Original Article

Factors predicting medication adherence among coronary artery disease patients in Saudi Arabia

A descriptive study

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ABSTRACT

الأهداف: قياس مدى الالتزام بالأدوية بين مرضى تصلب الشرايين التاجية وتحديد العوامل الاجتماعية والديموغرافية التي تنبئ بالالتزام بالأدوية.

المنهجية: أجريت دراسة مقطعيه باتباع إرشادات STROBE. أجريت الدراسة في مركز متخصص للقلب في المنطقة الغربية من المملكة العربية السعودية خلال الفترة من مارس 2019م ويناير 2020م. أكمل 278 مريضا الإستبانة الخاصه بالدراسة.

النتائج: أبلغ غالبية المشاركين (59.4%) عن التزام معتدل بالأدوية، وأفاد (30.6%) بالتزام ضعيف بالأدوية وما نسبته (10%) عن التزام جيد بالأدوية. وجدت الدراسة أن المرضى من النساء، والمرضى ذوي التعليم العالي، وغير المدخنين، والمرضى الذين يتابعون بانتظام مع طبيب القلب، والمرضى الذين لديهم دعم عائلي أظهروا التزامًا على بتناول الأدوية. أربعة من المتغيرات الاجتماعية الديموغرافية (الجنس، عدد زيارات الطبيب، دعم الأسرة، ومستوى التعليم) تنبأت بالالتزام بالأدوية.

الخلاصة: حوالي 30% من المشاركين أفادوا بضعف الالتزام بالأدوية. كان عدد زيارات طبيب القلب ومستوى دعم الأسرة عاملين من العوامل التي وجد أنها مرتبطة بالالتزام بالأدوية.

Objectives: To measure medication adherence among coronary artery disease (CAD) patients and identify sociodemographic factors that are medication adherence predictors.

Methods: A cross-sectional correlation design was carried out, following the STROBE guidelines. The study was carried out in a specialized cardiac center in the western region of Saudi Arabia between March 2019 and January 2020. A total of 278 patients completed the study survey.

Results: The majority of participants (59.4%) reported moderate medication adherence, and the remainder reported poor (30.6%) and good (10%) medication adherence. It was found that women patients, patients with higher education levels, non-smokers, patients who regularly followed-up with their cardiologist, and patients with family support showed significantly higher medication adherence. Four of the sociodemographic variables (gender, number of doctor visits, family support, and education level) predicted medication adherence.

Conclusion: Approximately 30% of the participants reported poor medication adherence. The number of cardiologist visits and the level of family support were 2 of the factors found to be associated with medication adherence.

Keywords: coronary artery disease, medication adherence, doctor visits, family support, Saudi Arabia

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Coronary artery disease (CAD) is a prevalent medical condition that impacts people all over the world. It is regarded as one of the primary causes of mortality and impaired functioning internationally. According to the World Health Organization (WHO), CAD is responsible for nearly 9 million fatalities annually, which represents 16% of all deaths worldwide.[1] The prevalence of CAD varies widely across different regions and countries. According to a systematic review and meta-analysis published in 2020, the estimated global prevalence of CAD was 7.2% in men and 4.9% in women.[2] While the highest rates have been documented in affluent nations, primarily in Western Europe and North America, the prevalence of CAD is

increasing in low- and middle-income countries due to rapid urbanization, lifestyle changes, and the aging population.[3,4]

In Saudi Arabia, CAD represents a noteworthy public health concern with high incidence rates. The incidence of CAD in Saudi Arabia was 220.89 cases per 10,000 people in 2019, which rose to 3030.52 cases per 10,000 people in 2020.[5] Approximately 5.5% of the population in Saudi Arabia is estimated to be affected by CAD, with slightly higher incidence rates observed in urban areas compared to rural regions.[6,7] According to the most recent WHO statistics published in 2020, there were 39,037 deaths in Saudi Arabia due to CAD in 2020, representing 29.1% of all deaths in the nation.[8] Hence, there is an urgent need for the healthcare system to adjust and improve health services to patients with CAD to address this health burden.

The worldwide burden of CAD is expected to increase due to population growth, aging, and changes in lifestyle factors. The emergence of CAD is strongly linked to particular lifestyle behaviors, including smoking, unhealthy diet, physical inactivity, and stress, as well as certain medical conditions such as hypertension, hypercholesterolemia, and diabetes.[9] However, non-adherence to medication may also be a crucial factor in the development of CAD. Medication non-adherence among CAD patients remains a significant challenge, with many patients failing to take their medications as prescribed. Medication non-adherence can lead to inadequate risk factor management, incorrect therapy escalation, poorer health outcomes, increased hospital readmissions, higher healthcare costs, and increased mortality rates.[10]

Medication adherence refers to how closely a patient follows the prescribed medication schedule, including medication timing, frequency, and dosage.[11] There is no universal agreement on what medication adherence level qualifies as "good" or the level that qualifies as "poor/non-adherence".[12] Traditionally, an 80% threshold has been used to categorize patients as either adherent or nonadherent, and Kleinsinger[13] defined medication adherence as a patient taking at least 80% of the medication doses prescribed by their doctor. In contrast, medication non-adherence refers to a patient's inability or unwillingness to follow the prescribed instructions for taking their medication, which may include taking less medication than prescribed or at incorrect times or frequencies.[14,15]

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Many CAD patients do not take their medications as prescribed, failing to follow the dosage, timing, or duration instructions provided by their doctors.[16] Hence, medication non-adherence contributes to worse health outcomes, higher healthcare costs, and greater resource utilization for these patients.[17] Several factors have been found to influence medication adherence among CAD patients, such as sociodemographic factors (namely, patient age, gender, and education level), the number of doctor follow-up visits, the level of family support, and smoking status.[11] The connection between age and medication adherence is intricate and multifaceted. While some studies have found that older age is associated with better medication adherence, others have reported the opposite.[18,19] Gender differences, on the other hand, might influence patient medication adherence.[20] Additionally, limited studies have examined the impact of the frequency of patients' follow-up visits to their healthcare provider (cardiologist) and how that could affect their medication adherence.[21] Also, the effect of family support must be examined to understand whether this could affect medication adherence. Finally, smoking can have a negative impact on medication adherence, as it can affect the efficacy and safety of medications.[22,23]

The 3 research questions addressed in this study were as follows: I) what is the level of medication adherence among CAD patients?; II) does medication adherence significantly vary with changes in any patient sociodemographic variables?; and III) does a patient's gender, age, level of education, frequency of doctor visits, smoking status, and level of family support explain medication adherence?.

We hypothesized that a patient's level of medication adherence is not related to their sociodemographic characteristics. Therefore, carrying out the study served 2 primary purposes. Initially, our aim was to assess the level of medication adherence among patients with CAD. Additionally, we intended to explore the correlation between sociodemographic factors and medication adherence and pinpoint variables that could serve as predictors of medication adherence.

Methods. The prior research articles that were published were retrieved from several research databases, including CINAHL, PubMed, and Google Scholar, to find related research that could support our study. Our search was limited to 5 years old published articles in peer review journals.

A cross-sectional correlation design was utilized. The research was carried out at a specialized cardiac center located in the western region of Saudi Arabia. The study

used a convenience sample of 278 patients diagnosed with CAD who were willing to participate and complete the study survey. The sample size estimation was based on Cohen's recommendation,[24] and the sample size was calculated using the G*Power software program using these parameters: effect size (f^2)=0.12, alpha=0.05, power=0.95, and number of predictors=6. Based on this method, the minimum sample size needed was 215 patients. The sample size was additionally increased by 15% to account for study attrition bias.

Only Middle Eastern adults aged 18 and older with a history of CAD, myocardial infarction, or stable angina for more than a year were included in the study. Also, participants had to be able to read and speak Arabic. Any patients with congenital heart disease were excluded because it could affect the validity of the results. Patients who had undergone bypass surgery or with cancer, end-stage heart failure, end-stage lung disease, or severe end-stage renal failure were also excluded. Similarly, any patients with mental disorders or abnormalities were excluded.

The study adgere to the principles of Helsinki Declaration. The study obtained ethical approval from the Institutional Review Board of Al-Madinah Al-Munawarah Cardiac Center, Saudi Arabia (approval no.: 2019R18). The survey included an informed consent statement at the beginning, which outlined the study's objectives and assured participants of the confidentiality of their data. The statement also clarified that the information gathered would solely be utilized for research purposes. All participants provided their signatures on the informed consent form.

Data were collected from patients visiting an outpatient cardiovascular clinics using a survey containing demographic questions and questions measuring patient medication adherence. The primary researcher and his research assistant distributed the survey to patients visiting the clinic between March 2019 and January 2020. The researcher and research assistant were available when patients needed assistance filling out the survey. Some patients were assessed by their relatives filling out the study survey.

The study survey has 2 sections. The first section contained items designed to collect information on sociodemographic variables, including the patient's age, gender, level of education, frequency of doctor visits (measured by the number of patient visits to their doctors), history of smoking, and family support. Patients were asked how many times per year they visited their cardiologist. Also, they were asked whether their family supported them in taking their medication. Family support includes reminding the patient regarding their medication, showing care to the patient, and encouraging the patient to visit their cardiologist.

The second section contained the 4-item Morisky medication-taking adherence scale (MMAS-4). The MMAS-4 is the shorter version of the MMAS-8, which researchers have used for more than 30 years to measure medication adherence among different patient populations.[25] The participants were asked whether they: I) had ever forgotten to take their medication; II) had a problem remembering to take their medication; III) had stopped taking their medication when they felt better; and IV) had stopped taking their medication when they felt their symptoms were worsening.[26] The validity and reliability of the MMAS-4 are well established with many studies confirming it has good validity and acceptable reliability (Cronbach's alpha=0.61).[25,27] Each patient's responses to the MMAS-4 items were used to classify their medication adherence as poor, moderate, or good. When a patient scored 4 out of 4 on the MMAS-4, this was considered good adherence. When a patient scored 2 or 3 out of 4 on the MMAS-4, this was considered moderate adherence. When a patient scored 1 or 0 out of 4 on the MMAS-4, this was considered poor adherence.[26]

Statistical analysis. The Statistical Package for the Social Sciences, version 27.0 (IBM Corp., Armonk, NY, USA) was used. The collected data were first examined for missing values, outliers, and the primary assumptions for statistical analysis. None of the primary or secondary assumptions were violated. Therefore, descriptive statistics, including mean and standard deviation (SD), were calculated to analyze the sociodemographic variables and the level of medication adherence among the study participants. Moreover, the t-test and a one-way analysis of variance (ANOVA) were applied to measure any differences between the sociodemographic variables and medication adherence. Finally, multiple linear regression was utilized to determine which sociodemographic variables could be used to predict medication adherence.

Results. This study included 278 patients diagnosed with CAD, and their mean age was 57 years. Most of the participants were men (75.8%) with university-level education (54.3%). Most of the participants visited their doctors twice yearly for checkups (32%). When asked regarding their smoking history, most reported no smoking history (53.2%), and 51.4% reported that they did not have family support during their CAD diagnosis (Table 1).

The participants' responses to the MMAS-4 items included in the study survey were used to determine

their adherence to their prescribed medication. The mean score for the MMAS-4 items was 2.12±1.08, indicating an overall moderate level of medication adherence among the CAD patients (Table 2).

Of all the participants, 59.4% were found to have moderate medication adherence, 30.6% had poor medication adherence, and 10% had good medication adherence (Table 2).

The results of the independent-samples T-test and the one-way ANOVA are presented in Table 3. Significant gender differences were found in terms of medication adherence, with women patients reporting higher levels of medication adherence (2.55±0.92) than men patients (1.9±1.09; t [276]=3.99, p<0.001). Moreover, patients who declared themselves non-smokers reported significantly higher medication adherence (2.24±1.06) than smokers (1.98±1.08; t [276]=2.00, p=0.046). In addition, patients who reported receiving family support showed significantly higher medication adherence (2.27±1.06) than those who reported receiving no family support (1.97±1.07; t [276]= -2.29, p=0.023).

A patient's level of education was found to play a significant role in their medication adherence (Table 2). The one-way ANOVA results revealed that education level significantly affected medication adherence, with F (2, 275)=3.74 and p=0.25. Moreover, the number of doctor visits reported by patients was found to significantly affect medication adherence. Patients who visited their doctor more than 3 times a year tended to have significantly higher medication adherence (F [2, 275]=2.52, p<0.001).

Table 1 - Demographic data of the study participants.

Variables	n (%)
Age (years), mean±SD	n=278, 57.0±12.9
Gender	
Male	208 (74.8)
Female	70 (25.2)
Level of education	
High school or less	107 (38.5)
University education	151 (54.3)
Higher education	20 (7.2)
Number of doctor visits in one year	
None	52 (18.7)
1	67 (24.1)
2	89 (32.0)
3 or more	70 (25.2)
History of smoking	
Yes	130 (46.8)
No	148 (53.2)
Family support	
Yes	135 (48.6)
No	143 (51.4)

Values are presented as numbers and precentages (%).
SD: standard deviation

Table 2 - Medication adherence categories (poor, moderate, and good adherence).

Variables	n (%)
MMAS-4 items, mean±SD (range)	2.12±1.08 (0-4)
Number of "no" answers	
0-1 (poor adherence)	85 (30.6)
2-3 (moderate adherence)	165 (59.4)
4 (good adherence)	28 (10.0)

Values are presented as numbers and precentages (%).
MMAS: Morisky medication-taking adherence scale,
SD: standard deviation

The findings of the multiple linear regression analysis are presented in Table 4. All of the collected demographic data (on each patient's gender, age, level of education, number of doctor visits, history of smoking, and family support) were included in the model. The R^2 value of 0.16 revealed that the predictors explained 16% of the variance in the outcome variable, with F (5, 272)=10.6 and p<0.001. The results showed that only the patient's gender (B= -0.23, p<0.001), number of doctor visits (B=0.13, p<0.021), family support (B= -0.13, p=0.019), and education level (B= -0.25, p<0.001) predicted medication adherence.

Discussion. Coronary artery disease is a leading cause of death worldwide, and medication adherence is essential to its management. Medication non-adherence is a serious problem among patients with cardiovascular diseases and is estimated to be higher than 60%.[28] Medication adherence can be challenging, and many patients struggle to take their medications as prescribed. Thus, the aims of this study were to measure medication adherence among CAD patients, to examine the relationships between sociodemographic variables and medication adherence, and to identify variables that could be used to predict medication adherence.

Regarding the level of medication adherence among the CAD patients included in this study, it was found that most patients reported a moderate level of adherence. However, some patients reported poor adherence, while others reported good adherence. Our results indicate that 30% of CAD patients do not adhere to their prescribed medication. This relatively high percentage is a concern, given that medication adherence is important to achieving positive health outcomes in CAD patients. Nevertheless, the findings from the current study related to medication adherence provide a more positive picture than those of Raffaa et al[29] who carried out a study in

Table 3 - Sociodemographic and medication adherence.

Variables	N	MMAS-4 items		
		Mean±SD	t/F	*P*-values
Gender				
Men	208	1.9±1.09	3.99	<0.001
Women	70	2.55±0.92		
Level of education				
High school or less	107	1.96±1.07		
University education	151	2.16±1.07	3.74	0.025
Higher education	20	2.65±1.03		
Number of doctor visit in one year				
None	52	1.78±0.97		
1	67	1.80±1.11	7.52	<0.001
2	89	2.24±1.09		
3 or more	70	2.51±0.95		
History of smoking				
Yes	130	1.98±1.08	2.00	0.046
No	148	2.23±1.06		
Family support				
Yes	135	2.27±1.06	-2.29	0.023
No	143	1.97±1.07		

MMAS-4: 4-item Morisky medication-taking adherence scale, N: number, SD: standard deviation

Table 4 - Predictive values of Sociodemographic factors on medication adherence among coronary artery disease patients.

Variables	Beta	SE	95% CI		β	*P*-values
			LL	UL		
Gender	-0.59	0.35	-0.890	-0.291	-0.23	<0.001
Age	-0.02	0.15	-0.011	0.007	-0.02	0.716
Level of education	0.24	0.05	0.037	0.451	0.13	0.021
Number of doctor visits	0.26	0.10	0.151	0.378	0.25	<0.001
Smoking history	-0.01	0.05	-0.274	0.249	-0.06	0.926
Family support	0.29	0.13	0.049	0.530	0.13	0.019

CI: confidence interval, SE: standard error, LL: lower limit, UL: upper limit

the Aseer region in southern Saudi Arabia. More than half of the heart failure patients included in their study had low medication adherence, while only a small proportion (7.3%) had high medication adherence. The findings of the current study on the level of medication adherence align with those of Altuwairqi[30] who found that approximately 33% of patients with cardiovascular diseases in Riyadh reported poor medication adherence. Notably, we found that age was not associated with medication adherence, and this finding contradicts those of Altuwairqi[30] who reveal a positive association between age and medication adherence.

According to several studies, men are more likely to develop CAD at an earlier age compared to women.[31] Therefore, it is unsurprising that the proportion of men was higher than the proportion of women in the current study. However, the results indicate that the women in the study reported significantly higher medication adherence than the men. Regarding the sociodemographic variables that can predict medication adherence, the current study revealed that gender is a predictive variable of medication adherence. This finding contradicts several studies, such as that of Mahmoodi et al[32] who found that men were consistently more likely to adhere to their diabetes and cardiovascular medications than women. Also, the current finding differs from that of Eindhoven et al[33] who found that most of their women patients reported lower medication adherence than the men. Given that complex and multidimensional factors likely contribute to the reported discrepancies between the adherence levels of men and women, no conclusive explanation has

been proposed to date for why women may adhere to medications more than men. However, several causative factors have been proposed. The finding that women reported higher medication adherence than men in our study could be explained by the existence of some sociocultural pressures that result in women taking a more active role and being more engaged in their health management. Furthermore, beliefs on and attitudes toward health and medication might be factors; women may have different beliefs and attitudes than men, which could influence their medication adherence.

In terms of education level, we found that medication adherence could differ significantly according to the education level of the patient. It can also predict the degree of medication adherence. Raffaa et al[34] studied the determinants of heart failure medication adherence in Southern Saudi Arabia and discovered, contrary to our findings, that those individuals with higher levels of education were more likely to be employed and had hectic schedules, which made it challenging for them to adhere to their medication regimen. In another study, by AlQarni et al,[35] it was found that education level was not a determinant of adherence in diabetic patients in Saudi Arabia.

Regarding smoking status, patients who identified as smokers or have been smokers reported lower medication adherence than non-smokers. This is consistent with the findings of Zyryanove et al[36] and Abbas et al[37] where smoker patients in their studies reported low medication adherence. In addition to the many negative consequences of smoking, the current study proves that patients who were actively smoking or were smokers tend to have lower medication adherence than non-smokers. There is no clear explanation why those patients tend to report lower medication adherence since there are few studies on the association between smoking and medication adherence.[37] Healthcare providers need to give more attention to smoker patients and help them adhere to their medication.

The current study revealed that the number of doctor visits by a patient predicted their medication adherence. Patients were asked how many times they visited their cardiologist in the last year. Patients who reported visiting their cardiologist 3 or more times in the last year had higher medication adherence than those who reported fewer visits. Clearly, the impact of the number of doctor visits on medication adherence can be significant. Studies have shown that patients who have regular interactions with their healthcare providers, including frequent doctor visits, are more likely to adhere to their medication regimens.[21] The findings of the current study are consistent with those of a study carried out in Jordan by Basheti et al,[38] who found a positive relationship between the number of monthly physician visits and medication adherence. Overall, the impact of the number of doctor visits on medication adherence is likely to be positive, as it can improve the patient's understanding of their treatment plan, provide them with necessary support, and increase their motivation for medication adherence.

Finally, we found that the level of family support experienced by a patient predicted medication adherence. This means that patients who receive support from their family members are more likely to adhere to their medication regimen compared to those who do not receive such support. While the extent of family support and its impact on medication adherence may vary according to the individual patient and their family dynamics, having supportive family members can be a significant predictor of medication adherence.

The implication of our findings suggests that most patients diagnosed with CAD have a problem adhering to their prescribed medication. Doctors' visits and family support are the 2 protectors that can't predict better medication adherence among CAD. Therefore healthcare providers must encourage patients to visit their cardiologist regularly. Moreover, family plays an essential role in patient medication adherence behavior. Patient's family should support their patients to maintain their health and well-being. Future research may focus on the type of family support patients receive and their relation to medication adherence. Moreover, how can the relationship between doctors and patients impact patients' medication adherence?. Future research might also measure the association between the number of medications patients take and their level of medication adherence.

Study strengths and limitations. This study represented one of the most recent efforts to assess medication adherence levels among CAD patients. It delved into the associations between medication adherence and sociodemographic variables to identify predictors for adherence to prescribed medications. However, the study was limited by the use of the MMAS-4. Using the MMAS-8 would have resulted in the generation of more reliable results, as this 8-item scale includes items for assessing different aspects of medication adherence, such as forgetfulness and intentional non-adherence. Although, the reliability of each scale may vary depending on the population being studied and other factors. Another limitation is that some of the sociodemographic variables were measured

on a dichotomous scale, which is a scale that consists of 2 opposing options, and this can limit the variance of the responses regarding each variable. Additionally, the use of a dichotomous scale can restrict the ability to carry out various statistical analyses. Another limitation in this study is the cross-sectional design, which only allows measurement of variables at one point in time. Hence, it is not possible to establish causality, and capturing changes that occur over time is difficult using this type of design.

In conclusion, we found that among a sample of Saudi Arabian patients with CAD, approximately 59.4% had moderate medication adherence, 30.6% had poor medication adherence, and approximately 10% had good medication adherence. Women patients, patients who received family support, non-smokers, and well-educated patients showed significantly higher levels of medication adherence. We also found that the patient's gender, number of doctor visits, level of family support, and education level predicted medication adherence. Hence, healthcare providers must encourage CAD patients to regularly visit their doctors, as this might improve their medication adherence and well-being. More studies are needed to examine the effect of family support on the medication adherence of CAD patients.

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