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Big Five Personality Traits and Medication Adherence in Type 2 Diabetes Patients in Southern Peru

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ABSTRACT

Medication adherence remains a major challenge in the management of type 2 diabetes mellitus (T2DM), yet the contribution of personality traits is insufficiently understood in Latin American populations. This cross-sectional analytical study examined associations between the Big Five personality traits and medication adherence among 92 adults with T2DM receiving outpatient care at the Regional Hospital of Moquegua in southern Peru during 2025. Personality traits were assessed using the 44-item Big Five Inventory, and adherence was measured with the eight-item Morisky Medication Adherence Scale. We evaluated associations using correlation analyses and binary logistic regression adjusted for age, sex, and diabetes duration, with bootstrap resampling and internal validation. Only 21.7\% of participants demonstrated optimal adherence, while 63.0\% had moderate adherence and 15.2\% had poor adherence. Higher conscientiousness (adjusted odds ratio [OR] = 3.62; 95\% confidence interval [CI]: 1.65--7.95) and agreeableness (OR = 2.62; 95\% CI: 1.37--5.02) were independently associated with greater odds of optimal adherence. In contrast, extraversion was inversely associated with optimal adherence (OR = 0.39; 95\% CI: 0.08--0.72). Neuroticism and openness to experience showed no statistically significant associations. These findings indicate that personality traits may complement clinical and sociodemographic factors in explaining medication-taking behavior among patients with T2DM. Person-centered interventions tailored to psychological profiles may help improve adherence, although longitudinal and multicenter studies are required to confirm these associations.

Keywords: Type 2 diabetes mellitus, Medication adherence, Personality, Conscientiousness, Big Five model, Peru.

Introduction

Type 2 diabetes mellitus (T2DM) is a major global public health challenges due to its increasing prevalence, chronic nature, and association with multiple cardiovascular, renal, neurological, and metabolic complications. In 2021, approximately 537 million adults were living with diabetes worldwide, and this number is projected to reach 783 million by 2045 (International Diabetes Federation, 2021; Hao *et al*., 2025; Svensson & Lindberg, 2026). More than 90% all cases correspond to T2DM, disproportionately affecting low- and middle-income countries where access healthcare, timely diagnosis, and continuity of care remain limited (NCD Risk Factor Collaboration, 2016; American Diabetes Association Professional Practice Committee, 2024; Guillen & Pereira, 2024; Zhang *et al*., 2024; Kunie *et al*., 2025). In Latin America, T2DM represents an increasing public health concern, while in Peru is prevalence is estimated at approximately 5.9%, with an upward trend associated with aging, urbanization, and lifestyle changes (Sinisterra-Loaiza *et al*., 2019, Morgan *et al*., 2025; Vera-Ponce *et al*., 2025). The growing burden of T2DM represents

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not only a clinical challenge but also a substantial socioeconomic concern, as long-term treatment, complications, disability, and premature mortality place considerable demands on patients, families, and healthcare systems.

Effective management of T2DM requires sustained adherence to pharmacological treatment, dietary recommendations, physical activity, glucose monitoring, and regular healthcare follow-up. However, maintaining these behaviors over time can be difficult because diabetes management involves multiple daily tasks and requires long-term behavioral commitment. Despite advances in pharmacological therapies and evidence-based clinical guidelines, medication adherence remains a major challenge in effective diabetes management. The World Health Organization defines adherence as the extent to which an individual´s behavior regarding medication use, dietary recommendations, and lifestyle modifications corresponds with recommendations agreed upon with healthcare professionals (World Health Organization, 2003; Nagesh *et al*., 2025). Poor adherence is associated with inadequate glycemic control, increased microvascular and macrovascular complications, higher hospitalization rates, reduced quality of life, and increased mortality (García-Pérez *et al*., 2013; Kardas *et al*., 2013; Damaševičius *et al*., 2025).

Medication adherence is a complex and multidimensional behavior influenced by interactions among clinical, socioeconomic, healthcare-related, psychological, and behavioral factors. In Latin America and Peru, adherence is influenced by economic, educational, healthcare-access, psychosocial, and behavioral factors, including financial constraints, lack of insurance, medication access, illness perceptions, self-efficacy, social support, and medication beliefs (Broadbent *et al*., 2006; Snoek, 2022; Calderon-Ramirez *et al*., 2024; Kajanova & Badrov, 2024; Kowalski *et al*., 2024; Salinas-Rehbein *et al*., 2024; Huber *et al*., 2025; Novak & Dvorak, 2025; Novak & Jelic, 2025; Salem *et al*., 2025). These factors may be particularly relevant in healthcare settings where patients face difficulties maintaining continuous treatment or adapting therapeutic recommendations to their everyday circumstances.

Among these determinants, personality traits have received increasing attention because of their relative stability over time and their potential to predict long-term health behaviors. The Five-Factor Model (Big Five) comprises neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness (John *et al*., 2008). A growing body of evidence suggests that these traits are associated with physical activity, dietary behaviors, healthcare utilization, and treatment adherence (Roberts *et al*., 2006; Kwatra *et al*., 2024; Parveen & Ghosh, 2025). Conscientiousness, characterized by self-discipline, organization, and goal-directed behavior, may facilitate consistent adherence, whereas agreeableness may promote cooperation and positive patient–provider relationships. Conversely, neuroticism may interfere with self-management through anxiety and maladaptive coping, while extraversion may be associated with less structured routines; evidence regarding openness remains inconsistent (Molloy *et al*., 2014; Altowijri, 2024).

Observational studies, systematic reviews, and meta-analyses have consistently identified conscientiousness as one of the strongest personality predictors of treatment adherence across chronic conditions (Bogg & Roberts, 2004; Molloy *et al*., 2014; Abdoul-Latif *et al*., 2025). Recent research in patients with T2DM has also reported positive associations between agreeableness and medication adherence, while extraversion and neuroticism have shown negative associations (Dimou *et al*., 2024; Zairkhanova *et al*., 2024; Dimou *et al*., 2025).

Therefore, this study aimed to examine the association between Big Five personality traits and medication adherence among patients with T2DM attending the Regional Hospital of Moquegua, Peru, in 2025. We hypothesized that higher conscientiousness and agreeableness would be associated with greater optimal medication adherence, whereas higher neuroticism and extraversion would be associated with lower adherence. The role of openness to experience was also examined given the inconsistency of previous findings.

Materials and Methods

Study Design and Context

A cross-sectional analytical study was conducted between January and December 2025 at the Regional Hospital of Moquegua, a public healthcare institution located in southern Peru serving predominantly urban and peri-urban populations (Seguro Integral de Salud). The study was designed and reported according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines for cross-sectional studies (von Elm *et al*., 2007). In addition, principles from the Transparent Reporting of a Multivariable Prediction Model for Individual

Prognosis or Diagnosis (TRIPOD) statement were considered when applicable to ensure transparency in reporting multivariable modeling procedures (Collins *et al*., 2015).

Participants and Sample Size

Participants were adults (≥18 years) with a confirmed diagnosis of type 2 diabetes mellitus, a disease duration of at least one-year, active pharmacological treatment for diabetes, and ability to complete study instruments. Patients with type 1 diabetes mellitus or gestational diabetes, severe psychiatric disorders, cognitive impairment, acute diabetic complications at the time of assessment, or difficulties in reading and understanding the questionnaires were excluded. Participants were consecutively recruited from scheduled consultations in the Endocrinology and Internal Medicine outpatient clinics using a non-probability convenience sampling strategy. The minimum sample size was calculated to detect a moderate correlation ($r = 0.30$) using Fisher's z transformation, assuming a two-sided significance level of 0.05 and a statistical power of 80%, resulting in a minimum required sample of approximately 84 participants. A total of 92 patients were ultimately included. Bootstrap resampling procedures were incorporated to improve the stability of parameter estimates and reduce model optimism in the context of a moderate sample size.

Variables and Instruments

Medication Adherence (Outcome Variable)

Medication adherence was assessed using the 8-item Morisky Medication Adherence Scale (MMAS-8) in its Spanish-adapted version (Morisky *et al*., 2008; Tan *et al*., 2014). Total scores range from 0 to 8 points and are categorized as optimal adherence (8 points), moderate adherence (6 to <8 points), and low adherence (<6 points). The MMAS-8 has demonstrated acceptable psychometric properties in populations with chronic diseases, with reported internal consistency coefficients ranging from $\alpha = 0.61$ to $\alpha = 0.83$ in validated Spanish-language versions (Tan *et al*., 2014; Elango & Govindaraju, 2025).

Personality Traits (Exposure Variables)

Personality traits were assessed using the 44-item Big Five Inventory (BFI-44) developed by (John *et al*., 1991) and validated in Spanish by (Benet-Martínez, & John, 1998). The instrument uses a five-point Likert response scale and evaluates five personality dimensions: neuroticism, extraversion, openness to experience, agreeableness, and conscientiousness. For statistical analyses, scores for each dimension were categorized into low, medium, and high levels according to sample-specific tertiles. This categorization was adopted to facilitate interpretation and maintain balanced group sizes. Previous validation studies in Spanish-speaking populations have reported internal consistency coefficients ranging from $\alpha = 0.75$ to $\alpha = 0.82$ across personality dimensions.

Sociodemographic and Clinical Variables

Age, sex, marital status, educational, occupation, duration of diabetes, pharmacological treatment, and self-reported comorbidities. Additional clinical information was obtained from medical records.

Data Collection Procedure

After providing written informed consent, participants completed the study instruments in a private area within the hospital. Data collection followed a standardized sequence consisting of: (1) a sociodemographic and clinical questionnaire, (2) the BFI-44, and (3) the MMAS-8. The average administration time ranged from 20 to 25 minutes. Data collection was supervised by a trained researcher who provided standardized instructions without influencing participants' responses. No missing data were identified in the primary study variables.

Statistical Analysis

Continuous variables were summarized using means and standard deviations (SD), and categorical variables as frequencies and percentages.

Monotonic associations between personality traits (coded as low = 0, medium = 1, high = 2) and medication adherence (coded as low = 0, moderate = 1, optimal = 2) were assessed using Spearman's rank correlation coefficients (rs). Ninety-five percent confidence intervals (95% CI) were estimated using non-parametric bootstrap resampling with

5,000 iterations. Associations in contingency tables were evaluated using Pearson's chi-square test and Cramér's V coefficient.

The primary analysis used a binary logistic regression model comparing optimal adherence (MMAS-8 = 8) with non-optimal adherence. This approach was selected because the low-adherence category contained a limited number of participants (n = 14), increasing the risk of overfitting in multinomial models. Personality traits were entered as standardized ordinal variables. Unadjusted and a priori adjusted models were fitted, with adjustment for age, sex, and diabetes duration. Odds ratios (ORs) and 95% Cis were estimated using 5,000 bootstrap resamples.

Model discrimination was assessed using AUC, calibration using the Brier score, and internal validation through stratified five-fold cross-validation and bootstrap optimism correction (Harrell, 2015). Multicollinearity was evaluated using variance inflation factors (VIF), with values <2 considered acceptable. A multinomial logistic regression including optimal, moderate, and low adherence was performed as a sensitivity analysis. Statistical significance was set at $p < 0.05$ (two-tailed).

Analyses were performed in Python 3.12 using SciPy 1.17 and scikit-learn 1.8, with a fixed random seed (42) to ensure reproducibility. Acronyms are provided in the Abbreviations table. The anonymized dataset and analysis code are available from the corresponding author upon reasonable request.

Ethical Considerations

The Institutional Research Ethics Committee of the Regional Hospital of Moquegua approved the study protocol, and the study was conducted in accordance with the principles of the Declaration of Helsinki. All participants provided written informed consent before enrollment and were informed of their right to withdraw from the study at any time without affecting their medical care. Confidentiality was ensured through anonymous coding procedures and secure data storage.

Results and Discussion

Sociodemographic and Clinical Characteristics of the Sample

A total of 92 patients with type 2 diabetes mellitus were included in the study. The mean age was 58.2 ± 12.9 years, and the average duration of the disease was 10.7 ± 8.5 years. Most participants were women (63.0%), were married or living with a partner (57.7%), and had a secondary school education or lower (73.9%).

Regarding medication adherence assessed using the MMAS-8 scale, 21.7% of patients demonstrated optimal adherence, whereas 63.0% showed moderate adherence and 15.2% exhibited poor adherence. These findings indicate that approximately four out of five patients did not achieve an optimal level of treatment adherence.

The sociodemographic and clinical characteristics of the study population are summarized in **Table 1**.

Table 1. Sociodemographic and clinical characteristics of patients with type 2 diabetes mellitus (n = 92).

Characteristic	n	%	Mean (DE)
Age (years)	—	—	58.2 (12.9)
Disease duration (years)	—	—	10.7 (8.5)
Sex			
Female	58	63.0	—
Male	34	37.0	—
Marital Status			
Married or cohabiting	53	57.7	—
Single, separated, or widowed	39	42.3	—
Educational Level			
No schooling or primary education	37	40.2	—
Secondary education	31	33.7	—
Technical or university education	24	26.1	—
Adherence (MMAS-8)			
Optimal (= 8)	20	21.7	—
Regular (6 < a < 8)	58	63.0	—

Poor (< 6)	14	15.2	—

Correlations among Big Five Personality Traits

Spearman's correlation matrix revealed low to moderate associations among the five personality traits assessed **(Table 2)**. The strongest positive correlation was observed between conscientiousness and agreeableness (rs = 0.374; p < 0.001), whereas the strongest negative association was found between neuroticism and openness to experience (rs = −0.379; p < 0.001). Significant positive correlations were also identified between conscientiousness and extraversion (rs = 0.253; p < 0.05), conscientiousness and openness to experience (rs = 0.213; p < 0.05), and openness to experience and agreeableness (rs = 0.244; p < 0.05). In contrast, extraversion showed weak and non-significant correlations with most of the remaining personality traits.

None of the observed correlations exceeded the commonly accepted threshold of |rs| = 0.70 used to identify potential multicollinearity issues. These findings suggest a relative independence among the dimensions of the Big Five model and support the stability of subsequent multivariable analyses. This interpretation was further reinforced by the low variance inflation factors observed in the regression models (VIF < 2), indicating the absence of meaningful collinearity among the predictors included.

Table 2. Spearman correlation matrix among the Big Five personality traits (n = 92).

Trait	Neuroticism	Conscientiousness	Extraversion	Openness	Agreeableness
Neuroticism	1	-0.308**	-0.105	-0.379***	-0.206*
Conscientiousness	-0.308**	1	0.253*	0.213*	0.374***
Extraversion	-0.105	0.253*	1	0.103	0.099
Openness	-0.379***	0.213*	0.103	1	0.244*
Agreeableness	-0.206*	0.374***	0.099	0.244*	1

Distribution of Treatment Adherence According to Personality Traits

The distribution of adherence levels showed significant differences according to the personality traits of conscientiousness and agreeableness **(Table 3)**. Patients with high levels of conscientiousness exhibited the highest proportion of optimal adherence (38.1%), compared with those with moderate (12.5%) and low levels (3.8%). Similarly, optimal adherence was more frequent among participants with high agreeableness (50.0%), whereas it was observed in only 16.7% and 6.2% of those with moderate and low levels, respectively. These associations demonstrated moderate effect sizes (Cramér's V = 0.30 and 0.31, respectively).

In contrast, no statistically significant associations were identified between adherence levels and neuroticism (p = 0.132), extraversion (p = 0.821), or openness to experience (p = 0.282). Nevertheless, a tendency toward lower rates of optimal adherence was observed among participants with high neuroticism, whereas higher rates of optimal adherence were noted among those with high openness to experience.

The complete distribution of adherence levels according to each personality trait is presented in **Table 3**.

Bivariate Association between Personality Traits and Treatment Adherence

Bivariate analyses revealed significant associations between medication adherence and the personality traits of conscientiousness and agreeableness. Conscientiousness showed a moderate positive correlation with adherence (rs = 0.41; 95% CI: 0.23–0.57; p < 0.001). Consistently, the chi-square analysis demonstrated a significant association between these variables (χ^2 = 17.01; p = 0.002), with a moderate effect size (Cramér's V = 0.30). Likewise, agreeableness was positively associated with adherence (rs = 0.34; 95% CI: 0.15–0.50; p = 0.001), and the contingency analysis also revealed a statistically significant association (χ^2 = 18.17; p = 0.001; Cramér's V = 0.31).

Table 3. Distribution of treatment adherence according to the level of each personality trait (percentages calculated by row within each trait level).

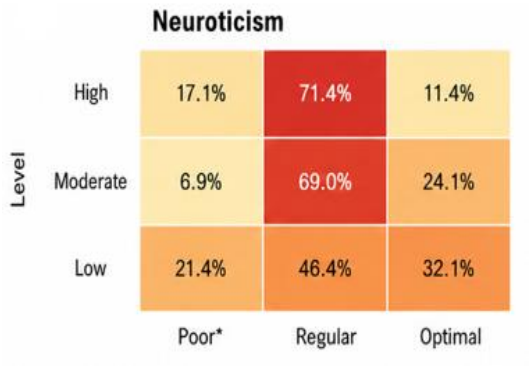
Trait / Level	Poor n (%)	Regular n (%)	Optimal n (%)	Association
Conscientiousness				p = 0.002; V = 0.30

Low (n = 26)	8 (30.8)	17 (65.4)	1 (3.8)	
Medium (n = 24)	3 (12.5)	18 (75.0)	3 (12.5)	
High (n = 42)	3 (7.1)	23 (54.8)	16 (38.1)	
Agreeableness				p = 0.001; V = 0.31
Low (n = 32)	5 (15.6)	25 (78.1)	2 (6.2)	
Medium (n = 36)	8 (22.2)	22 (61.1)	6 (16.7)	
High (n = 24)	1 (4.2)	11 (45.8)	12 (50.0)	
Neuroticism				p = 0.132; V = 0.20
Low (n = 28)	6 (21.4)	13 (46.4)	9 (32.1)	
Medium (n = 29)	2 (6.9)	20 (69.0)	7 (24.1)	
High (n = 35)	6 (17.1)	25 (71.4)	4 (11.4)	
Extraversion				p = 0.821; V = 0.09
Low (n = 55)	9 (16.4)	33 (60.0)	13 (23.6)	
Medium (n = 26)	3 (11.5)	17 (65.4)	6 (23.1)	
High (n = 11)	2 (18.2)	8 (72.7)	1 (9.1)	
Openness				p = 0.282; V = 0.17
Low (n = 30)	4 (13.3)	22 (73.3)	4 (13.3)	
Medium (n = 33)	5 (15.2)	22 (66.7)	6 (18.2)	
High (n = 29)	5 (17.2)	14 (48.3)	10 (34.5)	

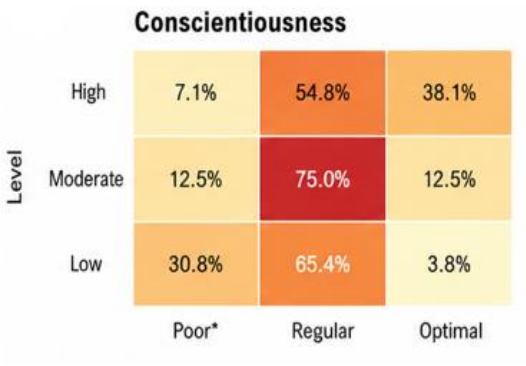
In contrast, no statistically significant associations were observed between adherence and neuroticism (rs = −0.13; 95% CI: −0.34 to 0.08; p = 0.222), extraversion (rs = −0.04; 95% CI: −0.24 to 0.16; p = 0.704), or openness to experience (rs = 0.12; 95% CI: −0.10 to 0.32; p = 0.256). Effect sizes for these traits were small and did not reach statistical significance.

Figure 1 *illustrates the distribution of adherence levels according to each personality trait. A clear positive gradient was observed for conscientiousness and agreeableness, characterized by a progressive increase in the proportion of patients with optimal adherence as trait levels increased. Specifically, optimal adherence was observed in 38.1% of participants with high conscientiousness compared with only 3.8% of those with low conscientiousness. Similarly, 50.0% of patients with high agreeableness demonstrated optimal adherence, whereas only 6.2% of those with low agreeableness achieved this level of adherence.*

Although neuroticism exhibited an inverse trend, with a lower proportion of optimal adherence among participants with higher levels of the trait, this association did not reach statistical significance. Likewise, extraversion and openness to experience did not show consistent patterns of association with adherence in the bivariate analyses.



a)



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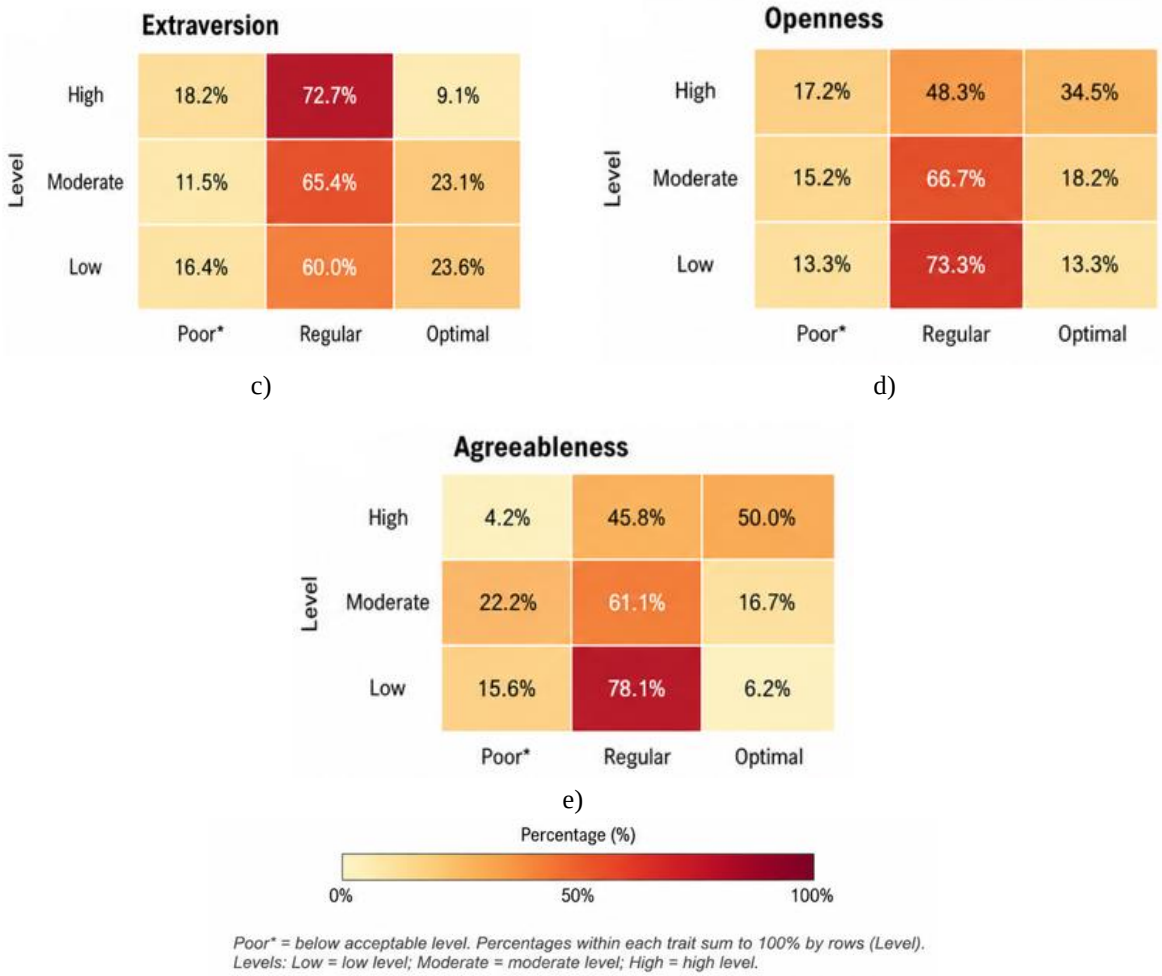

Figure 1. Percentage distribution of medication adherence categories across levels of the Big Five personality traits.

Multivariable Logistic Regression Model and Model Performance

In the binary logistic regression model adjusted for age, sex, and disease duration, conscientiousness and agreeableness were independently associated with a higher likelihood of optimal medication adherence **(Table 4)**. Conscientiousness exhibited the strongest positive association (OR = 3.62; 95% CI: 1.65–7.95; p = 0.007), followed by agreeableness (OR = 2.62; 95% CI: 1.37–5.02; p = 0.004). In contrast, extraversion was inversely associated with optimal adherence (OR = 0.39; 95% CI: 0.03–0.75; p = 0.007).

No statistically significant associations were observed for neuroticism (OR = 0.75; 95% CI: 0.12–2.03; p = 0.500) or openness to experience (OR = 1.27; 95% CI: 0.50–4.79; p = 0.567). Likewise, the covariates included in the model (age, sex, and disease duration) were not independently associated with optimal adherence.

The results of the crude and adjusted models were consistent, with only minimal changes in the magnitude of the coefficients after adjustment for potential confounding factors. **Figure 2** presents the adjusted odds ratios and their corresponding 95% confidence intervals.

The model demonstrated good discriminative ability, with an apparent area under the receiver operating characteristic curve (AUC) of 0.86. After optimism correction using bootstrap resampling with 5,000 iterations, the AUC was 0.79, suggesting stable performance following internal validation **(Figure 3)**. Model calibration was satisfactory, as indicated by a Brier score of 0.10. Furthermore, no evidence of multicollinearity was detected among the predictors, as all variance inflation factors were below 2.

As a sensitivity analysis, a multinomial logistic regression model was fitted using the three adherence categories. The direction and magnitude of the associations were consistent with those observed in the primary model, although the estimates were less precise because of the limited number of participants in the low-adherence category.

Table 4. Binary logistic regression analysis for optimal adherence (MMAS-8 = 8) versus non-optimal adherence: crude and adjusted models

Variable	Crude OR	95% CI	p	Adjusted OR	IC 95%	p
Conscientiousness	3.61	1.60–8.16	0.006	3.62	1.65–7.95	0.007
Agreeableness	2.64	1.34–5.20	0.005	2.62	1.37–5.02	0.004
Extraversion	0.40	0.10–0.74	0.006	0.39	0.08–0.72	0.007
Neuroticism	0.77	0.27–1.81	0.512	0.75	0.12–2.03	0.500
Openness	1.26	0.55–3.64	0.561	1.27	0.50–4.79	0.567
Age	—	—	—	0.92	0.28–3.79	0.881
Sex (female)	—	—	—	0.96	0.39–4.06	0.998
Disease duration	—	—	—	**0.93**	**0.07–3.01**	**0.915**

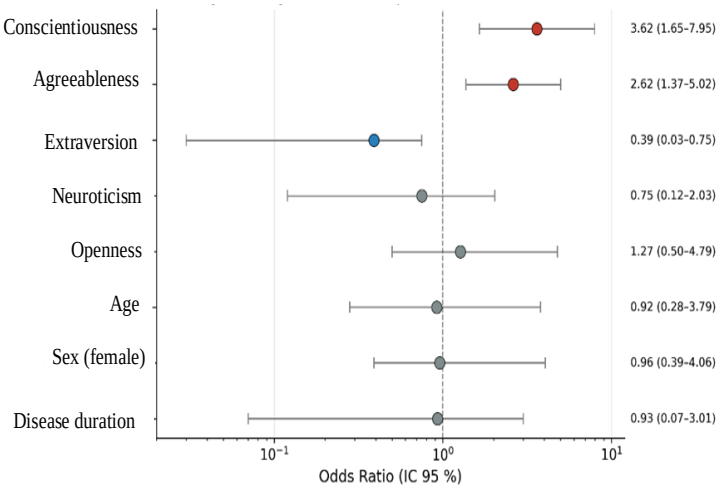

Figure 2. Forest plot of adjusted ORs with 95% CIs for predictors of optimal adherence.

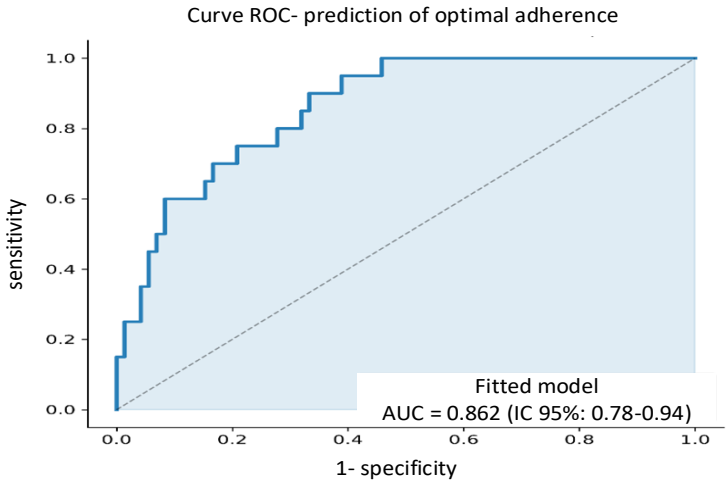

Figure 3. ROC curve of the adjusted logistic model for predicting optimal adherence.

Interpretation of the Main Findings

This study found that conscientiousness and agreeableness were positively associated with medication adherence among patients with type 2 diabetes mellitus in southern Peru, whereas extraversion was associated with poorer adherence. Neuroticism and openness to experience showed no significant associations. Conscientiousness demonstrated the strongest relationship with adherence, potentially reflecting the role of self-discipline, organization, responsibility, and goal-directed behavior in maintaining medication routines and self-care. Agreeableness also independently predicted optimal adherence, possibly through greater cooperation, trust in healthcare professionals, and receptiveness to therapeutic recommendations, emphasizing the potential value of empathic communication, therapeutic education, and psychosocial support in resource-limited settings.

Extraversion was associated with poorer adherence after adjustment, suggesting that socially oriented lifestyles may interfere with structured therapeutic routines and increase the likelihood of unintentional medication omissions. The absence of an association with neuroticism may indicate that contextual, structural, or economic barriers have a greater influence on adherence in this population. However, this interpretation should be considered cautiously.

The Big Five traits showed only low-to-moderate intercorrelations, with all variance inflation factors below two, indicating no relevant multicollinearity and supporting the inclusion of the personality dimensions in the multivariable models. Finally, openness to experience was not significantly associated with adherence, consistent with the heterogeneous evidence reported in previous studies. Its potential influence may depend on cultural and contextual factors, including access to health information, educational attainment, and participation in treatment-related decision-making. Overall, these findings suggest that personality traits, particularly conscientiousness and agreeableness, may contribute to explaining individual differences in medication adherence in patients with T2DM.

Findings in the Context and conscientiousness

The prevalence of optimal medication adherence observed in this study (21.7%) is consistent with the therapeutic compliance challenges reported among patients with type 2 diabetes mellitus in Latin America (García-Pérez *et al*., 2013). The high proportion of participants exhibiting moderate or poor adherence (78.2%) highlights the persistence of structural, economic, and organizational barriers that hinder effective chronic disease management in resource-constrained settings. These findings are in line with previous studies conducted in the region, which have identified limited access to medications, discontinuity of care, and socio-economic inequalities as important determinants of treatment adherence (Calderon-Ramirez *et al*., 2024).

The present findings further support the international evidence identifying conscientiousness as one of the most consistent predictors of treatment adherence. The magnitude of the association observed in our study (OR = 3.62) was even greater than that reported in some previous investigations and is consistent with systematic reviews and meta-analyses documenting a positive relationship between conscientiousness and a wide range of self-care behaviors among individuals with chronic diseases (Molloy *et al*., 2014; Dimou *et al*., 2024). Studies involving patients with diabetes and cardiovascular conditions have shown that individuals with higher levels of conscientiousness are better able to organize health-related behaviors, maintain therapeutic routines, and comply with long-term medical recommendations (Matsumura *et al*., 2018; Yamaoka *et al*., 2022). Taken together, our findings strengthen the evidence positioning conscientiousness as one of the principal psychological determinants of medication adherence.

Agreeableness was also independently associated with optimal adherence, consistent with previous studies conducted in chronic disease populations and with recent findings specifically reported among patients with type 2 diabetes mellitus (Axelsson *et al*., 2011). The literature suggests that this trait promotes cooperation with healthcare professionals, enhances physician–patient communication, and increases willingness to follow therapeutic recommendations (Dimou *et al*., 2024). The consistency of this finding across different cultural settings suggests that agreeableness may represent an important psychological resource for the success of interventions focused on therapeutic education and strengthening the healthcare relationship.

Conversely, the inverse association observed between extraversion and optimal adherence is consistent with the direction reported in recent meta-analyses, although the available evidence remains limited (Chapman *et al*., 2011). While extraversion was not significantly associated with adherence in the bivariate analyses, its effect emerged in the adjusted multivariable model, suggesting that the influence of this trait may depend on its interaction with other

personality dimensions (Axelsson *et al*., 2011). This finding may reflect the presence of partial effects that become apparent only after simultaneously controlling for the remaining Big Five traits. However, given the sample size and the limited number of studies available among patients with diabetes, this interpretation should be considered exploratory and requires confirmation through prospective and multicenter investigations.

Finally, no significant association was observed between neuroticism and medication adherence. This finding differs somewhat from earlier studies that identified neuroticism as a risk factor for poor adherence. However, more recent research suggests that this trait may be more closely related to emotional distress, disease-related fatigue, and other dimensions of psychological well-being than to medication-taking behavior itself (Snoek, 2022). The discrepancies observed across studies may be attributable to methodological differences, cultural characteristics of the populations examined, and variations in the assessment of both personality and treatment adherence. Similarly, openness to experience was not significantly associated with adherence, a finding that is consistent with the heterogeneous results reported in the international literature regarding this personality trait.

Clinical and Public Health Implications

The findings of this study have potentially important implications for clinical practice and the design of interventions aimed at improving medication adherence among patients with type 2 diabetes mellitus. The identification of conscientiousness and agreeableness as factors associated with a higher likelihood of optimal adherence suggests that the assessment of relatively stable psychological characteristics could complement traditional clinical evaluation. In this regard, the incorporation of brief instruments based on the Big Five personality framework may help identify patients who are potentially more vulnerable to adherence difficulties, particularly those with lower levels of conscientiousness or higher levels of extraversion (Gosling *et al*., 2003). Such information could be used to tailor educational interventions, strengthen behavioral support strategies, and optimize clinical follow-up for patients at greater risk of treatment non-adherence.

From a person-centered medicine perspective, these results support the need to consider individual psychological factors in the management of chronic diseases. While patients with high conscientiousness may primarily benefit from strategies focused on maintaining already established healthy behaviors, those with lower levels of this trait may require interventions aimed at enhancing organizational skills, establishing routines, and implementing behavioral reminder systems. Similarly, individuals with high levels of agreeableness may respond particularly well to interventions based on therapeutic communication and a strong physician–patient alliance, whereas patients with higher levels of extraversion may benefit from strategies that incorporate structured social support and monitoring mechanisms adapted to more dynamic lifestyles.

Nevertheless, it is important to recognize that treatment adherence is a multidimensional phenomenon in which psychological factors interact with structural, social, and healthcare-related determinants. In contexts such as Peru, variables related to health insurance coverage, socio-economic status, medication availability, continuity of care, and family support may exert effects that are as important as individual-level factors (Calderon-Ramirez *et al*., 2024; Salinas-Rehbein *et al*., 2024). Consequently, personality traits should not be interpreted as isolated determinants of adherence but rather as complementary components within broader biopsychosocial models of chronic disease management.

From a public health perspective, these findings support the development of comprehensive diabetes management programs that incorporate the assessment of psychosocial factors alongside interventions aimed at reducing structural barriers to treatment access and continuity of care. Combining patient-centered approaches with strategies designed to strengthen healthcare systems may contribute to improved medication adherence and, consequently, reduce the clinical and economic burden associated with type 2 diabetes mellitus.

Strengths of the Study

This study has several methodological and scientific strengths that should be considered when interpreting its findings. First, widely validated and internationally recognized instruments were used to assess medication adherence (MMAS-8) and personality traits (BFI-44), enhancing the comparability of the results with those reported in studies conducted in other settings. Second, robust statistical procedures were applied, including bootstrap resampling with 5,000

iterations, estimation of bias-corrected confidence intervals, stratified cross-validation, and optimism correction. These approaches contribute to improving the stability of the estimates and reducing the risk of model overfitting.

Furthermore, the study incorporated a comprehensive evaluation of model performance through measures of discrimination (area under the receiver operating characteristic curve [AUC]), calibration (Brier score), and multicollinearity assessment, thereby strengthening the internal validity of the findings. In addition, sensitivity analyses using multinomial logistic regression were conducted to verify the consistency of the associations observed in the primary model.

From a scientific perspective, this study represents one of the first investigations conducted in Peru to specifically examine the relationship between Big Five personality traits and medication adherence among patients with type 2 diabetes mellitus. As such, it provides original evidence from a Latin American setting that remains underrepresented in the international literature and contributes to expanding current knowledge regarding the psychological determinants of treatment adherence in middle-income populations.

Limitations

The findings of this study should be interpreted in light of several limitations. First, the cross-sectional design precludes the establishment of causal relationships between personality traits and treatment adherence. Therefore, the observed associations should be understood as statistical relationships rather than evidence of causality.

Second, the use of convenience sampling in a single regional hospital may limit the generalizability of the findings. Furthermore, although internal validation procedures, including bootstrap resampling and cross-validation, were employed, the number of patients with optimal adherence was relatively small compared with the number of predictors included in the multivariable model. In addition, the categorization of personality traits into tertiles may have resulted in some loss of information compared with the use of continuous scores.

Finally, although the models were adjusted for age, sex, and disease duration, detailed information on other potentially relevant factors was not available, including depressive symptoms, anxiety, social support, health literacy, socio-economic status, and the quality of the physician–patient relationship. These variables may act as confounders or mediators in the relationship between personality traits and medication adherence.

Despite these limitations, the consistency of the observed findings, together with the use of internal validation procedures, bootstrap resampling, and sensitivity analyses, enhances the robustness of the results and provides a useful foundation for future longitudinal and multicenter studies aimed at confirming these associations in larger and more diverse populations.

Future Research Directions

The findings of the present study open several avenues for future research. First, longitudinal studies are needed to assess the temporal stability of the observed associations and to establish more precisely the causal direction between personality traits and medication adherence. Such designs would help determine whether specific personality characteristics predict future changes in adherence behaviors or whether the long-term experience of living with a chronic disease influences certain psychological traits.

Second, replication of these findings in larger, multicenter, and more representative samples from different regions of Peru and other Latin American countries is warranted. This would allow researchers to evaluate the consistency of the identified associations and to explore the influence of sociocultural and contextual factors on the relationship between personality and treatment adherence.

Future studies should also incorporate psychological and social variables that may act as mediators or moderators, including depression, anxiety, diabetes-related distress, social support, health literacy, self-efficacy, resilience, and the quality of the physician–patient relationship. Integrating these factors would facilitate the development of more comprehensive explanatory models of the mechanisms linking personality traits to self-care behaviors.

Another promising line of research involves evaluating personalized interventions based on personality profiles. Experimental or quasi-experimental studies could determine whether strategies tailored to specific personality characteristics, such as low conscientiousness or high extraversion, are more effective in improving adherence and clinical outcomes than standardized interventions.

Finally, future investigations could combine subjective and objective measures of adherence by incorporating pharmacy dispensing records, electronic medication monitoring systems, biochemical indicators, or data derived from digital health technologies. Such an approach would help reduce the biases inherent in self-reported measures and provide a more accurate assessment of medication adherence among patients with type 2 diabetes mellitus.

Conclusion

In this sample of patients with type 2 diabetes mellitus receiving care at a public hospital in southern Peru, higher levels of conscientiousness and agreeableness were independently associated with a greater likelihood of optimal medication adherence, whereas higher levels of extraversion were associated with a lower likelihood of optimal adherence. No statistically significant associations were observed for neuroticism or openness to experience.

These findings suggest that specific personality traits represent relevant psychological factors for understanding medication adherence behaviors among individuals with type 2 diabetes mellitus. In particular, conscientiousness and agreeableness emerged as characteristics associated with better adherence, even after adjustment for relevant sociodemographic and clinical variables.

The results support the incorporation of person-centered approaches into chronic disease management programs and suggest that the assessment of relatively stable psychological characteristics may complement traditional strategies aimed at improving adherence. Nevertheless, adherence should be understood as a multidimensional phenomenon shaped by the interaction of psychological, social, and structural factors, including access to healthcare services, continuity of care, and family support.

Given the cross-sectional nature of the study, longitudinal and multicenter investigations are needed to confirm these associations and to evaluate the potential of personality-tailored interventions to improve medication adherence and clinical outcomes among patients with type 2 diabetes mellitus.

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