



# The Relationship between Type D Personality and Blood Groups Subtypes, and Medication Adherence in Iranian Patients with Type II Diabetes Mellitus

Mahsa Dastjerdi<sup>1</sup>, Sima Sabbagh<sup>2,3</sup>, Maryam Ghasemi Aliabadi<sup>1</sup>, Sahar Shafiee<sup>2</sup>, Mehdi Najarzadegan<sup>1</sup>, Sara Niknam<sup>2</sup>, Roqayeh Aliyari<sup>4</sup> and Rokhsareh Meamar<sup>2\*</sup>

1. School of Medicine, Islamic Azad University, Najafabad Branch, Isfahan, Iran

2. Isfahan Clinical Toxicology Research Center, Isfahan University of Medical Sciences, Isfahan, Iran

3. Clinical Development Research Center, Islamic Azad University, Najafabad Branch, Isfahan, Iran

4. Center for Health Related Social and Behavioral Sciences Research, Shahroud University of Medical Sciences, Shahroud, Iran

## Abstract

**Background:** The aim of this study was to investigate the relationship between blood groups and personality types, and medication adherence in Type 2 Diabetes Mellitus (T2DM).

**Methods:** 302 patients with T2DM were considered in the study. Their sociodemographic information and medical history were recorded. Type D personality and medical adherence were checked using DS-14 and MMAS-8 questionnaires, respectively. Blood samples were obtained from the patients to determine the types of ABO blood groups, HbA1c, fasting blood sugar and lipid profile.

**Results:** No significant association was found between the patients' characteristics including demographic and laboratory information and medical adherence to treatment. However, a significant difference in medical adherence was observed between patients with type D personality. According to logistic regression model, patients with type D [OR: 6.23, (95%CI: 2.34-16.55,  $p < 0.001$ )] had better adherence to medication, while the blood groups was not associated with medical adherence to treatment.

**Conclusion:** Type D personality cannot impair medical adherence in these patients. There was an association between type D personality and the ABO blood group, but the ABO blood group was not related to medical adherence.

**Keywords:** ABO blood-group system, Blood glucose, Diabetes mellitus Type 2, Glycated hemoglobin, Logistic models, Medication adherence, Type D personality

## \* Corresponding author

**Rokhsareh Meamar, MD, PhD**

Isfahan Clinical Toxicology Research Center, Isfahan University of Medical Sciences, Isfahan, Iran

**Tel:** +98 9133091206

**Email:** meamar@med.mui.ac.ir

**Received:** 1 Nov 2024

**Accepted:** 25 May 2025

## Citation to this article

Dastjerdi M, Sabbagh S, Ghasemi Aliabadi M, Shafiee S, Najarzadegan M, Niknam S, *et al.* The Relationship between Type D Personality and Blood Groups Subtypes, and Medication Adherence in Iranian Patients with Type II Diabetes Mellitus. *J Iran Med Council.* 2026;9(2):469-79.

## Introduction

Diabetes Mellitus (DM) refers to a group of metabolic disorders (1) that eventually cause an elevated risk of morbidity and mortality. The prevalence of adults with DM was 8.8% in 2015, and is predicted to increase to 10.4% by 2040 (2). Moreover, based on the assessments done in 2013 by the International Diabetes Federation (IDF), there are 382 million adults with Type 2 DM (T2DM) worldwide, 80% of which are from low- and middle-income countries (3,4). In fact, Iran was declared to be the second country in the Middle East in 2017 to have the highest number of patients diagnosed with T2DM (5).

Like other complex chronic diseases, T2DM needs constant treatment, thus necessitating extended lifelong care and consideration by healthcare personnel and patients (6). Accordingly, the main goal is to control glycemic indexes and reduce the complications of T2DM. Almost less than half the patients with T2DM encounter poor glycemic maintenance (HbA1c <7%) (7), which is mainly attributed to non-adherence or non-compliance to medication, indigence, lack of awareness, and inadequate follow-ups (8).

Medication adherence has been previously reported to be extensively varied in the patients with DM (9). An increased rate of medical complications such as cardiovascular diseases and mortality, as well as reduced quality of life, are the important consequences of poor medication adherence in these patients. Therefore, in order to maintain their health and prevent these complications, adherence to medication and treatment compliance is required (10). In this regard, one factor complicating the implementation of self-management could be different personality types; for example, type D personality, characterized by less frequent consultation with the doctor, makes both the physician and the person with this personality type unaware of the increased risk induced by diseases (7). Type D personality describes individuals who experience high levels of Negative Affectivity (NA) and Social Inhibition (SI) (11).

A significant association between type D personality and an increased risk of negative medical outcomes and poor medication adherence in the individuals suffering from chronic diseases and cardiovascular diseases has been previously reported (12). Previous study has been suggested that the type D personality

could not impair the medication adherence of diabetic patients, but no consensus has been reached yet (13). A recent study has been suggested an association between personality traits and ABO blood groups (14). For instance, AB blood group is more related to introvert behaviors, compared with the other blood groups (15). Moreover, the relationship between DM and ABO blood types has been studied previously (16). However, to the best of our knowledge, the relationship between blood groups and medication adherence with regard to personality types has not been investigated before.

## Materials and Methods

### Participants

This was a cross-sectional observational study conducted from 2016 to 2017. This research has been performed in accordance with the Declaration of Helsinki and has been approved by the Ethics Committee of by the Islamic Azad University. 302 patients, diagnosed with T2DM by an endocrinologist, according to the World Health Organization (WHO) criteria (17), were recruited from individuals referring to Shaban-Ali Clinic in Isfahan, Iran. Patients suffered from T2DM at least one year and at most, 35 years, with an age range of 23-89 years. The aim of the study was explained to the participants and written informed consent was obtained. Written informed consent was obtained from the patients (or their parent or legally authorized representative in the case of children under 18 years of age).

### Demographic information

Patients' demographic information, namely, age, sex, level of education, marital status, Body Mass Index (BMI) ( $kg/m^2$ ) (low: <20, middle: 20-24.9, high: 25-29.9, fat:>30) (18), and their medical history [such as HbA1c (%), duration (year), and complications of T2DM, including hypertension, neuropathy and cardiovascular disease and family history of T2DM], were recorded. Blood samples were obtained from the patients to determine the types of ABO blood groups (A, B, AB, and O). HbA1c served as the marker of the average glycemic control, fast blood sugar (FBS,  $mg/dl$ ) and lipid profile ( $mg/dl$ ). Lipid profiles, FBS and HbA1c were measured by Pars Azmoon kit (Iran), using a photometric method, and blood groups were

determined using the Sinnagen kit (Iran).

### Type D personality

In order to establish type D personality, the Persian version of the Type D personality scale (DS-14) questionnaire, developed by Denolet (19,20), was used. The questionnaire contains 14 items divided into two groups of 7, each for NA and Social Inhibition (SI). The NA comprises dysphoria, worry and irritability, and SI consists of discomfort in social interactions, reticence and social self-control. Scores were calculated based on a five-point Likert scale ranging from zero (false) to four (true), ranging from zero to 56. Also, in some studies, a cut-off equal or higher than ten in both subscales (NA and SI) was considered as type D personalities (19,20), but DS-14 score concordance was categorized with another paper by its original quartiles; lower than 15, 15 to 28, 29 to 42 and greater than 42 (21). It should be noted that the original median (score  $\geq 29$ ) was used in the logistic regression model. Cronbach's  $\alpha$  for NA and SI subscales was 0.84 and 0.86, respectively, in the Persian Version of DS-14 (19). In this study, Cronbach's  $\alpha$  was 0.88 and 0.86 for NA and SI, respectively. Afterwards, the Persian version of the 8-item Morisky medication adherence scale (MMAS-8) questionnaire, was given to the patients as a validated measurement tool used for non-adherence to medication (22,23). The questionnaire consisted of seven two-choice questions, where 1 means Yes and 0 stands for No; it includes five-point questions whose

scores are based on five-choices: "never=0, rarely=1, sometimes=2, often=3 and always=4". A score of 6 or higher is considered to be optimal adherence to medication (22).

### Statistical analysis

The descriptive statistics was presented as mean $\pm$ Standard Deviation (SD) and frequency as deemed normal distribution. Also, we used Chi-square or Fisher's exact, t, and one-way ANOVA. In addition, multiple logistic regression models were employed to calculate the Odds Ratio (OR) as an estimate of the relative risk of the different variables for the type D personality and medical adherence in model 1. Furthermore, the significant variables in model 1 and ABO blood groups is fitted in model 2. Statistical analysis was performed using Statistical Package for the Social Sciences software (SPSS, Version 23) by considering significant level less than 0.05.

### Results

In this study, 302 patients with T2DM, including 156 men and 146 women, were recruited. The medical adherence to treatment among people with T2DM was 11.6%. The medical adherence status of the patients with regard to their socio-demographic, clinical and laboratory information is shown in table 1.

Overall, no significant association was found between the patients' characteristics including demographic, laboratory information, and their

**Table 1.** The univariate relationship between patients' characteristics between medical and non-medical adherence

		Medical adherence N=35	Non-medical adherence N=267	p-value
Gender	Male	18(11.5)	138(88.5)	0.962
	Female	17(11.7)	129(88.3)	
Age (years)	$\leq 45$	2(8.7)	21(91.3)	0.653 <sup>a</sup>
	$> 45$	33(11.8)	246(88.2)	
Marital status	Married	33(11.4)	257(88.6)	0.641 <sup>a</sup>
	Single and Divorced	2(16.6)	10(83.4)	
Education level	College education	3(8.6)	32(91.4)	0.583 <sup>a</sup>
	Diploma and under	22(8.2)	245(91.8)	

Contd. table 1.

	Retired	9(11)	73(89)	
Occupation	Housewife	15(11)	121(89)	0.878
	Occupied	11(13.1)	73(86.9)	
	Positive	27(12.4)	190(87.6)	
Family history	Negative	7(8.9)	72(91.1)	0.390
	<25	11(11.2)	87(88.8)	
BMI kg/m <sup>2</sup>	≥25	24(11.8)	180(88.2)	0.894
	Mean±SD			
HbA1C (%)		7.82±1.65	7.59±1.44	0.472
FBS mg/dl		152.34±51.97	152.51±55.26	0.662
TG mg/dl		164.57±70.63	147.55±77.52	0.100
Cholesterol mg/dl		154.77±37.45	149.22±34.00	0.263
HDL mg/dl		41.46±10.80	43.06±8.49	0.449
LDL mg/dl		82.09±27.09	81.04±21.86	0.660

a: Fisher-exact test

FBS=Fasting Blood Sugar, TG=Triglycerides, HDL=High-Density Lipoprotein, LDL=Low-Density Lipoprotein, BMI=Body Mass Index.

**Table 2.** Comparison of type D personality score between medical and non-medical adherence among patients with T2DM

	Non-medical adherence	Medical adherence	p-value
	Mean±SD		
Social inhabitation	12.5±4.7	15.7±3.8	<0.001
	14.4±6.7	18.5±5.8	0.001
“Negative affectivity”	26.9±9.8	34.3±8.2	<0.001
	N (%)		
≤14	28(100)	–	0.002
15-28	124(93.2)	9(6.8)	
29-42	99(83.2)	20(16.8)	
>42	16(72.7)	6(27.3)	

adherence to treatment. The mean score of type D personality (p<0.001), social inhabitation (p<0.001), and negative affectivity (p=0.001) were statistically higher in patients with medical adherence rather than those without medical adherence (Table 2).

There was positive relationship between type D personality and medical adherence to treatment.

When the four ABO blood groups were considered, as shown in table 3, medical adherence did not generally show any significant differences, based on type D personality in the patients with T2DM in different blood groups.

Then, logistic regression models were performed to predict Type D personality. As shown in table 4, in model 1 by considering the socio-demographic and clinical variables there was no statistically significant

**Table 3.** Comparison of medical adherence in patients with type 2 diabetes mellitus in different ABO blood groups (A,B,AB, or O) in totally and type D personality

		A	B	O	AB	p-value
Total	Non-medical adherence (%)	16.7%	10.7%	7.5%	11.1%	0.240 <sup>a</sup>
	Medical adherence (%)	83.3%	89.3%	92.5%	88.9%	
Type D personality score	Non-medical adherence	28.2±9.9	28.1±10.3	25.6±9.5	23.9±8.4	0.093 <sup>b</sup>
	Medical adherence	32.8±7.9	38.4±6.4	33±11.3	35.3±3.1	0.435 <sup>b</sup>

a: chi-square test, b: one-way ANOVA test.

**Table 4.** Logistic regression models to predicting type D personality according to patients' variables

Model 1 <sup>a</sup>			Model 2 <sup>b</sup>		
Variables	OR(95%CI)	p-value	Variables	OR(95%CI)	p-value
Age ≤45 vs. >45 yrs	0.80(0.28,2.27)	0.681	Female vs. Male	2.01(1.29,3.37)	0.003
Female vs. Male	2.01(1.22,3.56)	0.007	Blood group A vs. AB	2.20(0.88,5.53)	0.090
Married vs. Single	1.12(0.25,4.96)	0.873	Blood group B vs. AB	3.59(1.39,9.24)	0.009
College education vs. diploma and under diploma	1.86(0.66,5.27)	0.243	Blood group O vs. AB	1.58(0.63,3.95)	0.325
BMI <25 vs. ≥25 (kg/m <sup>2</sup> )	0.73(0.43,1.24)	0.254			
HbA1C (%)	1.01(0.81,1.26)	0.910			
Duration (year)	1.01(0.98,1.04)	0.562			
Family history	1.11(0.94,1.93)	0.700			
Blood pressure (mmHg)	1.06(0.60-1.85)	0.957			
FBS (mg/dl)	1(0.99-1.00)	0.900			
TG (mg/dl)	1.00(0.99-1.00)	0.756			
HDL (mg/dl)	0.99(0.96-1.02)	0.644			
Cholesterol (mg/dl)	0.99(0.97-1.01)	0.258			
LDL (mg/dl)	1.01(0.99,1.04)	0.272			

a: model adjusted by demographics and clinical variables, b: significant variables in model 1 and ABO blood group.

FBS=Fasting Blood Sugar, TG=Triglycerides, HDL=High-Density Lipoprotein, LDL=Low-Density Lipoprotein.

variables related to type D personality except that the relative risk of type D in women is one times higher than men. In model 2 by regarding sex and ABO blood groups, sex had a positive relationship ( $p=0.013$ ) with type D personality; It means that women were (OR: 2.01, 95%CI:1.29, 3.37) more likely to have type D personality when compared to men, as well as blood group B had a higher chance of predicting type D personality (OR: 3.59, 95%CI: 1.39, 9.24,  $p=0.008$ , Table 4).

As shown in table 5, logistic regression models were conducted to predict medication adherence. Cholesterol was statistically related to medical adherence ( $p=0.048$ ). Also, there was a positive relationship between type D personality and medical adherence. Indeed, patients with type D personality OR: 6.23, (95%CI: 2.34-16.55,  $p<0.001$ ) had better adherence to medication by controlling socio-demographics and clinical covariates (model 1). Furthermore, there was no relationship between the

**Table 5.** Logistic regression models to predicting medical adherence

Model 1 <sup>a</sup>			Model 2 <sup>b</sup>		
Variables	OR(95%CI)	p-value	Variables	OR(95%CI)	p-value
Age (year)	1.71(0.25,11.46)	0.579	Age (year)	1.46(0.31,6.82)	0.633
Sex female vs. male	0.78(0.32,1.86)	0.570	Sex Female vs male	0.79(0.37,1.69)	0.543
Married vs. single	3.14(0.37,26.8)	0.293	Type D personality	3.93(1.72,9.02)	0.001
College education vs. diploma and under diploma	1.95(0.21,18.20)	0.556	Blood group A vs. AB	1.32(0.33,5.21)	0.759
Normal BMI vs. abnormal (kg/m <sup>2</sup> )	0.79(0.32,1.95)	0.600	Blood group B vs. AB	0.67(0.15-2.90)	0.333

Contd. table 5.

HbA1C(%)	1.03(0.75,1.43)	0.855	Blood group O vs. AB	0.59(0.14,2.53)	0.48
Duration(year)	1.01(0.96,1.07)	0.670	-	-	-
Family history	1.71(0.62,4.70)	0.300	-	-	-
Blood pressure(mmHg)	1.35(0.58,3.11)	0.493	-	-	-
FBS(mg/dl)	0.99(0.99,1.01)	0.833	-	-	-
TG(mg/dl)	1.00(0.99,1.01)	0.833	-	-	-
HDL(mg/dl)	0.97(0.92,1.02)	0.262	-	-	-
Cholesterol(mg/dl)	1.02(1.001,1.04)	0.043	-	-	-
LDL(mg/dl)	0.98(0.95,1.01)	0.151	-	-	-
Type D personality	6.23(2.34-16.55)	<0.001	-	-	-

a: adjusted model by demographics and clinical variables, b: significant variables in model 1 and ABO blood group also, adjusted by sex and age.

FBS=Fasting Blood Sugar, TG=Triglycerides, HDL=High-Density Lipoprotein, LDL=Low-Density Lipoprotein.

ABO blood group's medication adherence when the type D was simultaneously in model by adjusting sex and age (model 2, Table 5).

## Discussion

Medical adherence is an indispensable factor for metabolic maintenance and mitigation of complications (5). Based on the results of this study, medication adherence in type D personality and non-type D personality groups was significantly undesirable; however, compared to the other personality types, type D showed significantly better adherence to treatment. Similar result was extracted from another article (10).

A significant association between type D personality with the increased risk of negative medical outcomes and poor medication adherence in the individuals suffering from chronic diseases and cardiovascular diseases has also been reported (7,11). Type D personality was introduced as a comparably novel risk factor requiring particular clinical attention in patients with DM since association was mostly demonstrated with poor prognosis (24).

There have been many studies on the association between type D personality and medical adherence in various diseases. In most of such studies, individuals with type D personality have shown less interest in consultation with their physician (25), and poor medication adherence, especially for metabolic

syndromes; this could increase the risk of developing these diseases (26-30).

In addition, in a similar study performed in 2016 in a T2DM Chinese population, type D personality was shown to be associated with medication adherence (31). In addition, in one other study, individuals with asthma were examined with respect to their personality traits and reports of asthma symptoms. It was shown that people who experienced high levels of NA sometimes behaved correctly, because they were worried about their illness and showed interest in being aware of the symptom-related disease. This study revealed that patients with high levels of NA were associated with increased reports of symptoms (32). However, in a comparable study done in the Netherlands in 2015, the researchers showed that although type D personality was related to negative emotions and unhealthy behaviours, it was not associated with any standard biomedical risk factors (33).

Moreover, medical adherence in patients with DM with different ABO blood groups was evaluated and compared in the patients with type D personalities. In this comparison, medication adherence was more desirable individuals with type D personality and AB blood group. In patients with DM with type D and blood groups A, B and O, with/without considering the personality type, individuals with blood group A had a relatively better medication adherence while

the O blood type was the most undesirable. There is, however, no previous study evaluating the relationship between medication adherence and blood groups; so, for the first time, this study measured this relationship directly in a T2DM population in Iran. In the recent years, several studies have examined the relations between blood groups and behavioral patterns. For instance, in a study conducted in India in 2018, a significant association was seen between the AB blood group and extraversion behavioral patterns (34). Previous studies have also reported that medication adherence varies widely, depending on many factors such as age (35), education level, and socioeconomic status (36). However, in the present study, no significant differences were observed with respect to the obtained results and comparison of adherence to medication in each demographic factor. First, it was found that sex had no significant impact on medical adherence to the disease. Based on previous studies, few differences could be found in the suggestions made by health experts. Regarding the aspects of self-care, the gender difference was also negligible (37). although many similar studies have indicated that women have a stronger medical adherence than men (38). Analysis of this study showed that women had more type D presentation when compared with men and sex had a positive relationship with type D personality. It means that women have a higher chance of developing type D personality when compared to men. The results of a study done in Poland also showed the higher values of NA and SI in women, not men. There were sex differences in type D personality as well (39). Analysis of the current study showed that type D personality had a positive relationship with medication adherence. In addition, some studies show that type D personality was associated with medical adherence in patients with cardiac disease. (40,41) NA component of the type D personality is associated with medical adherence through self-efficacy (7,42,43), and SI is related to medication adherence too (25). According to the social cognitive theory by Bandura, self-efficacy is an important mediator between type D personality and medical adherence (44). A study conducted on

patients with Acute Coronary Syndrome (ACS) showed that NA and SI had a significant relationship with medication adherence (7). A previous study also showed an association between type D personality and medication adherence in the patients with heart failure (42), when type D personality was analyzed as a categorical variable. Contrary to the mentioned studies, two studies indicated that the type D personality was not associated with medication adherence in the patients with ACS (7), HF (42). The results of the present study also indicated no significant association between age groups and medication adherence. Previous studies examining the association between age and medication adherence in the patients with chronic heart failure found significant age-related medication adherence (42).

The results of this study showed that married people were more committed to their treatment. It was also shown that single patients with heart failure were less likely to adhere to their treatment and experience more cardiovascular events (45). However, the results of the present study showed that education level, occupation and relative social status were not related to their medication adherence. In the present study, more than 70% of the patients had a positive family history, but this did not lead to a significant relationship with medication adherence. Most of the subjects in this study were classified as having a high BMI. Sacco and colleagues showed that a high BMI could lead to depression in adults with DM (46). Moreover, no association to HbA1c was found. Analogous to the present study results, in a study done in Nigeria in 2015, demographic data showed that only sex had a significant relationship with medication adherence, and no significant association was found among other factors (47).

## Conclusion

In this study, a significant difference in medical adherence was observed between patients with type D personality; while the blood groups were not associated with medical adherence to treatment. However, given the overall poor medical adherence in patients with DM, more attention should be paid

to the follow-up treatment and regular contact with the physician. The impact of this cultural defect could cause type D personality features not only to be absent, but also to have more positive results in this field and cultural context.

### **Ethical issue**

All procedures were approved by the Islamic Azad University, Najafabad branch, Research Ethics Committee and were in accordance with the Declaration of Helsinki and APA ethical standards. The aims of the study were explained to the participants and the written informed consent was obtained.

### **Funding**

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

### **Limitations**

We are aware of the limitations of our study. First, the number of final participants was low. Although we obtained meaningful data, the result was not as much satisfactory as we wished. Moreover, our patients were all from one city. In other words, sample selection was limited to one part of the country, so cultural bias might have affected the results. Therefore, we suggest continuing the research in the form of a prospective study, along with strategies to encourage the participation of more patients from different parts of Iran.

### **Acknowledgement**

The authors would like to thank all who collaborated in this study.

### **Conflict of Interest**

There was no conflict of interest in this manuscript.

---

## **References**

1. Asmat U, Abad K, Ismail K. Diabetes mellitus and oxidative stress-A concise review. *Saudi Pharm J* 2016;24(5):547-53.
2. Ogurtsova K, da Rocha Fernandes JD, Huang Y, Linnenkamp U, Guariguata L, Cho NH, et al. IDF Diabetes Atlas: Global estimates for the prevalence of diabetes for 2015 and 2040. *Diabetes Res Clin Pract* 2017;128:40-50.
3. Aguirre F, Brown A, Cho NH, Dahlquist G, Dodd S, Dunning T, et al. *IDF diabetes atlas*. 2013.
4. DeFronzo RA, Ferrannini E, Groop L, Henry RR, Herman WH, Holst JJ, et al. Type 2 diabetes mellitus. *Nat Rev Dis Primers* 2015;1:15019.
5. Acharya AS, Gupta E, Prakash A, Singhal N. Self-reported adherence to medication among patients with type II diabetes mellitus attending a tertiary care hospital of delhi. *J Assoc Physicians India* 2019;67:26-9.
6. Polonsky WH, Henry RR. Poor medication adherence in type 2 diabetes: recognizing the scope of the problem and its key contributors. *Patient Prefer Adherence* 2016 Jul 22;10:1299-307.
7. Molloy GJ, Randall G, Wikman A, Perkins-Porras L, Messerli-Bürgy N, Steptoe A. Type D personality, self-efficacy, and medication adherence following an acute coronary syndrome. *Psychosom Med* 2012;74(1):100-6.
8. Cohen HW, Shmukler C, Ullman R, Rivera CM, Walker EA. Measurements of medication adherence in diabetic patients with poorly controlled HbA1c. *Diabet Med* 2010;27(2):210-6.
9. Mommersteeg P, Kupper N, Denollet J. Type D personality is associated with increased metabolic syndrome prevalence and an unhealthy lifestyle in a cross-sectional Dutch community sample. *BMC public health*. 2010;10(1):1-11.

10. Denollet J. Type D personality: A potential risk factor refined. *J Psychosom Res* 2000;49(4):255-66.
11. Denollet J, Schiffer AA, Spek V. A general propensity to psychological distress affects cardiovascular outcomes: evidence from research on the type D (distressed) personality profile. *Circ Cardiovasc Qual Outcomes* 2010;3(5):546-57.
12. Tsuchimine S, Saruwatari J, Kaneda A, Yasui-Furukori N. ABO blood type and personality traits in healthy Japanese subjects. *PLoS One* 2015;10(5):e0126983.
13. Karthik L, Kumar G, Keswani T, Bhattacharyya A, Chandar SS, Bhaskara Rao K. Protease inhibitors from marine actinobacteria as a potential source for antimalarial compound. *PLoS One* 2014;9(3):e90972.
14. Meo S, Rouq F, Suraya F, Zaidi S. Association of ABO and Rh blood groups with type 2 diabetes mellitus. *Eur Rev Med Pharmacol Sci* 2016;20(2):237-42.
15. Denollet J. DS14: standard assessment of negative affectivity, social inhibition, and Type D personality. *Psychosom Med* 2005;67(1):89-97.
16. Bagherian R, Ehsan HB. Psychometric properties of the Persian version of type D personality scale (DS14). *Iran J Psychiatry Behav Sci* 2011;5(2):12-7.
17. Organization WH. Report of a World Health Organization Consultation. Use of glycated haemoglobin (HbA1c) in the diagnosis of diabetes mellitus. *Diabetes Res Clin Pract* 2011;93:299-309.
18. Nuttall FQ. Body mass index: obesity, BMI, and health: a critical review. *Nutr Today* 2015;50(3):117-28.
19. Moharamzad Y, Saadat H, Shahraki BN, Rai A, Saadat Z, Aerab-Sheibani H, et al. Validation of the Persian version of the 8-item Morisky Medication Adherence Scale (MMAS-8) in Iranian hypertensive patients. *Glob J Health Sci* 2015;7(4):173-83.
20. Mommersteeg PM, Denollet J, Kavelaars A, Geuze E, Vermetten E, Heijnen CJ. Type D personality, temperament, and mental health in military personnel awaiting deployment. *Int J Behav Med* 2011 Jun;18(2):131-8.
21. Moradi S, Amrei MT, Janbabai G, Zamani F. Type D Personality and Its Relationship with Perceived Stress Among Women with Breast Cancer Attending a Referral Center in Northern Iran in 2017. *Iranian Journal of Psychiatry and Behavioral Sciences* 2020;14(3).
22. Denollet J, Pedersen SS, Ong AT, Erdman RA, Serruys PW, van Domburg RT. Social inhibition modulates the effect of negative emotions on cardiac prognosis following percutaneous coronary intervention in the drug-eluting stent era. *Eur Heart J* 2006;27(2):171-7.
23. Kupper N, Pedersen SS, Höfer S, Saner H, Oldridge N, Denollet J. Cross-cultural analysis of type D (distressed) personality in 6222 patients with ischemic heart disease: a study from the International HeartQoL Project. *Int J Cardiol* 2013;166(2):327-33.
24. Conti C, Carrozzino D, Patierno C, Vitacolonna E, Fulcheri M. The clinical link between type D personality and diabetes. *Front Psychiatry* 2016;7:113.9/
25. Li X, Zhang S, Xu H, Tang X, Zhou H, Yuan J, et al. Type D personality predicts poor medication adherence in Chinese patients with type 2 diabetes mellitus: a six-month follow-up study. *PLoS One* 2016;11(2):e0146892.
26. Finucane F, Sharp S, Purslow L, Horton K, Horton J, Savage D, et al. The effects of aerobic exercise on metabolic risk, insulin sensitivity and intrahepatic lipid in healthy older people from the Hertfordshire Cohort Study: a randomised controlled trial. *Diabetologia* 2010;53(4):624-31.
27. Hamilton M, Hamilton D, Zderic T. Role of low energy expenditure and sitting in obesity, metabolic syndrome, type 2 diabetes, and cardiovascular disease. *Diabetes* 2007 Nov;56(11):2655-67.

28. Cho ER, Shin A, Kim J, Jee SH, Sung J. Leisure-time physical activity is associated with a reduced risk for metabolic syndrome. *Ann Epidemiol* 2009;19(11):784-92.
29. Wu J-R, Song EK, Moser DK. Type D personality, self-efficacy, and medication adherence in patients with heart failure-A mediation analysis. *Heart Lung* 2015;44(4):276-81.
30. Svansdottir E, Denollet J, Thorsson B, Gudnason T, Halldorsdottir S, Gudnason V, et al. Association of type D personality with unhealthy lifestyle, and estimated risk of coronary events in the general Icelandic population. *Eur J Prev Cardiol* 2013;20(2):322-30.
31. Li X, Gao M, Zhang S, Xu H, Zhou H, Wang X, et al. Medication adherence mediates the association between type D personality and high HbA1c level in Chinese patients with type 2 diabetes mellitus: a six-month follow-up study. *J Diabetes Res* 2017;2017.
32. Mora PA, Halm E, Leventhal H, Ceric F. Elucidating the relationship between negative affectivity and symptoms: The role of illness-specific affective responses. *Ann Behav Med* 2007;34(1):77-86.
33. Neffs G, Speight J, Pouwer F, Pop V, Bot M, Denollet J. Type D personality, suboptimal health behaviors and emotional distress in adults with diabetes: Results from Diabetes MILES–The Netherlands. *Diabetes Res Clin Pract* 2015;108(1):94-105.
34. Sharifi M, Ahmadian H, Jalili A. The relationship between blood groups and" type A" personality. *Der Pharmacia Lettre* 2015;7(9):35-9.
35. Bezie Y, Molina M, Hernandez N, Batista R, Niang S, Huet D. Therapeutic compliance: a prospective analysis of various factors involved in the adherence rate in type 2 diabetes. *Diabetes Metab* 2006;32(6):611-6.
36. Odegard PS, Capoccia K. Medication taking and diabetes. *Diabetes Educ* 2007;33(6):1014-29.
37. Fitzgerald JT, Anderson RM, Davis WK. Gender differences in diabetes attitudes and adherence. *Diabetes Educ* 1995;21(6):523-9.
38. Ahmad NS, Ramli A, Islahudin F, Paraidathathu T. Medication adherence in patients with type 2 diabetes mellitus treated at primary health clinics in Malaysia. *Patient Prefer Adherence* 2013;7:525.
39. Gębska M, Dalewski B, Pałka Ł, Kołodziej Ł, Sobolewska E. Type D Personality and Stomatognathic System Disorders in Physiotherapy Students during the COVID-19 Pandemic. *J Clin Med* 2021;10(21):4892.
40. Gębska M, Kołodziej Ł, Dalewski B, Pałka Ł, Sobolewska E. The Influence of the COVID-19 Pandemic on the Stress Levels and Occurrence of Stomatognathic System Disorders (SSDs) among Physiotherapy Students in Poland. *J Clin Med* 2021;10(17):3872.
41. Zhan H, Zheng C, Zhang X, Yang M, Zhang L, Jia X. Chinese college students' stress and anxiety levels under COVID-19. *Front Psychiatry* 2021;12.
42. Wu J-R, Moser DK. Type D personality predicts poor medication adherence in patients with heart failure in the USA. *Int J Behav Med* 2014;21(5):833-42.
43. Williams L, O'Connor RC, Grubb N, O'Carroll R. Type D personality predicts poor medication adherence in myocardial infarction patients. *Psychol Health* 2011;26(6):703-12.
44. Bandura A. Health promotion from the perspective of social cognitive theory. *Psychology Health* 1998;13(4):623-49.
45. Wu J-R, Lennie TA, Chung ML, Frazier SK, Dekker RL, Biddle MJ, et al. Medication adherence mediates the relationship between marital status and cardiac event-free survival in patients with heart failure. *Heart Lung* 2012;41(2):107-14.
46. Sacco WP, Wells KJ, Vaughan CA, Friedman A, Perez S, Matthew R. Depression in adults with type 2 diabetes:

the role of adherence, body mass index, and self-efficacy. *Health Psychol* 2005;24(6):630-4.

47. Adeniran A, Akinyinka M, Wright KO, Bakare OQ, Goodman OO, Kuyinu YA, et al. Personality traits, medication beliefs & adherence to medication among diabetic patients attending the diabetic clinic in a teaching hospital in southwest Nigeria. *Journal of Diabetes Mellitus* 2015;5(04):319-29.