in Kuala Lumpur, Malaysia. Approval was obtained from the Research Ethics Committee of the Faculty of Medicine, Universiti Kebangsaan Malaysia (FF-2019-342). Patients who attended outpatient clinics at UKMMC and who were interested in participating were provided with detailed explanations of the study. Participants were screened for inclusion criteria, including (i) being 60 years and above, and (ii) having a confirmed diagnosis of type 1 or type 2 DM. The diagnosis of DM

was confirmed with medical records. Patients with conditions that impaired their mental capacity to give informed consent, for instance dementia and psychosis, were excluded from the study. All study participants gave their written informed consent before joining the study.

Measuring Tools

Study participants were asked to fill in a series of six self-administered questionnaires. The first two questionnaires asked details about demographics, social support, medical history, family history, history of diabetes, perceived management of diabetes, and medication adherence. Relevant recent laboratory results, including glycated haemoglobin (HbA1c) level, cholesterol levels, creatinine level, and albumin level were retrieved from the hospital's electronic databases. Another four validated instruments were used to evaluate personality traits, QOL, anxiety symptoms, and depressive symptoms.

The Big Five Inventory (BFI) was used to evaluate personality traits. The BFI is a 44-item, self-rated tool used to assess personality based on the five-factor model of personality i.e. openness to experience (10 items), conscientiousness (9 items), extraversion (8 items), agreeableness (9 items), and neuroticism (8 items) (John et al. 1991). The Malay version BFI showed good internal consistency as well as good convergent and discriminant validity (Muhammad et al. 2018).

The World Health Organization Quality of Life-BREF (WHOQOL-BREF) questionnaire is an abbreviated 26-item scale that was used to assess the domains of QOL (WHOQOL Group 1998b). The physical health domain of the WHOQOL-BREF questionnaire explores facets of QOL such as energy, mobility, pain and discomfort, sleep, capacity to work and to perform activities of daily living. The psychological health domain assesses body image, negative and positive feelings, self-esteem, spirituality and religiosity, and cognition. The social relationships domain explores aspects such as personal relationships, social support, and sexual activity. Finally, the environment domain enquires about financial resources, physical safety, home environment, participation in leisure activities, and transportation. A higher score indicates a better QOL in a particular domain. The Malay version of the WHOQOL-BREF has demonstrated good discriminant validity, construct validity, internal consistency, and test-retest reliability (Hasanah et al. 2003).

To control for the effects of mental illness on QOL, anxiety and depression were screened for using the 7-item Generalized Anxiety Disorder scale (GAD-7) and the Beck Depression Inventory-II (BDI-II), respectively. The GAD-7 is a self-reported questionnaire that has been found to have good reliability and validity in the screening of GAD (Spitzer et al. 2006). The Malay version of the GAD-7 was found to be valid and reliable in case-finding for anxiety with good sensitivity of 76% (95% CI 61-87%), a specificity of 94% (88-97%) (Sidik et al. 2012). The BDI-II is a self-reported questionnaire commonly used to screen for and assess the severity of depression. It is comprised of items that are related to depressive symptoms, such as hopelessness, guilt, and physical symptoms of fatigue (Beck et al. 1996). The Malay version of the instrument has been shown to have good validity and high level of internal consistency (Cronbach's α = 0.71 to 0.91) (Mukhtar & Oei 2008).

Data Analysis

Statistical analysis was carried out using the Statistical Package for Social Science (SPSS) version 20 (IBM Corp., Armonk, NY, USA). Descriptive statistics were computed in which categorical variables were reported in frequency and percentages, and continuous variables reported in median and interquartile range (IQR). The continuous variables were not normally distributed as demonstrated by the Kolmogorov-Smirnov test ($P < 0.05$). Correlations between continuous variables in the WHOQOL-BREF domain scores were calculated using the Spearman's correlation coefficients. The comparisons of the WHOQOL-BREF domain scores across categorical variables were evaluated with the Mann-Whitney U test and the Kruskal-Wallis test. Variables with significant differences from bivariate analyses were then entered into stepwise backward linear regression models for each QOL domains.

All the multiple linear regression models were checked to confirm

that the assumptions for multiple linear regression were satisfied i.e., (i) Scatterplot of the standardised residuals with the standardised predicted values were plotted with a Loess curve fitted through it. The relationship of standardised predicted to residuals was roughly linear around zero, indicating that the relationship between the dependent variable and the predictors was linear; (ii) Additionally, the variance around zero was scattered uniformly and randomly, thus showing homoscedasticity; (iii) In the Q-Q plot for standardised residuals, the points clustered around the diagonal line, indicating normal distribution for residuals; (iv) The variance inflation factor of all the independent variables were less than 10 and tolerance scores of all the independent variables in all the models were above 0.1, suggesting no multicollinearity between the independent variables; (v) Multivariate outliers were checked with the Mahalanobis Distance for the variables. Cases with the probability of <0.001 for the chi-square distribution of Mahalanobis Distance were flagged as multivariate outliers and excluded from the regression analyses. Statistical significance for all analyses was set to P<0.05.

RESULTS

Characteristics of Study Participants

A total of 170 study participants were included in the analyses. The median age of participants was 69 years (IQR: 65.0-73.0) and a slight majority of participants were male (52.1%). In terms of ethnicity, 62.4% of participants were Malay, 19.4% were Chinese, and 16.5% of participants were Indian. Nearly two-thirds of participants were Muslim (64.1%), while the remainder of participants practised Buddhism (14.1%), Hinduism (11.8%), or Christianity (7.6%). In addition, most participants were married (78.2%), retired (61.2%), and reported a household income of less than <RM 3,000 (65.3%).

Most participants reported having good social support (81.8%) and strong religiosity (80.0%). In terms of activity levels, roughly three-quarters of participants reported having an active lifestyle (75.3%) and a healthy diet (74.7%). Finally, most participants were non-smokers (73.5%), did not consume alcohol (91.8%), and had no history of recreational drug use (97.6%).

Regarding clinical characteristics, the median duration of diabetes was 15.0 years (IQR: 10.0-20.5). Approximately two thirds (65.3%) of participants had poor glycaemic control, defined as HbA1c levels >7.0%, and nearly half of the participants were on insulin therapy (40.6%). Despite these findings, three-quarters of participants perceived their diabetes to be well-managed (75.9%). In terms of laboratory findings, the median HbA1c was 7.3% (IQR 6.4-8.8), the median LDL cholesterol was 2.3 (IQR 1.9-3.0), and the median HDL cholesterol was 1.2 (IQR 1.0-1.4).

The median scores for the QOL domains were 14.0 for physical health (IQR: 12.6-15.4), 15.3 for psychological health (IQR: 13.9-16.7), 16.0 for social relationships (IQR: 13.3-16.0), and 15.0 for the environment (IQR: 13.66-16.00).

Table 1: Sociodemographic and clinical characteristics of the study sample

Variable	n	%
Gender		
Male	87	51.2
Female	83	48.8
Race		
Malay	106	62.4
Chinese	33	19.4
Indian	28	16.5
Other	3	1.8
Marital status		
Married	133	78.2
Single	4	2.4
Divorced/separated	5	2.9
Widowed	28	16.5
Education		
None	6	3.5
Primary school	33	19.4
Secondary school	78	45.9
Diploma	21	12.4
Undergraduate degree	13	7.6
Postgraduate degree	17	10.0
Missing	2	1.2
Employment		
Employed	51	30.0
Unemployed	13	7.6
Retired	104	61.2
Missing	2	1.2
Household income		
Employed	111	65.3
Unemployed	24	14.1
Retired	24	14.1
Missing	11	6.5
Religion		
Islam	109	64.1
Buddhism	24	14.1
Hinduism	20	11.8
Christianity	13	7.6
Other	3	1.8
Missing	1	0.6
Practice of religion		
Strongly disagree	9	5.3
Disagree	3	1.8
Neutral	22	12.9
Agree	69	40.6
Strongly agree	67	39.4
Strong social support		
Strongly disagree	1	0.6
Disagree	3	1.8
Neutral	27	15.9
Agree	97	57.1
Strongly agree	42	24.7

Variable	n	%
Active lifestyle		
Strongly disagree	2	1.2
Disagree	3	1.8
Neutral	37	21.8
Agree	100	58.8
Strongly agree	28	16.5
Healthy eating pattern		
Strongly disagree	2	1.2
Disagree	5	2.9
Neutral	35	20.6
Agree	101	59.4
Strongly agree	26	15.3
Missing	1	0.6
Smoking		
Never	125	73.5
Ex-smoker	39	22.9
Current smoker	6	3.5
Alcohol use		
Yes	12	7.1
No	156	91.8
Missing	2	1.2
Recreational drug use		
Yes	3	1.8
No	166	97.6
Missing	1	0.6
Insulin therapy		
Yes	69	40.6
No	75	44.1
Missing	26	15.3
'I am able to manage my diabetes well'		
Strongly disagree	3	1.8
Disagree	8	4.7
Neutral	29	17.1
Agree	68	40.0
Strongly agree	61	35.9
Missing	1	0.6
Diabetic control		
Good	59	34.7
Poor	111	65.3
Obesity		
BMI <25	43	25.3
BMI 25-30	46	27.1
BMI >30	35	20.6
Missing	46	27.1
Hypertension		
Yes	143	84.1
No	27	15.9
Dyslipidaemia		
Yes	95	55.9
No	75	44.1

Variable	n	%
Ischaemic heart disease		
Yes	59	34.7
No	111	65.3
Stroke		
Yes	18	10.6
No	152	89.4
Renal disease		
Yes	27	15.9
No	143	84.1

A complete list of sociodemographic and clinical characteristics collected can be seen in Table 1 and a summary of laboratory findings and outcome measure scores can be found in Table 2.

Findings from Bivariate Analysis

The results of bivariate analysis are shown in Table 3 and Table 4. For the physical health domain, the score was positively associated with HDL cholesterol level, albumin level, BFI extraversion, agreeableness, and conscientiousness scores, while negatively associated with age,

Table 2: Laboratory results, BMI, GAD-7, BDI, BFI and WHOQOL-BREF scores of the study sample

Variable	Median	IQR
HbA1c (%)	7.3	6.4 - 8.8
LDL	2.3	1.9 - 3.0
HDL	1.2	1.0 - 1.4
Creatinine	104.1	76.0 - 183.6
Albumin	39.0	36.0 - 41.0
BMI	26.9	23.7 - 30.1
GAD-7	0.0	0.0 - 3.0
BDI-II	4.0	2.0 - 7.0
BFI		
Extraversion	3.4	3.0 - 3.8
Agreeableness	3.9	3.6 - 4.1
Conscientiousness	3.7	3.4 - 4.0
Neuroticism	2.5	2.0 - 2.8
Openness	3.2	3.0 - 3.5
WHOQOL-BREF		
Physical health	14.0	12.6 - 15.4
Psychological	15.3	13.9 - 16.7
Social relationships	16.0	13.3 - 16.0
Environment	15.0	13.7 - 16.0

Table 3: Relationship between domains of WHOQOL-BREF and continuous variables in the study

Variable	Physical health	Psychological	Social relationships	Environment
Age				
n	170	170	170	170
Spearman's r	-0.188*	-0.08	-0.06	-0.171*
Body mass index				
n	123	123	123	123
Spearman's r	0.06	0.10	0.14	0.15
Duration of DM				
n	157	157	157	157
Spearman's r	-0.14	-0.212**	-0.15	-0.195*
HbA1c				
n	153	153	153	153
Spearman's r	0.00	-0.10	-0.06	-0.11
LDL cholesterol				
n	151	151	151	151
Spearman's r	-0.07	0.09	0.05	0.05
HDL cholesterol				
n	153	153	153	153
Spearman's r	0.209**	0.225**	0.196*	0.235**
Creatinine				
n	158	158	158	158
Spearman's r	-0.212**	-0.05	-0.04	-0.174*
Albumin				
n	155	155	155	155
Spearman's r	0.301**	0.15	0.13	0.16
GAD-7 score				
n	170	170	170	170
Spearman's r	-0.301**	-0.405**	-0.297**	-0.319**
BDI-II score				
n	170	170	170	170
Spearman's r	-0.482**	-0.411**	-0.347**	-0.333**
BFI extraversion				
n	170	170	170	170
Spearman's r	0.270**	0.440**	0.346**	0.444**
BFI agreeableness				
n	170	170	170	170
Spearman's r	0.231**	0.432**	0.451**	0.527**
BFI conscientiousness				
n	170	170	170	170
Spearman's r	0.367**	0.420**	0.411**	0.482**
BFI neuroticism				
n	170	170	170	170
Spearman's r	-0.391**	-0.582**	-0.453**	-0.530**
BFI openness				
n	170	170	170	170
Spearman's r	0.14	0.12	0.11	0.210**

*P<0.05; **P<0.01

Table 4: Relationship between domains of WHOQOL-BREF and categorical variables in the study

Variable	Physical health		Psychological		Social relationships		Environment	
	Median	IQR	Median	IQR	Median	IQR	Median	IQR
Gender[a]								
Male	14.29	3.43	15.33	3.07	16.00	2.67	15.00	2.29
Female	13.71	3.43	15.33	2.67	16.00	2.67	15.00	2.50
P	0.368		0.931		0.389		0.893	
Race[b]								
Malay	14.29	3.43	15.33	2.67	16.00	2.67	15.00	1.63
Chinese	13.71	4.00	15.33	4.00	14.67	2.67	14.50	3.00
Indian	13.71	2.29	14.67	2.49	15.34	4.00	15.00	3.88
Others	13.71	5.14	16.00	0.00	16.00	0.00	13.50	0.00
P	0.715		0.178		0.263		0.312	
Marital status[b]								
Married	14.29	3.43	15.33	3.21	16.00	2.67	15.00	3.00
Single	13.15	5.43	15.60	4.10	16.00	7.33	15.00	3.63
Divorced/ separated	14.29	7.58	16.34	6.66	14.00	5.99	15.50	2.50
Widowed	13.43	2.72	15.33	3.01	16.00	2.50	14.75	1.50
P	0.455		0.994		0.645		0.760	
Education[b]								
None	16.00	7.72	17.33	7.00	16.00	12.00	16.00	8.75
Primary school	13.43	2.86	15.00	3.00	16.00	4.00	14.75	2.63
Secondary school	13.71	2.86	15.20	2.67	16.00	4.00	14.50	2.00
Diploma	14.58	3.14	15.33	2.34	16.00	2.67	15.00	2.88
Undergraduate degree	15.03	2.29	15.67	3.36	16.00	2.33	16.00	3.63
Postgraduate degree	14.86	4.57	17.33	2.67	16.00	4.00	17.50	2.50
P	0.134		0.056		0.725		0.002**	
Employment[b]								
Employed	13.33	2.86	14.00	4.00	16.00	4.00	14.00	3.00
Unemployed	13.71	2.86	15.33	3.33	14.67	4.00	16.50	5.00
Retired	14.86	2.86	15.33	2.67	16.00	2.67	15.00	1.50
P	0.016*		0.030*		0.120		0.003**	
Household income[b]								
<RM3,000	13.71	2.86	15.27	2.84	16.00	2.67	14.50	2.50
RM3,000-6,000	13.71	2.86	15.33	2.67	16.00	5.33	15.50	4.00
>RM6,000	15.15	4.00	16.00	2.00	16.00	2.67	16.50	3.25
P	0.240		0.019*		0.712		<0.001**	
Religion[b]								
Islam	14.29	3.43	15.33	2.67	16.00	2.67	15.00	2.00
Buddhism	13.71	4.29	16.00	4.00	14.67	4.00	14.50	4.00
Hinduism	13.14	3.00	14.67	2.73	15.34	4.33	15.00	5.13
Christianity	14.29	2.86	14.00	3.00	14.67	3.34	15.50	3.75
Other	13.14	0.00	12.00	0.00	14.67	0.00	12.50	0.00
P	0.245		0.025*		0.399		0.273	
Practice of religion[b]								
Strongly disagree	14.00	6.72	13.67	8.17	14.00	6.33	14.75	4.63
Disagree	12.00	0.00	14.67	0.00	14.67	0.00	13.00	0.00
Neutral	13.72	4.43	15.33	4.66	15.34	4.00	14.50	4.75
Agree	14.29	2.57	14.40	2.67	16.00	2.67	14.50	2.00
Strongly agree	14.29	3.14	16.00	2.00	16.00	2.34	15.50	3.00
P	0.411		0.001**		0.306		<0.001**	

Variable	Physical health		Psychological		Social relationships		Environment	
	Median	IQR	Median	IQR	Median	IQR	Median	IQR
Social support[b]								
Disagree	10.29	0.00	11.33	0.00	10.67	0.00	10.50	0.00
Less agree	13.71	0.00	14.67	0.00	14.67	0.00	14.50	0.00
Neutral	12.57	3.43	13.33	3.33	12.00	4.00	14.00	2.35
Agree	14.29	2.86	15.33	2.67	16.00	2.00	14.50	2.50
Very agree	14.29	2.86	16.00	2.67	16.00	5.34	17.00	3.50
P	0.007**		<0.001**		<0.001**		<0.001**	
Active lifestyle[b]								
Strongly disagree	10.86	0.00	10.67	0.00	9.34	0.00	11.25	0.00
Disagree	12.00	0.00	13.33	0.00	16.00	0.00	14.00	0.00
Neutral	12.86	2.86	13.34	3.33	14.34	4.00	13.86	3.50
Agree	14.25	3.09	15.33	2.54	16.00	2.67	15.00	2.00
Strongly agree	14.86	3.43	17.33	2.67	16.00	5.00	17.00	3.50
P	0.001**		0.001**		0.006**		<0.001**	
Healthy eating pattern[b]								
Strongly disagree	9.43	0.00	10.40	0.00	8.00	0.00	11.00	0.00
Disagree	12.29	3.14	12.67	3.33	12.00	4.66	13.50	3.25
Neutral	13.71	3.43	14.67	3.34	14.67	4.00	14.50	3.00
Agree	13.71	2.86	15.33	2.20	16.00	2.67	15.00	2.00
Strongly agree	14.86	2.85	16.67	2.67	16.00	6.00	17.50	4.00
P	0.009**		0.003**		0.005**		<0.001**	
Smoking[b]								
Never	14.00	3.14	15.33	2.77	16.00	2.67	15.00	2.50
Ex-smoker	13.71	3.00	15.33	4.00	14.67	4.00	14.50	2.50
Current smoker	14.29	3.05	15.33	2.00	16.00	1.33	14.00	3.75
P	0.867		0.505		0.524		0.392	
Alcohol use[a]								
Yes	14.29	2.43	15.33	2.33	16.00	1.00	15.50	3.13
No	13.71	3.14	15.33	3.34	16.00	2.67	15.00	2.39
P	0.510		0.605		0.177		0.312	
Recreational drug use[a]								
Yes	13.71	0.00	12.00	0.00	14.67	0.00	13.50	0.00
No	14.29	3.43	15.33	2.77	16.00	2.67	15.00	2.57
P	0.595		0.369		0.660		0.373	
Insulin therapy[a]								
Yes	14.00	2.72	15.33	3.34	16.00	2.67	15.00	3.50
No	14.86	2.86	16.00	2.00	16.00	2.67	15.00	2.50
P	0.200		0.138		0.806		0.366	
'I am able to manage my diabetes well'[b]								
Strongly disagree	13.71	0.00	12.00	0.00	13.33	0.00	13.50	0.00
Disagree	12.00	0.00	14.67	0.00	14.67	0.00	12.50	0.00
Neutral	12.57	3.43	13.33	4.00	13.33	4.00	13.50	2.50
Agree	14.58	2.41	15.33	1.60	16.00	2.67	15.00	2.13
Strongly agree	14.86	2.86	15.33	3.33	16.00	2.67	15.43	4.00
P	<0.001**		<0.001**		0.003**		<0.001**	
Diabetic control[a]								
Good	14.29	2.86	15.33	2.13	16.00	2.00	15.43	2.50
Poor	14.29	3.29	15.33	3.34	16.00	2.67	14.75	3.38
P	0.364		0.062		0.235		0.127	

Variable	Physical health		Psychological		Social relationships		Environment	
	Median	IQR	Median	IQR	Median	IQR	Median	IQR
Obesity[b]	14.58	2.86	15.33	2.50	16.00	2.67	15.00	2.82
BMI <25	13.71	3.43	15.33	3.34	16.00	4.00	14.50	3.50
BMI 25-30	14.29	3.26	15.33	3.83	16.00	3.67	15.50	4.00
BMI >30	0.657		0.563		0.584		0.119	
P								
Hypertension[a]								
Yes	14.00	2.86	15.33	3.34	16.00	2.67	15.00	2.13
No	14.86	4.00	16.00	2.66	16.00	4.34	15.50	4.25
P	0.009**		0.041*		0.052		0.072	
Dyslipidaemia[a]								
Yes	14.29	2.86	15.33	2.67	16.00	2.67	15.00	2.00
No	14.00	2.86	15.33	2.67	14.67	2.67	15.00	3.38
P	0.301		0.972		0.950		0.743	
Ischaemic heart disease[a]								
Yes	13.71	2.43	15.33	4.00	15.34	4.00	15.00	2.75
No	14.29	2.52	15.33	2.67	16.00	2.67	15.00	2.75
P	0.026*		0.541		0.456		0.077	
Stroke[a]								
Yes	13.14	2.86	15.33	4.00	14.67	4.00	14.50	1.50
No	14.29	2.86	15.33	2.67	16.00	2.67	15.00	3.00
P	0.047*		0.055		0.044*		0.103	
Renal disease[a]								
Yes	13.14	2.86	15.33	4.33	14.67	4.00	14.50	3.63
No	14.29	3.09	15.33	2.67	16.00	2.67	15.00	3.00
P	0.149		0.884		0.714		0.427	

[a]Mann-Whitney U test; [b]Kruskal-Wallis test
* $P<0.05$; ** $P<0.01$; *** $P<0.001$

creatinine level, GAD-7 score, BDI-II score, and BFI neuroticism scores. Retired employment status, greater affirmation of social support, practice of active lifestyle, healthy eating pattern, and perceived self-efficacy in diabetic management were associated with higher score. Meanwhile, hypertension, ischaemic heart disease, and stroke were associated with lower score in the physical health domain.

For the psychological domain, the score was positively associated with HDL cholesterol level, BFI extraversion, agreeableness, and conscientiousness scores, but negatively associated with

duration of DM, GAD-7 score, BDI-II score, and BFI neuroticism score. Higher household income, Buddhism as religion, greater affirmation of practice of religion, social support, practice of active lifestyle, healthy eating pattern, and perceived self-efficacy in diabetic management were associated with higher score in the psychological domain, whereas employed status, and hypertension were associated with lower score.

As for social relationships, HDL cholesterol level, BFI extraversion, agreeableness, and conscientiousness scores showed positive associations,

while GAD-7 score, BDI-II score, and BFI neuroticism score showed negative association with the domain score. Stronger affirmation of social support, practice of active lifestyle, healthy eating pattern, and perceived self-efficacy in diabetic management were associated with higher score for social relationships domain, but stroke was associated with lower socre.

Finally, significant variables from bivariate analysis that had positive association with the environment domain score were HDL cholesterol level, BFI extraversion, agreeableness, conscientiousness, and openness scores, while age, duration of DM, creatinine level, GAD-7 score, BDI-II score, and BFI neuroticism score had negative association with the domain score. Education at postgraduate level, being unemployed, high household income, higher affirmation of the practice of religion, social support, practice of active lifestyle, healthy eating pattern, and perceived self-efficacy in diabetic management were also associated with higher score for the environment domain.

Stepwise Linear Regression Analysis

Regression analysis showed that, after controlling for other factors, higher conscientiousness scores ($\beta=0.156$; P=0.044) and lower neuroticism scores ($\beta=-0.176$; P=0.028) on the BFI were significantly associated with a greater QOL in the physical health domain. Furthermore, higher BFI extraversion scores ($\beta=0.209$; P=0.001) and higher BFI conscientiousness scores ($\beta=0.248$; P<0.001) were each associated with a

greater psychological QOL. In addition, higher extraversion scores ($\beta=0.172$; P=0.012) and agreeableness scores ($\beta=0.286$; P<0.001) were associated with a better social relationships QOL. Finally, higher extraversion scores ($\beta=0.202$; P=0.002), higher agreeableness scores ($\beta=0.327$; *P*<0.001), and lower neuroticism scores ($\beta=-0.223$; P=0.001) on the BFI were associated with a better QOL in the environment domain (Table 5).

DISCUSSION

In this study, we evaluated the relationship between personality and QOL in elderly patients with DM. Not only is diabetes more prevalent among the elderly population due to its chronicity, but patients in this age group also face their own unique challenges in terms of managing and living with their diabetes illness. To the best of our knowledge, our study is the first to examine the relationship between personality and QOL, specifically in a sample of elderly patients with DM in Malaysia. In keeping with the current literature, we found there to be an association between personality traits and QOL. More specifically, we found an association between personality traits and each of the individual domains of the WHOQOL-BREF questionnaire-physical, psychological, social relationship, and environmental.

Studies have previously established an association between personality and QOL in the general diabetic population. In fact, in a large population sample of patients with type 2 DM, Imayama et al. (2011) found that personality was

Table 5: Significant factors for each domain of WHOQOL-BREF in stepwise linear regression analyses

Domain	Variable	R^2	B	β	P
Physical health	Constant		14.065		
	Age	0.244	-0.058	-0.138	0.047
	Albumin	0.300	0.093	0.179	0.010
	BDI-II score	0.330	-0.134	-0.331	<0.001
	BFI conscientiousness	0.357	0.748	0.156	0.044
	BFI neuroticism	0.375	-0.703	-0.176	0.029
	Fitness test: F=17.040, P<0.001				
Psychological	Constant		5.860		
	Practice of religion	0.377	0.326	0.140	0.013
	Active lifestyle	0.523	0.452	0.146	0.011
	Duration of DM	0.558	-0.043	-0.186	0.001
	GAD-7 score	0.592	-0.255	-0.446	<0.001
	BFI extraversion	0.615	0.912	0.209	0.001
	BFI conscientiousness	0.634	1.149	0.248	<0.001
	Fitness test: F=36.324, P<0.001				
Social relationships	Constant		1.887		
	Healthy eating pattern	0.251	0.935	0.246	<0.001
	GAD-7 score	0.336	-0.270	-0.363	<0.001
	BFI extraversion	0.409	0.918	0.172	0.012
	BFI agreeableness	0.475	1.775	0.286	<0.001
	Fitness test: F=33.013, P<0.001				
Environment	Constant		3.654		
	Education	0.354	0.248	0.140	0.016
	Practice of religion	0.476	0.314	0.141	0.014
	Active lifestyle	0.538	0.715	0.241	<0.001
	Duration of DM	0.571	-0.031	-0.139	0.016
	BFI extraversion	0.597	0.857	0.202	0.002
	BFI agreeableness	0.614	1.562	0.327	<0.001
	BFI neuroticism	0.632	-0.802	-0.223	0.001
	Fitness test: F=30.208, P<0.001				

the strongest independent variable that affected the health related QOL and life satisfaction. Another study found that personality was a major determinant of QOL in patients with diabetes, largely through its effect on mediating variables such as coping style and mood (Rose et al. 1998).

In recent years, much research has focused on the potential role of neuroticism in patients with chronic illnesses such as DM. Neuroticism is defined as a "tendency to experience negative emotions" (McCrae & Costa

2008) and it is characterised by facets such as anxiety, angry hostility, and depression (John & Srivastava 1999). In this current study, we found that elderly participants who scored higher on the trait of neuroticism were more likely to have a poorer physical QOL and poorer environment QOL. It is possible that this is because of neuroticism on mediating factors such as mood, behaviour, and coping strategy. For example, one study found that diabetic patients who scored higher on neuroticism were more likely to exhibit depressive symptoms and less likely to adhere to diabetes lifestyle management plans (Novak et al. 2017). Similarly, in a sample of patients with type 2 DM, it has been shown that higher levels of neuroticism were associated with greater chronic fatigue and reduced QOL (Momeniarbat et al. 2017). Furthermore, higher levels of neuroticism in diabetic adolescents were also associated with fewer proactive coping strategies and poorer psychological QOL (Kalka & Karcz 2020).

On the contrary, we found that elderly participants who scored higher on the trait of conscientiousness were more likely to have a better physical QOL and a better psychological QOL. Conscientiousness is associated with facets such as self-discipline, competence, and dutifulness (John & Srivastava 1999). Again, as was the case with neuroticism, it is possible that conscientiousness indirectly affects QOL through its effect on mediating factors, such as mood, behaviour, and coping strategy. For instance, one study found that in a sample of DM patients undergoing distress reduction interventions, those with greater conscientiousness were more likely to improve their medication adherence and reduce their disease-associated emotional burden (Fisher et al. 2014). Similarly, higher levels of conscientiousness have been associated with better disease-related self-care behaviours, such as better glucose monitoring (Skinner et al. 2014). Another study found conscientiousness to be associated with more effective coping strategies in patients with DM (Lawson et al. 2010). These findings can manifest clinically as well, as it has been shown that low levels of conscientiousness may contribute to a faster rate of renal failure among patients with DM (Brickman et al. 1996).

Finally, in this study, participants who scored higher on the trait of agreeableness were more likely to have a better social relationship QOL and a better environment QOL. Agreeableness is associated with facets such as altruism, tendermindedness, and trust (John & Srivastava 1999). There has been less research centred around the trait of agreeableness in the context of DM. However, it has been found that the trait of agreeableness was associated with increased levels of seeking social support (Lawson et al. 2010). This could in part explain why we found there to be an association between the level of a patient's agreeableness and their social QOL.

This current study should be interpreted considering a few limitations. Firstly, the sample size used in this study was small and the

study was conducted in a single tertiary healthcare referral centre in Kuala Lumpur, Malaysia. As such, the findings may not be generalisable to the entire population of elderly patients with diabetes. Further, due to the cross-sectional nature of the project, no causal relationships between any of the personality traits and any of the domains of QOL can be made. Social desirability bias might have affected responses to some of the questions, resulting in higher tendency to endorse health behaviours (e.g., active lifestyle) and reduced inclination to affirm unhealthy behaviours (e.g. alcohol and drug use). Future research should aim to involve multi-centre subject recruitment of elderly diabetic patients to confirm this study's findings. Additionally, the mediating roles of mood and coping styles on the influence of personality traits on QOL in the patient population warrant further research.

CONCLUSION

Findings of the present study suggest that personality traits may play an important role in moderating the impact of DM on the lives of patients, even among elderly patients with DM, who are likely to have lived with the disease for a longer period. Traits such as conscientiousness and agreeableness may act as protective factors for the QOL in elderly patients with diabetes, whereas the trait of neuroticism could potentially be a risk factor for reduced QOL in these patients. Our study emphasises the important role of personality traits

on the physical, psychological, social relationship, and environmental QOL of an elderly patient with DM. Health care providers should be aware of the various psychosocial factors, particularly the personality traits, that can contribute to a patient's illness experience. By recognising how a patient's personality may contribute to their ability to manage and cope with their disease, health care providers will be better equipped to provide quality care to each of their patients.

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