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Original article

Medication non-adherence among outpatients with myocardial infarction: A hospital-based study

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ABSTRACT

Background: Despite the availability of effective medications for the treatment of myocardial infarction (MI), treatment outcomes are suboptimal due to medication non-adherence. The aim of this study was to assess medication adherence and its associated factors among patients with MI.

Methods: This cross-sectional study was conducted on outpatients with MI in the cardiology clinic at a major hospital in Jordan. Medication adherence was assessed using the validated Arabic version of the 4-item Medication Adherence Scale. Ordinal regression was conducted to identify the variables associated with medication non-adherence.

Results: A total of 333 patients participated in the study. The median age was 58 years (57–60). Medication non-adherence was expressed by 54.6 % of the participants. Having less than college/university education (Coefficient = −0.625, 95%Cl (−1.191 to −0.06), P = 0.03) and increased medication-related concerns (Coefficient = −0.065, 95 % Cl (−0.126 to −0.003), P = 0.04) were associated with decreased medication adherence. Other factors, including having no family history of cardiovascular disease (CVD) (Coefficient = 0.757, 95%Cl (0.218–1.295), P = 0.006) and increased medication necessity (Coefficient = 0.186, 95%Cl (0.133–0.239), P < 0.001) were associated with high medication adherence.

Conclusion: The current study demonstrated a high rate of medication non-adherence in MI patients, necessitating the need to develop tailored pharmaceutical care interventions that address patients' medication-related beliefs, focusing on their perceptions of medication necessity and concerns, particularly in patients with low education level and those with a positive family history of CVD.

1. Introduction

Ischemic heart disease (IHD) is a group of cardiac issues, such as stable and unstable angina and myocardial infarction, that arise because of blocked coronary arteries, which are responsible for supplying blood to the heart muscle. A total obstruction of blood supply to the heart muscle causes myocardial infarction (MI), which results in the death of heart muscle cells.[1] According to a meta-analysis, the prevalence of MI was 3.8 % in adults under the age of 60 and 9.5 % in people over the age of 60 worldwide.[2] Jordan had a higher prevalence of MI (5.9 %) when compared to western countries.[3]

MI is undeniably the primary contributor to global morbidity and mortality. Annually, it accounts for more than 15 % of all deaths.[4] According to the Institute for Health Metrics and Evaluation (IHME), IHD prevalence accounts for 54.7 % of annual deaths in Jordan,[5] making it the most prevalent cause of death in the country and representing 43.3 deaths per 100, 000 population in females and 52.7 deaths per 100, 000 population in males in 2019.[6]

Despite the availability of effective treatments for MI, treatment outcomes are suboptimal due to medication non-adherence. Medication adherence refers to a patient's willingness to take prescribed medications as directed by their healthcare providers.[7] Medication

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non-adherence is a major barrier to achieving the desired outcomes of different effective pharmacologic therapy in various medical conditions. Improved drug adherence has been recognized as a critical step in enhancing health outcomes for individuals with chronic diseases, and it has prompted numerous changes in our healthcare system.[8] The economic consequences of non-adherence are also substantial, with poor medication adherence being responsible for at least one-third of all hospital admissions related to medication.[9]

Medication adherence rates in patients with MI varied in the literature. Some studies showed that almost half of the participants had high rates of medication adherence,[10,11] while other studies showed lower adherence rates.[12] Diverse results have been observed concerning the factors linked to medication non-adherence among patients with MI. A study revealed that income and gender were associated with medication adherence.[10] Another study found that individuals' beliefs and concerns about the medications were the most influential factors impacting medication adherence.[13] Another one reported that age, comorbid conditions like hypertension, education level, employment status, smoking, problems with affordability, and the complexity of the medications were associated with medication adherence.[14] Another study revealed that age, smoking, body mass index, depression, and patients' lipid profiles (high-density lipoprotein (HDL), total cholesterol, and triglycerides) were predictors of medication adherence.[15] Given the wide range of factors linked to medication non-adherence among patients with MI, there is a need for additional research to identify the predictors of medication non-adherence in this population. In Jordan, medication adherence among MI patients remains unexplored. Hence, this study sought to shed light on medication adherence levels and provide insight into the factors associated with medication non-adherence among patients with MI.

2. Methods

2.1. Study design and subjects

A cross-sectional study was conducted on patients with MI who attended the cardiology clinic at King Abdullah University Hospital in Jordan between April and August 2022. The diagnosis of MI was established by the cardiologist according to the updated ACC/AHA guidelines.[16] The inclusion criteria consisted of patients aged 18 years or older who had a confirmed diagnosis of MI for at least 6 months and received at least one medication for MI. Patients with cognitive impairment were excluded from the study. Eligible patients were informed about the voluntary nature of participation and the right to withdraw from the study at any time. Patients who agreed to participate were asked to sign an informed consent form. The interview took an average of 10–15 min to complete. The study received ethical approval from the Institutional Review Board (IRB) of KAUH at Jordan University of Science and Technology (Ref. #97/147/2022) on 02/03/2022.

2.2. Sample size calculation

The following equation was used to compute the minimum sample size required to conduct ordinal regression: 50 + 8P, where P is the number of predictors. The original aim of the study was to evaluate the association of the 33 variables with the medication adherence level. Therefore, the minimum required sample size was 314.

2.3. Study instruments

During the clinic visits, the research pharmacist (RM) employed a customized questionnaire to gather socio-demographic information from the participants. Medical files and hospital data were used to collect disease and medication-related information. The collected data also included biomedical parameters such as low-density lipoproteins (LDL), high-density lipoproteins (HDL), triglycerides (TGs), total cholesterol, glycosylated hemoglobin A1c (HbA1c), systolic blood pressure (SBP), and diastolic blood pressure (DBP).

2.4. The 4-item Medication Adherence Scale

The validated Arabic version of this survey was used to evaluate patients' willingness to adhere to their prescribed medications.[17,18] The four items were: Do you forget to take your medications? Are you careless about the time of taking your medications? Do you stop taking your medications when you feel better? Do you stop taking your medications when you feel worse? Each affirmative response received a score of one, while negative responses were assigned a score of zero, with a total score ranging from 0 to 4. Adherence was categorized into three groups: low for patients with three or more "yes" responses, moderate for those with one or two "yes" responses, and high for those with four "no" responses.

2.5. Beliefs about medicines questionnaire (BMQ)

The validated Arabic version of the BMQ-specific was used to assess common personal beliefs regarding the necessity and concerns associated with the use of prescription drugs.[19] It consists of 10 items that are divided into two scales, with 5 items each. Participants responded to the questionnaire using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating stronger beliefs. The items on the necessity scale were: 1) My medicine protects me from becoming worse; 2) My health, at present, depends on medicine; 3) My health, in the future, will depend on my medicines; 4) My life would have been impossible without my medicines; 5) Without my medicines, I would be very sick. The concern scale items were as follows: 1) I sometimes worry about becoming too dependent on medicine; 2) My medicine disrupts my life; 3) I sometimes worry about the long-term effects of medicine; 4) Having to take medicine worries me; 5) My medicine is a mystery to me.

2.6. Statistical analysis

Statistical analyses were performed using SPSS version 28. Categorical variables were reported as frequencies and percentages. The normality of the continuous variables was evaluated using Q-Q plots, which indicated a departure from the normal distribution, and therefore continuous variables were presented as medians with a corresponding 95 % confidence level (Cl). To determine the associations between different variables and adherence levels, bivariate analyses were conducted using Chi-square tests for categorical variables and Spearman's rank correlation for continuous variables. Subsequently, an ordinal regression was conducted to identify the variables associated with adherence levels. The independent variables with p-values less than 0.2 in the bivariate analysis were included in the regression analysis. A P value of <0.05 was considered statistically significant.

3. Results

The study included 333 patients with a history of MI. The median age was 58 years (57–60). The majority of the patients were males (75.4 %), married (95.8 %), physically inactive (82.2 %), had low education (64.7 %), had low monthly income (68.2 %), and had a family history of CVD (69 %). Sociodemographic characteristics of the study patients are presented in Table 1.

Most of the patients had comorbidities other than MI. The majority of the patients had hypertension (92.2 %), and/or diabetes (54.1 %) and nearly half of them had dyslipidemia (47.7 %). Only few patients had heart failure (12 %), arrhythmia (9.3 %), and chronic kidney disease (6 %). The medians for systolic blood pressure (SBP) and diastolic blood pressure (DPB) were 125 (124–129) and 80 (80–83), respectively. The medians for the patients' lipid profiles were 4.29 (4.15–4.44) for total

Table 1
Sociodemographic characteristics of the study patients (n = 333).

Characteristics		Median 95 % (lower-upper) or frequency (%)
Age		58 (57–60)
Gender	Male	251 (75.4 %)
	Female	82 (24.6 %)
Marital status	Other[a]	14 (4.2 %)
	Married	318 (95.8 %)
Educational level	Low (less than collage/ university)	214 (64.7 %)
	High (collage/ university)	117 (35.3 %)
Currently employed	No	212 (63.9 %)
	Yes	120 (36.1 %)
Monthly income	Less than 500 JDs	223 (67.0 %)
	More than 500 JDs	110 (33.0 %)
Residency	Countryside	141 (42.5 %)
	City	191 (57.5 %)
Performing regular physical activity	No	272 (82.2 %)
	Yes	59 (17.8 %)
Smoking	No	192 (57.7 %)
	Yes	141 (42.3 %)
BMI[a](kg/m^2)	<24.9	51 (15.3 %)
	25–29.9	130 (39 %)
	>30	152 (45.6 %)
Family history of CVD[a]	No	103 (31 %)
	Yes	229 (69 %)

[a] BMI: Body Mass Index, Other: single, separated, divorced, or widowed, CVD: Cardiovascular Disease.

cholesterol, 1.78 (1.69–1.95) for triglyceride, 1 (0.98–1.04) for HDL, and 2.38 (2.22–2.56) for LDL. Lastly, the median for HbA1c level was 6.23 (6.10–6.45).

As shown in Table 2, the median for the number of MI medications was 4 (4–5). The median for the total number of medications taken by the patients was 7 (7–8). The most commonly reported medication administration frequency was twice daily, accounting for 57.5 % of the patients. The results indicated that the majority of the patients received antiplatelet therapy (94.0 %), including aspirin (91.3 %), clopidogrel (48.9 %), or dual antiplatelet therapy (46.2 %). While the least commonly prescribed medications were amiodarone, digoxin, and warfarin (3 %, 3.3 %, and 3.3 %, respectively).

Table 3 shows that the majority of patients had a high adherence level (45.4 %), 43.5 % had moderate adherence, and only 11.1 % showed low medication adherence. The most common reason for medication non-adherence was forgetfulness (48.3 %). The most commonly reported medication necessity was "my medicines protect me from becoming worse" (84.3 %) followed by "without my medicines, I would be very sick" (71.1 %). On the other hand, the least reported medication necessity was "my health in the future will depend on my medicines" (36 %). The most common medication-related concern was "I sometimes worry about the long-term effects of my medicines" (34.2 %), while the least was "my medicines disrupt my life" (14.1 %). The median for the medication necessity score was 18 (17–20) out of a maximum score of 25, and the median for the medication-related concerns score was 10 (10–11) out of a maximum possible score of 25. Results of the bivariate analysis revealed that education (P = 0.001), monthly income (P = 0.001), medication necessity (P = 0.001), medication-related concerns (P = 0.004), performing regular physical activity (P = 0.01), residency (P = 0.004), diabetes mellitus (P = 0.011), and metformin (P = 0.023) were significantly associated with medication adherence.

Results of the ordinal regression (Table 4) revealed that having less than college/university education (Coefficient = −0.625, 95%Cl (−1.191 to −0.06), P = 0.03) and increased medication-related concerns (Coefficient = −0.065, 95 % Cl (−0.126 to −0.003), P = 0.04) were associated with decreased medication adherence. On the other hand, having no family history of CVD (Coefficient = 0.757, 95%Cl (0.218–1.295), P = 0.006) and increased medication necessity (Coefficient = 0.186, 95%Cl (0.133–0.239), P < 0.001) were associated with increased medication adherence.

Table 2
Medication history of the study patients (n = 333).

Medications		Median 95 % (lower-upper) or frequency (%)
Number of MI medications		4 (4–5)
Total number of medications		7 (7–8)
Frequency of drug administration	Once	52 (15.7 %)
	Twice	191 (57.5 %)
	Thrice or more	89 (26.8 %)
Medications for Blood Pressure control		
Beta blockers	No	57 (17.1 %)
	Yes	276 (82.9 %)
ACEIs[a]	No	220 (66.1 %)
	Yes	113 (33.9 %)
ARBs[a]	No	218 (65.5 %)
	Yes	115 (34.5 %)
CCBs[a]	No	241 (72.4 %)
	Yes	92 (27.6 %)
Diuretics	No	198 (59.5 %)
	Yes	135 (40.5 %)
Vasodilators	No	261 (78.4 %)
	Yes	72 (21.6 %)
Medications for Lipid control		
Statins	No	15 (4.5 %)
	Moderate intensity	76 (22.8 %)
	High intensity	242 (72.7 %)
Fibrates	No	314 (94.3 %)
	Yes	19 (5.7 %)
Medications for Blood Glucose control		
Metformin	No	212 (63.7 %)
	Yes	121 (36.3 %)
Sulfonylurea	No	286 (85.9 %)
	Yes	47 (14.1 %)
DPP-4 inhibitors[a]	No	306 (91.9 %)
	Yes	27 (8.1 %)
Insulin	No	273 (82 %)
	Yes	60 (18 %)
Antiplatelets		
Antiplatelet	No	20 (6.0 %)
	Yes	313 (94.0 %)
Aspirin	No	29 (8.7 %)
	Yes	304 (91.3 %)
Clopidogrel	No	170 (51.1 %)
	Yes	163 (48.9 %)
Dual antiplatelet therapy	No	179 (53.8 %)
	Yes	154 (46.2 %)
Anticoagulants		
Warfarin	No	322 (96.7 %)
	Yes	11 (3.3 %)
Anti-arrhythmic drugs		
Amiodarone	No	323 (97 %)
	Yes	10 (3 %)
Digoxin	No	322 (96.7 %)
	Yes	11 (3.3 %)
Other medications		
PPIs[a]	No	69 (20.7 %)
	Yes	264 (79.3 %)

[a] MI: Myocardial Infarction, ACEIs: Angiotensin Converting Enzyme Inhibitors, ARBs: Angiotensin Receptor Blockers, CCBs: Calcium Channel Blockers, DPP-4 inhibitors: Dipeptidyl Peptidase-4 inhibitors, PPIs: Proton Pump inhibitors.

4. Discussion

The present study revealed a high level of medication non-adherence among patients with MI, reaching a concerning rate of 54.6 %. Education level, family history of CVD, as well as scores pertaining to the perceived necessity and concerns surrounding medication usage, emerged as significant determinants of medication adherence.

In comparison to the non-adherence rate, previous research has

Table 3
Medication adherence of the study participants (n = 333).

Questionnaire items		Frequency (%)
Do you ever forget to take your medications?	No	172 (51.7 %)
	Yes	161 (48.3 %)
Are you sometimes careless about taking your medications on time?	No	233 (70 %)
	Yes	100 (30 %)
When you feel better, do you sometimes stop taking your medications?	No	290 (87.1 %)
	Yes	43 (12.9 %)
Sometimes if you feel worse when you take your medicine, do you stop taking it?	No	313 (94 %)
	Yes	20 (6 %)
Adherence level	High	151 (45.4 %)
	Moderate	145 (43.5 %)
	Low	37 (11.1 %)

consistently reported high levels of medication non-adherence among patients with MI. A study conducted in Pakistan revealed strikingly suboptimal adherence to prescribed medication in post-MI patients, with only 45 % of them found to be adherent.[10] Lower adherence rates were reported in cohort studies that followed post-MI patients for one year, where only one-third of the patients-maintained adherence throughout the entire follow-up period.[14,20] An earlier study conducted to examine the adherence to antiplatelet therapy among patients receiving acute MI interventions revealed that the adherence rate was quite high at 1 month, but with time it started to decline to reach 46.3 % at 12 months.[21] On the other hand, better medication adherence rates were observed among MI patients in earlier studies conducted in Italy,[22] and China.[11] These disappointing findings underscore the urgent need to explore the factors associated with medication non-adherence, aligning with one of the primary goals of our study. By investigating these factors, we aimed to contribute to the understanding of medication adherence challenges and potentially inform interventions to improve adherence rates among MI patients.

The findings of the current study indicated that a relatively low percentage (36 %) of the participants believed that their future health would be dependent on the prescribed medications. Additionally, 34.2 % of them expressed concerns about the potential long-term effects of these medications. Higher percentages were reported in previous research.[23] A significant proportion of individuals in Palestine diagnosed with type 2 diabetes hold a firm belief in the necessity of anti-diabetic medications for their present and future health. Nonetheless, they also expressed concerns regarding the potential negative effects associated with the use of these medications.[23] In the present study, a significant association was observed between medication-related beliefs and medication adherence. Patients who expressed higher concerns and a lower perceived necessity regarding their medications exhibited significantly lower levels of medication adherence. Similar results were reported in previous studies conducted among patients with different chronic diseases such as CVDs,[24] coronary artery disease,[25] stroke,[26] rheumatoid arthritis,[26] and diabetes mellitus.[23,26] Medication adherence can be influenced by complex psychological factors,[27] as patients' decisions to adhere to treatment seem to be affected by their evaluation of the perceived risks and benefits associated with it. In this regard, it is crucial to introduce pharmacist-led services that educate MI patients about the necessity of their medications and address any concerns regarding their safety in order to enhance adherence and optimize therapeutic outcomes for these patients. Hence, it is imperative for healthcare professionals to effectively communicate the significance of medications to MI patients and highlight their role in the secondary prevention of future cardiovascular events.[28] While emphasizing the

Table 4
Multivariate analysis of the factors associated with medication adherence.

Variables		Coefficient	95 % Cl		P value
			Lower bound	Upper bound	
Gender	Male	−0.076	−0.672	0.519	0.801
	Female (REF)	0	.	.	.
Educational level	Less than collage/university	−0.625	−1.191	−0.060	0.030
	Collage/university (REF)	0	.	.	.
Currently employed	No	−0.040	−0.609	0.528	0.890
	Yes (REF)	0	.	.	.
Monthly income	Less than 500 JDs	−0.336	−0.916	0.245	0.257
	More than 500 JDs (REF)	0	.	.	.
Residency	Countryside	−0.452	−0.940	0.035	0.069
	City (REF)	0	.	.	.
Performing regular physical activity	No	−0.597	−1.296	0.102	0.094
	Yes (REF)	0	.	.	.
Family history of CVD[a]	No	0.757	0.218	1.295	0.006
	Yes (REF)	0	.	.	.
Hypertension	No	0.743	−0.263	1.749	0.148
	Yes (REF)	0	.	.	.
Diabetes mellitus	No	0.309	−0.387	1.005	0.384
	Yes (REF)	0	.	.	.
Arrhythmia	No	−0.254	−1.055	0.546	0.533
	Yes (REF)	0	.	.	.
Frequency of drug administration	Once	−0.129	−1.000	0.743	0.772
	Twice	−0.143	−0.773	0.488	0.658
	Thrice or more (REF)	0	.	.	.
Vasodilators	No	−0.555	−1.154	0.044	0.070
	Yes (REF)	0	.	.	.
CCBs[a]	No	0.430	−0.130	0.991	0.132
	Yes (REF)	0	.	.	.
Metformin	No	0.130	−0.582	0.842	0.720
	Yes (REF)	0	.	.	.
Sulfonylurea	No	0.236	−0.495	0.966	0.527
	Yes (REF)	0	.	.	.
Triglycerides		−0.086	−0.240	0.068	0.274
Medication necessity		0.186	0.133	0.239	<0.001
Medication-related concerns		−0.065	−0.126	−0.003	0.040

[a] CVD: Cardiovascular disease, CCBs: Calcium Channel Blockers.

importance of MI pharmacotherapy, healthcare professionals should also address any concerns regarding potential side effects of the treatments, strive to find solutions to mitigate or minimize them, and remove misconceptions with respect to the treatment's long-term toxicity. It's crucial to note that people from different cultural backgrounds may have different beliefs about medications, and they may have different attitudes towards specific treatment classes depending on their socio-demographic and cultural group.[29] A systematic review highlighted the significant association between cultural factors and medication adherence.[30] For example, some individuals from certain Asian backgrounds believe that modern medications are harmful and potentially addictive. This belief can lead to the perception that such medications should be avoided, resulting in medication non-adherence.[31] In a study conducted in Ethiopia, most of the participating patients held the cultural belief that they needed to accumulate good deeds in their daily lives for their diseases to get better.[32] Therefore, further research is required to better understand culture-specific perceptions of medication use and their effect on adherence. Such research can inform the development and evaluation of patient-centered, culturally tailored interventions.[33]

Consistent with the results reported in earlier studies,[11,14,34] the current study revealed that a low education level was significantly associated with medication non-adherence. Patient education plays a vital role in improving treatment adherence because it empowers patients with knowledge and encourages them to take responsibility for managing their disease according to treatment guidelines.[35] Consequently, it is crucial for future pharmaceutical care programs to consider the educational background of MI patients when designing customized interventions that aim to enhance medication adherence among this population.

The current study discovered a robust correlation between having a family history of CVD and medication non-adherence. This association can potentially be explained by the impact of family members with CVD on individuals who have experienced an MI within the same family. When MI patients witness their family members struggling with CVD and its complications, it can trigger emotional and psychological effects such as anxiety, depression, or fear regarding their own health. These emotional and psychological factors can significantly influence the attitudes and behaviors of MI patients, potentially leading to medication non-adherence.[27] Therefore, MI patients with a family history of CVD should be specifically targeted in clinical pharmacy interventions aimed at promoting awareness of the importance of adherence to cardiovascular treatment.

The current study has some limitations. The cross-sectional study design cannot confirm the cause-effect relationship, the protopathic bias cannot be excluded, and the longitudinal outcomes cannot be measured. Moreover, the social desirability associated with the use of a self-report method to assess medication non-adherence could have affected the accuracy of the results. The study was conducted at only one hospital site, which might limit the generalizability of the findings. The convenient sampling technique used in this study might cause selection bias. In addition, the relatively higher proportion of males to females in this study suggests a non-homogeneous sample, potentially affecting the generalizability of the results. Lastly, it is recommended to utilize the Charles Comorbidity Index to assess the mortality risk among this group of patients in future studies.

5. Conclusions

The current study demonstrated a suboptimal medication adherence rate among patients with MI. Education level, family history of CVD, and medication-related necessity and concerns were the significant determinants of medication non-adherence. Improving patients' perception of medications' necessity and reducing their concerns about associated side effects, particularly among patients who have a low education level and family history of CVD, may help enhance medication adherence among patients with MI, thus improving their therapeutic outcomes.

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Authorship contribution

Conceptualization: ASJ, RM, SM, MK; Data curation and analysis: RM, WA, YNAH; Visualization: ASJ, TLM, MK; Writing-original draft: ASJ, RM, SRA; Writing-review and editing: ASJ, RM, SM, SRA, WA, TM, YNAH. All authors have read and agreed on the final version of the manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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