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Investigating the Influence of Personality Traits on Medication Adherence: A Cross-sectional Study

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ABSTRACT

Medical advancements have revolutionised healthcare, yet patient adherence to medication and healthcare provider instructions remains a major challenge. Non-adherence severely affects patients' prognosis, hindering their health improvement. It's crucial to understand the complex factors influencing adherence, including patient behaviour, socioeconomic conditions, and healthcare providers' guidance. This study evaluated medication adherence in 178 adult patients with chronic diseases in community pharmacies. These patients completed the questionnaires (adherence to Refills and Medications Scale; Big-Five Factor Markers). The mean value of patients' adherence to medication was 17.17. The findings showed that disease type and patients' personality traits significantly impacted adherence. Autoimmune patients and those with high conscientiousness (personality type 3) displayed better adherence. Suggested solutions for increasing adherence could include the use of daily/weekly pill cases, detailed instructions from healthcare professionals, and smart device reminders. These findings underscore the need for tailored interventions that consider individual patient characteristics to improve medication adherence and patient outcomes.

1. Introduction

In healthcare, one significant obstacle that can hinder optimal effectiveness of the treatment is patients' non-adherence to medication treatment.[1] In chronic diseases, adherence encompasses

more than just the medication intake. It involves multiple behaviours, such as maintaining a healthy diet, engaging in regular exercise, attending medical appointments, and more.[2] These interconnected behaviours have a profound impact on patients' overall health and well-being. The question arises as to why patients may struggle with adhering to their prescribed medications and instructions. The term "compliance" itself implies a patient's strict obedience to the instructions and medication, often without considering their perception, understanding, and acceptance of the situation. For this reason, the term "compliance", according to the World Health Organization (WHO), has been replaced by the term "adherence", where patients are in control of their medication behaviour and interact and communicate with healthcare professionals.[3] Therefore, many studies are being conducted on finding methods to assess patient's non-adherence, as it is important to identify the reasons leading to this fact and eventually find methods to improve adherence.

Unfortunately, the potential of this issue has not been fully elucidated yet and if more attention is given to patient's adherence, along with the right medication regimen, then this could potentially lead to a significant improvement in patient healthcare. This will increase patient's quality of life as well as the prevention of anything unexpected that arises during treatment. Moreover, healthcare professionals must not only prescribe medications, but also provide clear instructions on their proper usage and administration. Gil-Guillen et al. conducted a review categorizing the risk factors associated with non-adherence.[4] The data were obtained from the fields of rheumatology, oncology, and cardiology, with the objective of identifying common factors and potential interventions to improve adherence. Therefore, apart from dispensing, a healthcare professional is also obliged to define the state of patient's health and assure the accurate medication reception, creating an understanding and trustful environment towards the healthcare professional and the treatment regimen.[5] Proper guidance to the patient on the importance of medication and proper administration is crucial in preventing confusion and misconceptions that may lead to non-adherence. This responsibility lies mainly on pharmacists and nurses who should accurately and clearly explain to the patient the dosing regimen changes, the importance of every medication, and their potential side effects.[6] A critical factor in improving medication adherence is patient's and family members' education provided by healthcare professionals. A recent study focusing on patients with multiple sclerosis (MS) discovered that medication adherence training based on the Theory of Planned Behaviour yielded noteworthy improvements in knowledge, attitudes, norms, intention, control, and performance.[7] In addition, comprehensive monitoring of the patient's medication regimen has been found to improve adherence and overall health status, highlighting further the importance of proper communication, and monitoring in achieving successful treatment outcomes.[8]

Properly assessing the patient's adherence to medication is crucial to identify the reasons for reduced adherence that may deteriorate the disease and find ways to improve it in order to increase the patient's quality of life.[9] Two types of methods are available to monitor and assess adherence: direct and indirect.[10,11] Direct methods of measuring patient's medication adherence include analysing drug levels in body fluids, monitoring biomarkers influenced by the drug, and observing drug intake. However, these methods, although precise in controlled environment, can be impractical and cost-prohibitive for daily use. Furthermore, they do not provide an assessment of adherence rates and may be influenced by underlying diseases and genetic factors. Electronic Medication Packaging Devices offer a potentially more objective and accurate approach by recording daily doses and offering audiovisual reminders.[12,13] Indirect methods include simple questions, questionnaires, dose counting, patient reports, and repetitive prescriptions.[11,14,15] Simple questions are subjective and unreliable, as patients may overestimate their adherence or try to convince healthcare providers that they are taking their medication correctly. Dose counting can assess whether patients receive daily doses and adherence can also be assessed through patient interviews and note-taking.[16] The common aspect of these methods is subjectivity, as the answers in all cases are

based on the patient's judgment, and the assessment of the level of adherence is to a general extent, not an accurate measurement. However, the significant advantages of electronic medication packaging devices, including their simplicity, low cost, and immediate availability of results, make them a crucial tool in clinical practice.[15,17,18]

Patient's adherence to medication is influenced by a variety of factors, including demographic characteristics, socioeconomic status, and medication-related factors.[19] Socioeconomic factors, such as education, marital status, and insurance coverage, as well as demographic characteristics, like age and race, can all impact a patient's adherence to medication. [20,21] Patients with neurological conditions, such as depression or dementia, also have a lower adherence rate due to reduced cognitive function. Adherence is also affected by treatment factors, such as polypharmacy, duration, and adverse effects, which can lead to a non-flexible dosing regimen and discontinuation of treatment.[22] The healthcare system plays a crucial role in ensuring patient's adherence, with mutual trust and communication between the patient, healthcare professionals and pharmacists.[11,20,23] Finally, in addition to the aforementioned factors, patients' personality appears to play a pivotal and primary role in determining their adherence to medication.

Personality traits are characteristics that define the way individuals interact with the world around them. These traits can provide valuable information about the best method of communicating with people and the types of jobs and tasks they are best suited for. However, personality traits can also be key indicators of other aspects of a person's life, such as innovativeness and life satisfaction. The Big Five Personality Traits theory is widely used and dominant as a theory to this day. It was proposed in 1999 by Robert McCrae and Paul Costa Jr and is based on the 35 bipolar clusters of terms related to personality traits developed by Cattell (1943) and the classic Myers-Briggs Type Index (MBTI), adding an important fifth trait of personality trait, namely neuroticism or emotional stability, which is a key domain predicting depression and anxiety disorders. The Big Five Personality Traits model includes extraversion, agreeableness, conscientiousness, openness to experience, and neuroticism. OCEAN is a common acronym.[24–26]

Extraversion refers to the extent to which individuals interact with the external world and experience excitement and positive emotions, while Agreeableness is the extent to which individuals value cooperation and social harmony. Conscientiousness is the extent to which individuals value planning, possess the quality of persistence, and are achievement-oriented. Openness to experience is the extent to which individuals are receptive to new ideas, emotions, and experiences. Finally, Neuroticism is the extent to which individuals experience negative emotions, such as anxiety, depression, and mood swings. Several aspects and ranges from high to low on a spectrum of characteristics distinguish each trait.[27]

The study aims to estimate the adherence rate of patients receiving long-term medication, for chronic diseases, in private community pharmacies, evaluate their personality characteristics and study the possible correlation between demographic characteristics and personality with adherence rates. Additionally, the study aims to explore other variables, such as the cost of drugs and the behaviour of healthcare professionals, to find any correlation with medication adherence. Statistical methods were used to analyse the data.

2. Materials and Methods

A cross-sectional study was conducted to recruit patients from private community pharmacies in three Greek cities including the capital city. Adult patients who were receiving long-term medication for chronic diseases and Greek spoken were included in the study. Patients with dementia and severe mental disorders were excluded. The study was conducted in the community pharmacies after the permission of the pharmacists. The participants were recruited between May 2022 and January 2023. They were approached through the pharmacists at the local pharmacies where they are supplied their medications for chronic diseases.

Adherence to Refills and Medications Scale

(ARMS): Kripalani et al. developed the ARMS, which initially drew inspiration from the Morisky and Hill-Bone questionnaires.[28] The original questionnaire consists of 12 questions that assess medication adherence. Each item follows a Likert scale format, where respondents choose from options such as "none," "some", "most" or "all the time". Each item was scored on a 5-point Likert scale. Permission to use the ARMS questionnaire in Greek was obtained.

50 question IPIP questionnaire: The 50-question IPIP questionnaire is designed to assess the Big Five Personality Traits - Extraversion (Type 1), Agreeableness (Type 2), Conscientiousness (Type 3), Neuroticism (Type 4), and Openness to Experience (Type 5) and their facets. It consists of a series of statements or items that respondents rate on a Likert scale, indicating the extent to which they agree or disagree with each statement.[29] Permission to use the questionnaire in Greek was obtained. The questions of this part aimed to determine the extent to which personality traits influenced medication adherence.

In the present study, a questionnaire-based interview, conducted in Greek, and consisted of three parts. The **first part** aimed to gather information on the sample's demographic characteristics, such as gender, age, marital status, education level, occupation and medication profile, including the disease, the number of different types of medicines taken daily and the duration of medication. These questions were designed to determine the extent to which demographic characteristics and disease influence medication adherence.

Additionally, the participants were asked about proposals that could potentially help them adhere to their medication, such as using daily or weekly pill cases, smart device reminders, home care, detailed instructions from their doctor or pharmacist and reduced drug prices. The **second part** of the questionnaire employed the Adherence to Refills and Medications Scale (ARMS) questionnaire.[28] Finally, the **third part** used the "50 question IPIP questionnaire" (Big-Five Factor Markers).[29]

Questionnaire is divided in two categories adherence and personality. The category of adherence consists of 12 questions, while the category of personality consists of 50 questions. Cronbach alpha value is 0.86 in ARMS adherence category and 0.87 in IPIP personality category, which corresponds in high reliability of questionnaire. These indicators were consistent with others in the literature.[30]

For statistical data-analysis, parametric and non-parametric methods such as t- test, Wilcoxon test, Chi-square test, Fisher exact test, Anova, Pearson correlation test, Ordinal logistic regression, Logistic regression were used. The reliability of the questionnaire was assessed independently, in each category (adherence, personality), with statistical criterion Cronbach alpha, which is the most common measurement of internal consistency. Statistical analysis of the data conducted with statistical package R (www.r-project.org, v3.6.2), while the level of statistical significance defined as 0.05.

The Research Ethics Committee of the University approved this study (Registration number: EI-2103). All participants understood the study purpose and process before participating in the study and filling out the informed consent. All collected data were anonymous and only members of the research team had access to them. The data collected was solely used for research purposes.

3. Results and Discussion

None of the common methods of measuring adherence, direct or indirect, are ideal, since each of these have their limitations, whereas the perfect method should be reliable, practical, of low cost, easy to use and manageable. Taking into account these considerations, the current study adopts a practical and straightforward approach through the use of questionnaires. However, these questionnaires are not self-completed, but are filled, by the pharmacist, after discussion of the patient's missed doses, feelings, and direct measurement values, such as blood pressure and sugar, along with next prescription planning and more. The questionnaire considers not only the patient's demographic characteristics and medication-related factors, but also their personality traits, which is considered as a critical factor. **Ta-**

Table I. Demographic characteristics and medication profile.

VARIABLE	Frequency	Proportion (%)
Demographic characteristics		
GENDER		
Man	79	44.4
Woman	99	55.6
AGE		
18-35	39	21.9
36-50	41	23.0
51-65	48	27.0
>65	50	28.1
MARITAL STATUS		
Divorced	12	6.7
In relationship	14	7.9
Married	95	53.4
Unmarried	36	20.2
Widow/er	21	11.8
EDUCATION LEVEL		
Compulsory education	24	13.5
Secondary education	45	25.3
College /technical school	25	14.0
University	60	33.7
Master/PhD	24	13.5
OCCUPATION		
State employee	17	9.6
Private employee	35	19.7
Self-employment	36	20.2
Retired	56	31.5
Unemployee/Student	26	14.6
Housekeeping	4	2.2
Other	4	2.2

Medication profile		
NO OF MEDICATION		
1	56	31.5
2	41	23.0
3	30	16.9
4 or more	51	28.7
DISORDERS		
Cardiac disorders	97	54.5
Respiratory disorders	27	15.2
Hormone disorders	83	46.6
Neurological disorders	42	23.6
Autoimmune.disorders	29	16.3
Cancer	9	5.1
Chronic pain	19	10.7
other	31	17.4
YEARS ON MEDICATION		
< 2 years	42	23.6
2-5 years	48	27
> 5 years	88	49.4

ble I provides an overview of the demographic characteristics and medication profile of the sample. The dataset consists of 178 adult patients, from private community pharmacies, receiving long-term medication, for chronic diseases, with an age range of 18-92 years and a mean age of 51.8 years.

The primary objective of this study was to evaluate patients' adherence to medication. In this study, the average adherence score was 17.17. A score 12 indicates perfect adherence, while scores greater than 12 indicate lower adherence. Among the participants, 17.4% had perfect adherence, while 82.6% did not. The average value of adherence as continuous variable had mean value 17.17 (min=12, max=38). 17.4% (31 out of 178) of the sample reported perfect adherence (score=12), while the remaining 82.6% (147 out of 177) reported lower adherence (score>12).

The adherence values observed in this study align with previous research results that utilised the same measurement tool (ARMS) for assessing adherence across various diseases, including diabetes mellitus, hypertension and more. For instance, similar adherence rates were found in studies conducted in Qatar and Belgrade, which investigated medication adherence among patients with uncontrolled diabetes and those taking antiparkinsonian medication, respectively. As such, the study conducted by Jaam et al. (2018)[31] in Qatar investigated medication adherence among patients with uncontrolled diabetes and found that 73.0% of participants did not exhibit perfect adherence. Similarly, another study by Radojević et al. (2022)[32] conducted in Belgrade explored

Table II. Types of personality scores**.**

Variable	Mean	Median	Min	Max
Personality 1	30.70	30	11	50
Personality 2	38.75	40	21	50
Personality 3	36.29	38	14	50
Personality 4	28.81	29	11	49
Personality 5	33.20	34	14	50

Table III. Correlation of Adherence and Personality type.

Adherence	> 12	= 12
Mean Personality 2	38.73	41.23
Mean Personality 3	35.28	42.39
Mean Personality 5	32.91	36.1

Correlation	Personality 2	P-Value
Personality 3	0.27	< 0.001
Personality 5	0.34	< 0.001

Table IV. Proposals about adherence.

Proposals	Frequency	Proportion (%)	p-value
A. Daily or weekly box pills			
Total (N=178)	94	52.8	
>12(N=147)	84	57.1	0.01
=12(N=31)	10	32.3	
B. Reminder in a smart device			
Total (N=178)	91	51.1	
>12(N=147)	78	53.1	0.38
=12(N=31)	13	41.9	
C. Home care			
Total (N=178)	17	9.6	
>12(N=146)	15	10.2	0.74
=12(N=31)	2	6.5	

D. More detailed instructions from their doctor/pharmacist			
Total (N=178)	92	51.7	
>12(N=147)	76	51.7	0.07
=12(N=31)	10	32.3	
E. Price reduction			
Total (N=178)	102	57.4	
>12(N=147)	85	57.8	0.84
=12(N=31)	17	54.8	

patient adherence to antiparkinsonian medication and identified factors influencing adherence in Parkinson's disease patients. The study reported a mean adherence value of 14.9, with 74.1% of patients exhibiting low adherence and none achieving perfect adherence (value of 12). Patients with both Parkinson's disease and depression demonstrated significantly lower adherence compared to Parkinson's disease patients without depression. These findings indicate the importance of effective medication management and planning for patients and the effect of mental and psychiatric condition of the patients on their adherence. Additionally, the study suggests that individual personality traits might influence medication adherence. These adherence scores are also relevant to another recent 12-item Arabic version of ARMS with 17.93 and good consistency,[33] and slightly increased than another one in Korea with 15.53 for patients with type 2 diabetes.[34] ARMS seems to be a more appropriate tool for the adherence evaluation on medication, especially for the elderly and patients, institutionalised or not, with chronic multipathological conditions.[35,36]

Jin et al.[37] examined how functional health literacy (FHL) affected medication adherence among elderly patients in South Korea. Their study revealed that 47.5% of participants achieved perfect adherence, indicating that factors such as education level, diseases, dosing frequency and satisfaction, with patient counselling and medication analysis, played role in influencing adherence. Nita et al.[38] aimed to assess the adherence of elderly patients with chronic diseases (hypertension, diabetes, asthma, etc.), in Indonesia, using the ARMS scale. The study revealed that 88.3% of patients had low adherence. In a study conducted by Lomper et al.[39], a Polish version of the ARMS (ARMS-P) was developed to assess adherence levels among the hypertensive population in Warsaw. The study reported an average adherence value of 19.7. Similarly, Park et al.[40] conducted research in South Korea to examine medication adherence and related factors among elderly individuals, living alone with chronic diseases. In their study, the average adherence score was calculated to be 16.08. In Indonesia, where the prevalence of diabetes mellitus is steadily rising, a study conducted by Andanalusia et al.[41] examined the adherence of patients to their antidiabetic medication. The study reported a mean adherence value of 19.52, indicating a moderate level of adherence. Only 8.3% of the sample demonstrated perfect adherence, while the remaining 91.7% exhibited imperfect adherence. Our results are in accordance with this study's results, as far as the adherence of the patients on their therapeutic pharmaceutical regimen is concerned, including most of the major chronic conditions and diseases and the overall adult age range.

In our study we also examined whether demo-

graphic characteristics such as gender, age, marital status, level of education, profession, number of medicaments, years of medication intake and assistance in taking medication had a statistically significant correlation with medication adherence. The results showed no significant association between these parameters and medication adherence. These results are in accordance with other recent studies, with no statistically significant correlation between the adherence and the age, sex, education level and years of pharmaceutical treatment.[40,42] However, in this study a significant correlation was found between personality characteristics or the type of disease and adherence, since among the diseases, autoimmune disease patients demonstrated the greater adherence (9 out of 29) compared to those without such a disorder (p-value=0.02).

Concerning the different types of personality, a score in questions answered by the participants was calculated, which correspond in the specific type of personality. Mean score for personality 1 is 30.70, for personality 2 is 38.75, for personality 3 is 36.29, for personality 4 is 28.81 and for personality 5 is 33.20 (score equal to 50 corresponds to score that represents absolutely the specific type of personality) (**Table II**).

Moreover, statistically significant correlation was found between adherence and type of personality 2 (p-value=<0.001), personality 3 (p-value<0.001) and personality 5 (p-value=0.06). Personality types 2, 3 and 5 are statistically significantly correlated (personality 2 with 3 cor=0.27, p-value<0.001, personality 2 with 5 cor=0.34, p-value<0.001). Thus a model with adherence and personality types 2,3 and 5 was run and found out that statistically significant remains only the variable of personality type 3. Consequently, the correlation between adherence, and type 2 and 5, is secondary nominal correlation. Furthermore, adherence as a continuous variable has a statistically significant negative correlation only with personality type 3 (p-value<0.001, cor=-0.39), which means that as personality score increases, adherence score decreases (thus adherence is improved) (**Table III**).

Regarding conscientiousness (personality type 3), the positive correlation with adherence could be attributed to the fact that this group of patients is capable of understanding the importance of their treatment and the seriousness of their disease. This type may also be closely related to the health literacy of the patient, a factor that has been found to have a moderator effect on the relationship between adherence and medication concerns and illness perceptions.[43] Furthermore, in a secondary manner, personality types 2 and 5 gave improvement to the adherence rates, but only when conscientiousness intervened. These results are in accordance with Axelsson et al,[44] where adherence is related to conscientiousness and agreeableness and in case the former was low the adherence was decreased too, in irrelevant to agreeableness manner. However, this finding was not present in this study, since the majority of the patients had high level characteristics of personality type 3. In another study Hazrati and his colleagues[45] also found personality type 3 to be positively correlated with adherence factor; however the extraversion was found to be an independently positive factor as well.

The study has also investigated potential solutions to improve medication adherence. All participants who completed the questionnaire were asked if they would be helped from some proposals for more efficient intake of their medicines. Subsequently, the responses of the samples were divided into two subgroups (Adherence=12 and Adherence>12), and the results were analysed separately and compared (**Table IV**). Most patients consider the reduction in drug prices as the most crucial factor for their adherence. However, no difference was observed between patients with perfect and imperfect adherence in this regard. The majority of patients with imperfect adherence reported that the proposals concerning (A) daily or weekly pill cases, (B) reminders through electronic applications and (D) more detailed instructions from doctors/pharmacists would help improve adherence. These methods, which remind them to take their drugs, could be highly beneficial, particularly in cases where the number of drugs is increased, simplifying their dosage and treatment scheme.[19] Moreover, the more analytical and detailed instructions from healthcare professionals to the patient is another important factor that could improve the patient's adherence, according to their beliefs. The ad-

ministrative and commercial responsibilities within their respective work units consume valuable time for healthcare professionals, limiting their ability to fulfill their scientific role. This can result in a lack of communication with patients, which in turn can contribute to increased instances of drug abuse, undertreatment, and a higher frequency of observed adverse reactions. This could be prevented by adoption of a patient-centered care character of the provision of health services, giving analytical instruction to patients, and considering potent concerns of them, building a trustful relationship with the health instructor. This lack of adherence may also rely on the heavy schedule of the professionals, and towards the reversal of such, may be the involvement of the family doctor in every general health system or the establishment of advising services as a separate and autonomous part of the pharmacist profession. Indeed, a study by Hsu et al., showed that the most important health system related factors that facilitate adherence were the overall quality of pharmacy services, the availability of multiple systems for medication refills, the existence of a person available for communication, when questions or concerns arose, offering counselling on the importance of adherence, and the providing of tools such as pill boxes and up-to-date drug lists.[46]

While this research has potentially interesting findings, it is important to acknowledge some limitations. Patient recruitment was restricted to three main cities of the country, limiting the diversity of the sample. Additionally, although the sample size was adequate, it was relatively small for ensuring the safe generalizability of statistical findings. Future studies may assist towards the overcoming of these limitations.

4. Conclusion

Patient adherence was and remains a complicated and vital factor. Although, there are quite a few strategies for its improvement, healthcare professionals are sometimes, due to many reasons, unable to follow them. In this present work, it has been shown a moderate mean adherence rate, unrelated to the demographic characteristics, and the conscientiousness as an important independent factor for the adherence improvement. Among the conditions or diseases, people with autoimmune diseases had a high level of adherence compared to others, whilst simple adherence improvement methods, like daily or weekly box pills, reminder on a smart device and more detailed instructions from health professionals, seem to be able to increase the rates of adherence, signifying the remarkable importance of support, motivation and health literacy improvement, through a multidisciplinary approach that should be carried out with the support of all those involved in the prescription and the administration of drugs. □

Authorship statement

Concept – P.T.N., C.T.; Supervision – C.T.; Data Collection and/or Processing – E.C., K.K., E.A.,V.R. ; Analysis and/or Interpretation – K.K., E.A., C.T.; Literature Search – E.C., V.R.; Writing – E.C., E.A.; Critical Reviews – P.T.N., C.T.

Conflict of interest

The authors declare no conflict of interest.

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