

Measuring Medication Adherence in Chronic Diseases: The Psychometric Properties of Simplified Medication Adherence Questionnaire in Patients with Chronic Diseases in Rural Greece

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Abstract

Introduction: Medication adherence is one of the most important factors in the effectiveness of treatment, especially for patients with chronic diseases. This study aims to assess the adherence of patients with chronic diseases and investigate the parameters that influence it. It will also examine the psychometric properties of the SMAQ scale, a tool used to assess adherence.

Purpose: The study's main purpose was to assess the psychometric properties of the SMAQ scale, including its reliability and validity, to evaluate the adherence of patients with medication and to analyse the factors that shape it, focusing on the influence of gender, diagnosis, level of education, marital status, and living conditions.

Methodology: The study was based on a sample of patients with chronic diseases, such as cardiovascular diseases, rheumatoid arthritis, and systemic lupus erythematosus. The patient's compliance with medication was assessed using the SMAQ scale. Statistical analysis included chi-square analysis to examine the association between participant characteristics and compliance, while logistic regression analysis was also performed to assess the parameters that predict non-compliance.

Results: The chi-square analysis revealed significant associations between compliance and parameters such as gender, type of disease, level of education, and marital status. Men and patients with cardiovascular diseases showed better compliance. Logistic regression indicates that diagnosis is the most important factor in predicting non-compliance. Regarding the psychometric properties of the SMAQ, the scale showed satisfactory reliability with Cronbach's Alpha = 0.717 and stability (Intraclass Correlation Coefficient = 0.525). Confirmatory factor analysis (CFA) confirmed the unidimensional structure of the scale, with good fit values (CFI, TLI, GFI > 0.9).

Conclusions: The results of the study provide valuable data on the factors that influence the compliance of patients with chronic diseases. The diagnosis appears to be the most important predictor of non-compliance, while the evaluation of the SMAQ scale indicates that it is a reliable and valid tool for measuring compliance. The study highlights the need for strategies that will improve compliance, especially for patients with chronic diseases who may face psychological and social challenges. Limitations of the study include the sample size and the absence of data on other psychological parameters, such as mental health, which should be addressed in future research.

Keywords

Mental Health, Adherence, Patients with Chronic Disease, Rural Greece, Psychometric Properties, Simplified Medication Adherence Questionnaire

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Introduction

Treatment adherence, as well as the causes and consequences of non-adherence, has garnered significant research interest in the scientific community over the years. Many researchers focus on the concepts of adherence, compliance, persistence, and concordance as terms commonly used to describe a person's commitment to a therapeutic regimen (Sabaté, 2003; Sharif-Nia et al., 2024; Alikari et al., 2017). Treatment adherence refers to the extent to which an individual's behavior—such as taking medication, adopting a diet, and changing their lifestyle—aligns with the recommendations of a health professional and results from an agreement with the patient (Sabaté, 2003).

Adherence emphasizes the collaborative patient-physician relationship and the patient's participation in making decisions about their treatment. In contrast, compliance describes the patient's passive role, where they simply "follow the doctor's instructions," imparting a paternalistic character to the therapeutic relationship (Chakrabarti, 2014). The concept of concordance focuses on a more egalitarian relationship, where the patient and doctor work together to make mutually acceptable treatment decisions (Martin et al., 2005). The practice of adhering to a medication regimen for the entire recommended period is known as medication persistence, defined as "the duration of time from initiation to discontinuation of therapy" (Cramer et al., 2008). These constructs, however, are considered distinct rather than interchangeable (Cramer et al., 2008).

Adherence and concordance are seen as more modern terms, recognizing the importance of active patient involvement enhanced through effective communication with healthcare professionals. Conversely, compliance is now viewed as an outdated concept.

According to Burnier (2024), non-adherence in therapeutic regimens poses significant challenges in managing chronic diseases, resulting in poor disease control and increased risks of

complications. Factors such as complex medication plans, patients' limited understanding of their disease, and socioeconomic status influence adherence levels (Burnier, 2024; Romash, 2023). Nfor and Warri (2024), in a qualitative study, identified factors contributing to non-adherence among hypertensive patients. These included limited knowledge about the disease and its treatment, negative attitudes toward disease management, time constraints, lack of social support, and poor relationships with healthcare professionals (Nfor & Warri, 2024).

A systematic review by Gast and Mathes (2019) explored factors influencing adherence to medication for chronic conditions. The findings revealed that higher educational levels and employment positively correlate with adherence, while ethnic minority status, unemployment, and high drug costs negatively impact adherence, highlighting social inequalities in healthcare. Additional factors, such as age, disease duration, and treatment complexity, showed inconsistent results, while drug costs consistently had a negative effect. These results underscore the need for targeted interventions in vulnerable populations to improve adherence (Gast & Mathes, 2019).

While various methods exist to assess treatment adherence, self-reported measures are commonly used in healthcare settings. One such tool is the Simplified Medication Adherence Questionnaire (SMAQ), known for its simplicity and validity in clinical settings. The SMAQ quickly evaluates adherence, making it particularly suitable for time-constrained environments. It has demonstrated reliability and validity, with high sensitivity and specificity in detecting non-adherence based on patient self-reporting (Knobel et al., 2002).

SMAQ evaluates various aspects of adherence, including missed doses (intentional or unintentional), medication timing, dosage changes, and subjective compliance assessments. Its multidimensional approach enables its application across diverse populations and conditions, facilitating comparisons and customization to individual needs. Moreover, it

serves as a risk detection tool, aiding clinicians in identifying patients with low adherence and implementing tailored interventions. SMAQ's importance lies in enhancing adherence, a critical factor for successful treatment in chronic diseases requiring long-term medication use (Agala et al., 2020; VATREN et al., 2011).

Purpose

Despite extensive international research on medication adherence, data on patients with chronic conditions in rural areas of Greece remain limited. Therefore, the purpose of this study is to examine the psychometric properties of a Greek-adapted SMAQ in patients with chronic diseases and identify demographic factors associated with treatment adherence.

Methodology

Study setting and participants

From January 2024 to August 2024, individuals suffering from cardiovascular or rheumatic disease located in Trikala and Heraklion took part in an anonymous survey using the convenience sample approach. Inclusion criteria were to have a diagnosis of one of the diseases, be able to read and speak Greek and be free of serious mental health disorders.

Data collection

Data were collected via an anonymous questionnaire consisting of two parts:

The first part contained questions regarding demographic and clinical characteristics such as gender, age, diagnosis, etc.

The second part was the simplified medication adherence questionnaire. The Simplified Medication Adherence Questionnaire (SMAQ) is a tool that assesses patients' adherence to their medication therapy, providing a quick and easy way to assess compliance, particularly in chronic diseases such as HIV, diabetes, and hypertension. It consists of 6 questions that focus on missed doses, frequency of missed doses, changes in dosage, difficulty in taking medication at specific times, recent missed doses, and subjective assessment of compliance. Responses are typically binary (Yes/No), and even a single negative indication (e.g., missed dose or change in dosage) can classify the patient as non-compliant. The SMAQ has the advantage of being quick and easy to administer, understandable by patients with low educational levels, and suitable for use in time-constrained settings. However, it depends on the honesty of the responses, is less detailed than other tools, such as the Morisky scale, and can be influenced by socially desirable

responses. It is used both in clinical studies and in daily clinical practice to detect patients who need more support (Agala et al., 2020; VATREN et al., 2011).

The translation and cultural adaptation process

Adhering to WHO's guidelines (WHO, 2012) the translation and cultural adaptation of the SMAQ involved several stages. Initially, two independent bilingual translators, both healthcare professionals, translated the English version into Greek. These translations were then merged and revised by a third translator to create a single Greek version. This Greek version was then translated into English by two separate individuals who were proficient in English. The resulting English versions were combined into a single version by a third translator. This final English version was administered to ten patients diagnosed with one of the mentioned diseases, and the cognitive interview method was employed. During this process, patients shared whether they encountered any confusing or challenging aspects. Generally, nine out of the ten patients reported no such issues.

Statistical analysis

Descriptive and inferential statistics are applied to this study. The data was examined using descriptive statistics (frequency, mean values, and standard deviations) and inductive statistics to address all the research questions. Analyses of variance (ANOVA), independent t-tests, spearman and Pearson correlation, regressions, internal consistency (Cronbach's coefficient), and confirmatory factor analyses were carried out using SPSS26.0 and JASP. The significance level was set to $p \leq 0.05$

Ethics

The study was approved by the ethics committee. Participants were approached by the researchers, who provided them with the necessary information, assured them of their anonymity, and clarified that they could withdraw from the study at any time.

Results

Most of the sample comprises females (73.1%) and participants diagnosed with cardiovascular disease (53.8%). Over half of the participants are married (55.0%), and most live with others (69.9%). The study includes a notable proportion of individuals with rheumatoid arthritis (28.5%) and widowed individuals (28.1%), reflecting diverse living arrangements and social statuses among the sample. Detailed participants' characteristics are presented in Table 1

Over half (54.8%) are reporting that consistently take their medication on time, but 54% have discontinued medication when feeling unwell, and 57.2% have forgotten doses. Most participants (77.9%) missed a dose 1-2 times in the past week, and 58.4% have never forgotten

medication during weekends. Regarding adherence in the past three months, 83.5% missed medication up to two times, while 16.5% missed it more than twice

Table 1. Participants Characteristics

Variable	Group ¹	N	Percentage
Gender	Male	67	26.9
	Female	182	73.1
Diagnosis	Rheumatoid Arthritis	71	28.5
	Systemic Lupus Erythematosus	44	17.7
	Cardiovascular Disease	134	53.8
Marital Status	Single	25	10.0
	Married	137	55.0
	Divorced	17	6.8
	Widowed	70	28.1
Living arrangement	alone	75	30.1
	Cohabited	172	69.9

Considering that, according to the SMAQ scoring system, a patient is classified as non-adherent if they report missing even a single dose of medication, the adherence rate in our sample is 27.2%. Detailed statistics are presented in Table 2.

Reliability analysis of the SMAQ

The test-retest method was applied to explore the test-retest repeatability of the SMAQ. Twenty-five patients completed the questionnaire at baseline and two weeks later.

Table 2. Participants' Medication Adherence Behaviors

Items	Responses	N	Percentage
Do you always take your medication at the appropriate time?	YES	137	54.8
	No	113	45.2
When you feel bad, have you ever discontinued taking your medication?	YES	135	54
	No	115	46
Have you ever forgotten to take your medication?	YES	143	57.2
	No	107	42.8
In the LAST WEEK, HOW MANY TIMES did you fail to take your prescribed dose?	Never	5	2
	1-2 times	194	77.9
	3-5 times	44	17.7
	6-10 times	5	2
	More than 10 times	1	0.4
Have you ever forgotten to take your medications during the weekend?	No	146	58.4
	Yes	104	41.6
In the past 3 months, how many days did you not take your medication at all?	up to two times	208	83.5
	More than two times	41	16.5

This interval is interposed so that the individuals do not recall their answers. Upon the analysis, significant correlations were observed between the two-administration ($p < 0.001$) facts (Intraclass Correlation Coefficients = 0.525) that reveal that the scale is stable through time. In addition, Cronbach's Alpha had a value of 0.717 suggesting acceptable internal consistency of the scale. Moreover, the value of Cronbach's Alpha will not increase if the scale discarded items. All items exhibited strong correlations to the total score. This fact adds to the excellent internal consistency of the scale.

Construct validity of SMAQ

Finally, we performed a CFA to test the one-factor structure of the scale. Regarding CFA, the model tested was equivalent to the original factorial structure of the SMAQ as proposed by other authors. The model presented a reasonably good fit to the data. Tucker-Lewis index (TLI) was near 0.9, comparative fit index (CFI) and goodness of fit index (GFI) were above 0.9 and standardized root mean square residual (SRMR) was 0.075 and lower than 0.10. Overall, our CFA confirmed the unidimensional structure of the scale.

Bivariate analysis

The results in Table 3 summarize the association between patient characteristics and treatment adherence, as assessed by chi-square tests. Gender, type of disease,

educational status, marital status, and living arrangements were significantly associated with adherence. Male patients and those with cardiovascular disease were more adherent, while lower adherence was observed among those with rheumatoid arthritis lower educational levels, and individuals living alone.,

Logistic Regression analysis

The logistic regression model examines predictors of non-adherence to treatment, considering factors such as gender, age, education, marital status, living arrangement, and type of disease. Among the variables analyzed, type of disease showed a statistically significant association with non-adherence to treatment ($p < .001$), with a negative estimate indicating reduced adherence for certain disease types. Other factors, such as gender, age, education, marital status, and living arrangements, were not statistically significant predictors ($p > 0.05$). Detailed information is presented in Table 4.

The table 4 includes parameter estimates, standard errors, z-values, Wald statistics, confidence intervals, and p-values for each variable. Non-adherence is coded as class 1. Confidence intervals reflect the range of effect estimates at a 95% confidence level.

Table 3: Chi-Square Results on Adherence to Treatment and Patient Characteristics

		Adhering to treatment	Not adhering to treatment	Chi-Square	p-value
Gender	Male	26	41	6.103	0.013
	Female	42	140		
Type of Disease	Rheumatoid Arthritis	1	70	65.812	< 0.001
	Systemic Lupus Erythematosus	2	42		
	Cardiovascular Disease	65	69		
Educational	Classes in primary school	16	32	34.068	<0 .001
Status	Primary school	26	22	16.936	<0 .001
	Junior High school	8	13		
	High school	11	43		
	University	6	61		
	Postgraduate	1	10		
Marital Status	Single	4	21	16.936	<0 .001
	Married	28	109		
	Divorced	4	13		
Living arrangement	Widowed	32	38	7.114	0,008
	Alone	29	46		
	Cohibated	39	136		

Table 4. Logistic regression analysis predicting non-adherence to treatment.

	Estimate	Standard Error	z	Wald Statistic	95% Confidence interval		p
					Lower bound	Upper bound	
<i>(Intercept)</i>	8.688	2.281	3.808	14.503	4.216	13.159	< .001
<i>Gender</i>	0.207	0.399	0.517	0.268	-0.576	0.990	0.605
<i>Age</i>	0.005	0.021	0.242	0.058	-0.036	0.047	0.809
<i>Educational Status</i>	-0.180	0.153	-1.182	1.396	-0.480	0.119	0.237
<i>Marital Status</i>	-0.266	0.246	-1.083	1.172	-0.749	0.216	0.279
<i>Living arrangement</i>	-0.017	0.446	-0.038	0.001	-0.891	0.857	0.970
<i>Type of disease</i>	-2.704	0.682	-3.965	15.722	-4.041	-1.367	< 0.001

Non-Adhered coded as class 1.

Discussion

Interpretation of Findings

The results of our study show that medication adherence is strongly influenced by disease type, as demonstrated by both correlations and logistic regression. Patients with rheumatoid arthritis and systemic lupus erythematosus are more likely to be non-adherent, highlighting the need for targeted interventions in these groups. In addition, low education and living alone emerged as important factors associated with non-adherence. These findings reinforce the literature on the need for an individualized approach to patient support.

The sample of our study has high heterogeneity in terms of diagnosis, marital status, and living conditions, a fact that strengthens our results. Despite the heterogeneity in our study most participants were women (73.1%) and were diagnosed with cardiovascular disease (53.8%), reflecting the prevalence of these diseases and the participation of women in relevant studies. Notara, Kokkou, and Panagiotakos (2024) discuss the prevalence of cardiovascular disease in women and highlight that women's cardiovascular health is often neglected in scientific research, with women being underrepresented in relevant clinical trials.

This has led to a lack of understanding of the specific risks faced by women, which are influenced by factors such as pregnancy, menopause, and hormonal changes. The "Go Red for Women" initiative, also discussed in the article, emphasizes the need to strengthen prevention and awareness of cardiovascular diseases in women while promoting their participation in research. At the same time, the Hellenic Cardiological Society highlights that women face increased risks after menopause due to increased lipids and cholesterol, while conditions such as preeclampsia during pregnancy increase the risk of future heart disease. Representation of women in studies is crucial for improving treatment approaches, developing targeted prevention measures, and ensuring equal care regardless of gender (Notara, Kokkou, & Panagiotakos, 2024).

Despite the general consistency (54.8%) in adhering to the medication schedule, there is a high percentage of participants who have forgotten or skipped doses, especially during difficult times (57.2% missed doses, 54% stopped medication when feeling unwell). Prabahaar et al. (2021) explored the factors influencing medication adherence in patients with chronic diseases in Tabuk, Saudi Arabia, emphasizing the challenges that patients face in managing their treatment regimens. From the

total of 208 participants 159 (76.44%) participants were adherent to their medications and nearly one-quarter of patients were nonadherent to their medications. According to their results, significant differences between male and female patients regarding their medication adherence were observed. A recent systematic review from Chen, Gao, and Lu (2024) suggests that patients' adherence to treatments is influenced by psychological and emotional factors, such as the perception of illness or the difficulties patients face during their difficult times (Chen, Gao, & Lu, 2024). This shows that adherence depends not only on the patient's habits but also on emotional and psychological states that can cause medication omissions or discontinuation. For example, while patients may have the intention to follow their prescription, factors such as the perception of the severity of the condition or emotional reactions to symptoms can be an obstacle to full compliance. This reinforces the importance of addressing not only the routine of taking medications but also the psychological aspects of the illness, to improve treatment adherence rates. The findings of the chi-square analysis in this study indicate that medication adherence is significantly associated with the gender, education, marital status, and living conditions of patients. Men and patients with cardiovascular diseases showed better adherence, while patients with rheumatoid arthritis and systemic lupus erythematosus showed lower adherence. Also, patients with lower levels of education and those living alone were more likely to not adhere to the medication schedule. These findings agree with other studies examining factors that influence medication adherence. According to the review by Gast and Mathes (2019), factors such as socioeconomic status, family support, and patient perception of treatment are determinants of adherence. Their studies suggest that patients with chronic diseases, such as hypertension and diabetes, are more prone to relapse and non-compliance with medication recommendations when social factors and family support are insufficient. The study by Al-Noumani et al. (2023) reinforces these findings, showing that social factors and family support are also important factors affecting compliance in patients with chronic diseases in Oman.

Patients with less family support had higher rates of non-compliance, which indicates the importance of family support in the management of chronic diseases. According to the research by Alikari et al. (2015), family support and social factors are also associated with compliance in patients undergoing hemodialysis. Their study showed that patients with better social support had better compliance, highlighting the importance of social support in enhancing medication adherence. Furthermore, the study by Alikari et al. (2015) is in agreement with the findings of the present study, as patients who live alone or have limited social support are more prone to non-adherence. Men, as also reported in the review by Gast and Mathes (2019), appear to be more likely to adhere to their medication regimen compared to women, highlighting the importance of gender as a factor in adherence. These results highlight the need to consider socioeconomic and psychological factors in developing strategies to promote medication adherence, particularly for patients with chronic diseases.

The results of the analysis of the stability and internal consistency of the SMAQ scale in the present study are encouraging. The Internal Consistency Coefficient (Cronbach's Alpha = 0.717) indicates good internal consistency of the scale, while the stability through Intraclass Correlation Analysis (Intraclass Correlation Coefficient = 0.525) is acceptable and confirms the reliability of the scale for repeated measurements at repeated intervals. These findings agree with other studies focusing on the validity and reliability of the Simplified Medication Adherence Questionnaire (SMAQ). The study by Knobel et al. (2002), for example, validated the SMAQ scale in patients with HIV, confirming the validity of the scale and its good consistency in a large group of patients. The authors found that the SMAQ scale was reliable in assessing medication adherence in these patients, which reinforces its suitability in other populations with chronic diseases. Ortega Suárez et al. (2011) also validated the SMAQ scale in kidney transplant patients receiving tacrolimus, highlighting the validity of the scale for use in different types of patients with different treatments. The results showed that the SMAQ scale was a good fit and

was reliable in assessing adherence in patients with kidney disease. Finally, the study by Soares et al. (2024) in Brazil validated a Portuguese version of the SMAQ scale in adults with hypertension and found that the scale also had high internal consistency and stability, confirming the general reliability of the scale in populations from different geographical areas and medical conditions. All these studies support the utility and reliability of the SMAQ scale for assessing medication adherence in diverse population groups, which strengthens its validity and use in the present study.

Strengths and Limitations

Strengths of the study include the reliability of the methodology, the variety of participant characteristics, and the use of reliable statistical tools, such as chi-square analysis and logistic regression. However, limitations include the size and homogeneity of the sample, the reliance on self-reported data, and the lack of data on other factors such as mental health or socioeconomic status (Gast & Mathes, 2019; Al-Noumani et al., 2023). Nevertheless, the findings enhance our understanding of the parameters that influence adherence and provide useful information for improving adherence promotion strategies in patients with chronic diseases.

Conclusions

The study findings indicate that patients' compliance with medication is influenced by important factors such as gender, diagnosis, level of education, and living conditions. Men and patients with cardiovascular diseases showed better compliance, whereas a diagnosis of rheumatoid arthritis or systemic lupus erythematosus was associated with lower levels of adherence. The results of the logistic regression analysis confirm that the type of disease is the strongest predictor of non-compliance. In addition, the use of the SMAQ scale proved to be reliable, offering a useful tool for assessing compliance. Despite the potential of the study, limitations such as sample size and the lack of data on other factors (e.g., mental health) limit the generalizability of the results.

Despite these limitations, the study provides valuable evidence for improving adherence in the treatment of chronic diseases.

Conflict of interest

The authors declare no conflict of interest.

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