

Medication Adherence and Cardiovascular Outcomes in Elderly Patients: A Cross-Sectional Study in the Al Ahsa Region, Saudi Arabia

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Abstract

Background: Medication non-adherence is a major concern among elderly cardiovascular disease (CVD) patients leading to poor health outcomes. With an aging Saudi population and rising CVD burden, this issue warrants greater attention.

Objective: This study aimed to assess medication adherence and its impact on cardiovascular outcomes among elderly CVD patients in the Al-Ahsa region of Saudi Arabia.

Methods: In this cross-sectional study, 150 elderly patients aged ≥ 60 years with established CVD were recruited from healthcare facilities in Al-Ahsa. Medication adherence was measured using the Morisky Medication Adherence Scale (MMAS). Cardiovascular outcomes including blood pressure control, recurrent CVD events, hospital readmissions and mortality were compared between adherent and non-adherent groups.

Results: 20% of patients showed low adherence (MMAS score <5), 45% moderate adherence, and 35% high adherence (MMAS score 8). Non-adherent patients had worse systolic and diastolic blood pressure control, more recurrent CVD events (37.3% vs 16%), increased cardiovascular hospital readmissions (20% vs 6.7%), and higher mortality (13.3% vs 4%) compared to adherent patients.

Conclusion: Medication non-adherence was highly prevalent among elderly CVD patients and significantly associated with worse cardiovascular outcomes. Routine screening and targeted interventions to improve adherence are warranted in this high-risk group.

Keywords: Medication adherence; cardiovascular disease; elderly; morbidity; mortality

Introduction:

Cardiovascular disease (CVD) remains the leading cause of mortality worldwide, responsible for over 17 million deaths annually.¹ The Kingdom of Saudi Arabia (KSA) has witnessed a rising burden of CVD in recent decades, largely driven by high prevalence of risk factors like diabetes, obesity, hypertension and sedentary lifestyles.² CVD now accounts for over 40% of all deaths in KSA, posing a major public health challenge.³

Elderly people aged 60 years and above are disproportionately affected by CVD compared to younger

populations.⁴ Multiple large-scale studies have demonstrated that advanced age is an independent risk factor for adverse cardiovascular outcomes including myocardial infarction, stroke, heart failure hospitalizations and cardiovascular mortality.⁵⁻⁷ The aging process is characterized by structural and functional changes in the heart and vessels, leading to their increased susceptibility to disease.⁸ Comorbidities like hypertension, diabetes and renal impairment which are highly prevalent in the elderly further accentuate the CVD risk.⁹

In addition to age and comorbidities, lack of adherence to prescribed cardiovascular medications is an important remediable risk factor for poor outcomes in elderly patients.¹⁰ Medication non-adherence is defined as the failure to take medications as prescribed, encompassing not initiating treatment, sub-optimal implementation of the dosing regimen or early discontinuation of treatment.¹¹ Estimates from Saudi Arabia suggest that medication non-adherence among elderly patients ranges from 30% to over 50%.¹²⁻¹⁴ The most frequently reported reasons are forgetfulness, complex regimens, lack of comprehension about the medication benefits, side effects, access and affordability issues.¹⁵

Medication non-adherence has consistently been linked with adverse cardiovascular outcomes across multiple studies globally. A meta-analysis by Chowdhury et al found a 43% increased risk of all-cause mortality among non-adherent patients compared to adherent counterparts.¹⁶ Another meta-analysis demonstrated significantly higher rates of cardiovascular events like myocardial infarction and stroke among non-adherent hypertensive patients versus those with high adherence.¹⁷ Medication non-adherence also leads to increased risk of hospital readmissions.¹⁸

Suboptimal adherence prevents optimal control of CVD risk factors like hypertension, dyslipidemia and diabetes, further compounding the cardiovascular risk.¹⁹ Poor adherence causes progression of atherosclerotic disease, while abrupt discontinuation of certain drugs like beta blockers, antiplatelets and anticoagulants increases the risk of acute cardiovascular events and death.²⁰ Therefore, medication-taking behavior is a critical determinant of cardiovascular health, particularly in high-risk elderly patients.

There is limited research on medication adherence in the elderly Saudi population. Small studies conducted in Riyadh and Jeddah have found high rates of non-adherence among elderly patients ranging from 30% to over 50%.^{21,22} Predictors identified include polypharmacy, low health literacy, lack of family support, cognitive impairment and depression. A study in Najran province demonstrated that 59% of elderly patients had poor adherence, which was linked with worse blood pressure control.²³ However, data is sparse on the nationwide scope of the problem and its impact on hard clinical outcomes like recurrent CVD events, hospitalizations and mortality.

Al Ahsa region in the Eastern province of Saudi Arabia has one of the largest proportions of elderly residents in the country.²⁴ With its rapidly growing aging population coupled with high prevalence of CVD risk factors like diabetes, Al Ahsa represents an optimal location to

investigate medication adherence and resultant cardiovascular outcomes among elderly Saudi patients. Findings would help quantify the magnitude of non-adherence in this vulnerable group and highlight the adverse health impact of poor medication-taking behavior. This may provide the impetus for healthcare policymakers to prioritize resources and interventions aimed at improving adherence and CVD-related outcomes in the elderly.

Therefore, this study aims to determine the prevalence of medication non-adherence and its effects on cardiovascular outcomes including blood pressure control, hospital readmissions and mortality among elderly patients aged ≥ 60 years with established CVD in Al Ahsa region, Saudi Arabia.

Methods

Study Design:

The research was conducted as a cross-sectional study to assess medication adherence and its correlation with cardiovascular outcomes among elderly individuals aged 60 years and above who had a documented history of cardiovascular disease in the Al Ahsa region, Saudi Arabia.

Participant Selection:

150 Elderly patients diagnosed with established cardiovascular disease, including myocardial infarction, heart failure, stroke, or coronary artery disease, were recruited from diverse healthcare facilities within the Al Ahsa region. Selection was carried out through hospitals, primary care centers, and specialized cardiovascular clinics. Informed consent was obtained from all participants or their legal representatives.

Data Collection:

1. **Demographic and Clinical Data:** Information encompassing age, gender, medical history, duration and specific types of cardiovascular disease, comorbidities (e.g., diabetes, hypertension, renal impairment), and the current prescribed medications were extracted from medical records and obtained through structured patient interviews.
2. **Morisky Medication Adherence Scale:** The Morisky Medication Adherence Scale (MMAS) is a self-reported questionnaire designed to assess an individual's adherence to medication. It's a widely used tool for measuring medication adherence and consists of a series of questions related to medication-taking behavior. The scale was developed by Donald E. Morisky and his colleagues and has been validated for various health conditions and age groups. The original MMAS contains 8 items, where

respondents are asked about their medication-taking behavior and habits

3. **Cardiovascular Outcomes Assessment:** The study emphasized assessing cardiovascular outcomes, such as monitoring blood pressure control, documenting recurrent cardiovascular events (e.g., myocardial infarction, stroke), noting hospital readmissions due to cardiovascular causes, and tracking mortality rates.

Data Analysis:

Statistical analysis was performed to examine the association between medication non-adherence and cardiovascular outcomes. Descriptive statistics summarized demographic characteristics and levels of medication adherence. The relationship between medication adherence and cardiovascular outcomes was assessed using appropriate statistical methods, including logistic regression, correlation analysis, and survival analysis. Factors influencing medication adherence and their impact on cardiovascular outcomes were explored.

Ethical Considerations:

This study adhered to ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the relevant institutional review board or ethics committee overseeing the participating healthcare facilities, ensuring participant confidentiality and informed consent throughout the study.

Results:

Table1 presents the demographic and clinical characteristics of the study participants categorized into adherent and non-adherent groups, along with the overall total for the study. It provides an overview of various essential characteristics. The mean age for adherent individuals was 67.5 years (± 4.2), slightly lower than the non-adherent group at 68.3 years (± 3.9), resulting in an overall average age of 67.9 years (± 4.0) across the study. In terms of gender distribution, the study enrolled 85 participants, with 40 (53.3%) being male in the adherent group and 45 (60.0%) in the non-adherent group.

Furthermore, the distribution of cardiovascular diseases (CVD) within the study revealed that myocardial infarction was the most prevalent, with 35 (46.7%) adherent and 40 (53.3%) non-adherent individuals, constituting half of the total participants. Heart failure was the second most prevalent, observed in 20 (26.7%) adherent and 18 (24.0%) non-adherent individuals.

The table also highlights the prevalence of common comorbidities among the study participants. Among the comorbid conditions, diabetes was observed in 50 (66.7%) adherent and 55 (73.3%) non-adherent participants, constituting 105 (70.0%) of the total participants. Hypertension was observed in 60 (80.0%) adherent and 65 (86.7%) non-adherent participants, making up 125 (83.3%) of the total participants.

Table 1: Demographic and Clinical Characteristics of Study Participants

Characteristic	Adherent (n=75)	Non-Adherent (n=75)	Total (N=150)
Age (years)	67.5 (± 4.2)	68.3 (± 3.9)	67.9 (± 4.0)
Gender (Male/Female)	40 (53.3%)	45 (60.0%)	85 (56.7%)
Type of CVD			
- Myocardial Infarction	35 (46.7%)	40 (53.3%)	75 (50.0%)
- Heart Failure	20 (26.7%)	18 (24.0%)	38 (25.3%)
Comorbidities			
- Diabetes	50 (66.7%)	55 (73.3%)	105 (70.0%)
- Hypertension	60 (80.0%)	65 (86.7%)	125 (83.3%)

In Table 2, the levels of medication adherence assessed through the Morisky Medication Adherence Scale (MMAS) are presented. The table displays the distribution of adherence levels among the study participants based on their MMAS scores. Approximately 35% of the elderly individuals with established cardiovascular disease in the Al Ahsa region demonstrated high adherence, scoring the maximum MMAS score of 8. Around 45% of the participants exhibited moderate adherence, recording

scores ranging from 5 to 7 on the MMAS. Conversely, a notable proportion, approximately 20% of the elderly patients, indicated low adherence, scoring less than 5 on the MMAS. These figures underscore the diversity in medication adherence levels among the study population, indicating a substantial portion with suboptimal adherence, which may have implications for their cardiovascular health outcomes.

Table 2: Medication Adherence Levels using MMAS.

MMAS Score Range	Frequency (%)
High Adherence (8)	35%
Moderate Adherence (5-7)	45%

Low Adherence (<5)	20%
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The table exhibits key cardiovascular outcomes in both the adherent and non-adherent groups. Blood pressure control, represented as systolic/diastolic measurements (mean \pm standard deviation), demonstrates a lower average blood pressure among adherent individuals (128/75 mmHg \pm 5) compared to the non-adherent group (135/78 mmHg \pm 6).

In terms of recurrent cardiovascular events, a notable difference is observed between the two groups, with a lower percentage of such events reported among adherent participants (16.0%) compared to non-adherent individuals (37.3%).

Furthermore, the data shows hospital readmissions due to cardiovascular disease were less frequent among adherent patients (6.7%) in contrast to those categorized as non-adherent (20.0%).

Regarding mortality rates, the adherent group exhibited a lower percentage of deaths (4.0%) in comparison to the non-adherent group (13.3%). These findings suggest a potential association between medication adherence and improved cardiovascular outcomes, evidenced by differences in blood pressure control, reduced recurrent events, lower hospital readmissions, and decreased mortality rates among adherent individuals in this study.

Table 3: Cardiovascular Outcomes among Adherent and Non-Adherent Groups

Outcome Measure	Adherent Group (n=75)	Non-Adherent Group (n=75)
Blood Pressure Control	128/75 mmHg (\pm 5)	135/78 mmHg (\pm 6)
Recurrent Cardiovascular Events	12 (16.0%)	28 (37.3%)
Hospital Readmissions due to CVD	5 (6.7%)	15 (20.0%)
Mortality Rates	3 (4.0%)	10 (13.3%)

In Table 4, the analysis of factors influencing medication adherence and cardiovascular outcomes indicates statistically significant associations between several key variables. The p-values obtained from correlation and regression analyses demonstrate the strength and significance of the relationships. The results reveal that age and gender, as well as the type and duration of cardiovascular disease, exhibit a statistically significant association ($p < 0.05$ and $p < 0.01$, respectively) with medication adherence and cardiovascular outcomes. Furthermore, comorbidities, such as diabetes and hypertension, demonstrate an even stronger association (p

< 0.001), suggesting a highly significant impact on both medication adherence and subsequent cardiovascular outcomes. Notably, the Morisky Medication Adherence Scale (MMAS) scores also show a substantial correlation with adherence and cardiovascular outcomes ($p < 0.001$), signifying the importance of adherence assessment in predicting and managing cardiovascular health in this elderly population. These findings underscore the multifaceted nature of variables influencing both medication adherence and subsequent cardiovascular outcomes in elderly patients with established cardiovascular disease.

Table 4: Factors Influencing Medication Adherence and Cardiovascular Outcomes

Factors Assessed	Correlation/Regression Analysis (p-value)
Age, Gender	$p < 0.05$
Type and Duration of CVD	$p < 0.01$
Comorbidities	$p < 0.001$
MMAS Scores	$p < 0.001$

Discussion

This cross-sectional study aimed to assess the prevalence of medication non-adherence and its impact on cardiovascular outcomes among 150 elderly patients aged ≥ 60 years with established cardiovascular disease in the Al Ahsa region of Saudi Arabia. The findings demonstrate a high prevalence of suboptimal adherence, with approximately 20% of participants exhibiting low adherence based on MMAS scores < 5 . Moderate adherence was most common, seen in 45% of individuals. Only 35% of elderly patients showed high medication

adherence. These results align with previous smaller studies in Saudi Arabia that found non-adherence rates ranging from 30-50% in elderly cohorts.¹²⁻¹⁴

Our study expands on this data by quantifying non-adherence in a larger representative elderly sample in Al Ahsa using a validated tool like the MMAS. The region has one of the highest proportions of elderly residents in Saudi Arabia, with studies projecting further growth in the aging population.²⁴ Therefore, medication non-adherence

is a highly relevant issue impacting a sizable elderly cohort at increased cardiovascular risk.

The repercussions of poor adherence are clearly evidenced in our study by worse cardiovascular outcomes among non-adherent elderly patients compared to their adherent counterparts. Systolic and diastolic blood pressure was notably higher in the non-adherent group, reflecting suboptimal hypertension control. Poor adherence prevents achieving target blood pressure goals, which worsens long-term cardiovascular prognosis.¹⁹ Our findings align with existing literature demonstrating a significant association between medication non-adherence and inadequate blood pressure control.²⁵

In addition, the non-adherent cohort experienced markedly higher rates of recurrent cardiovascular events (37.3% vs 16%), cardiovascular-related hospital readmissions (20% vs 6.7%) and mortality (13.3% vs 4%). These results substantiate similar observations by Chowdhury et al, who found a 43% increase in mortality with non-adherence, and by Corrao et al, where non-adherent hypertensive patients had elevated rates of cardiovascular events and hospitalizations versus adherent individuals.^{16,17} Discontinuing essential therapies like beta-blockers, antiplatelets and anticoagulants amplifies the risk of acute events due to the loss of cardiovascular protection.²⁰ Therefore, our findings reaffirm the fundamental link between medication adherence and reduced cardiovascular morbidity and mortality, particularly in higher risk elderly patients.

Analysis of factors influencing adherence and subsequent cardiovascular outcomes revealed statistically significant associations with age, gender, comorbidities, and duration of CVD. Increasing age exhibited lower adherence, likely reflecting greater cognitive decline, functional impairment, complex regimens and lack of social support among older patients.^{9,15} Male gender was associated with poorer adherence, congruent with previous studies showing men are less likely to adopt health-seeking behaviors.²⁶ Comorbidities like hypertension and diabetes showed the strongest correlation with non-adherence and adverse outcomes. Elderly patients with multiple comorbid conditions often have complex polypharmacy regimens, increasing the risk of non-adherence due to side effects, costs, poor comprehension of drug benefits, and forgetfulness.¹⁵ Lastly, longer duration of CVD also showed significant correlation with worse adherence and outcomes. Patients likely become more casual about medication use over time and require regular reinforcement.²⁷

The Morisky score itself was the most predictive factor, which validates the MMAS as an important screening tool. Clinicians can use the scale to identify patients at high risk

of non-adherence and deliver targeted interventions. Systematic reviews demonstrate that MMAS has high reliability and validity for measuring medication adherence across diverse chronic conditions including CVD.²⁸ Our study provides further evidence supporting its use as a simple, self-reported assessment tool among elderly CVD patients.

Certain limitations should be considered when interpreting the results. The cross-sectional design assessed adherence and outcomes at a single time point, limiting conclusions about longitudinal trends. A prospective cohort study would better establish temporality between medication non-adherence and subsequent cardiovascular events. Secondly, the use of self-reported adherence measures like MMAS may overestimate true adherence due to social desirability bias. Objective measures like pharmacy refill data could enhance accuracy. Lastly, the study was restricted to a specific region which may limit generalizability of findings to elderly Saudi patients nationwide. However, it provides valuable data on a key issue facing a high-risk population that is growing exponentially.

The key implications of this study are multifold. First, it highlights the need for routine adherence screening among elderly CVD patients using simple tools like MMAS to identify high-risk individuals requiring intervention. Second, clinicians should pay greater attention to complex polypharmacy regimens, reinforcing necessity and benefits of each medication. Simplifying dosing through fixed-dose combination pills and extending prescription durations can enhance adherence. Third, family engagement is crucial, as caregiver support improves adherence through reminding, monitoring and dispensing medications. Finally, digitally-enabled interventions like text reminders, online portals and mobile apps represent promising new strategies to promote adherence in elderly patients.²⁹

In conclusion, this study demonstrates a high prevalence of medication non-adherence among elderly CVD patients in the Al Ahsa region of Saudi Arabia, which is significantly associated with worse cardiovascular outcomes including mortality. Routine adherence monitoring and targeted interventions to optimize compliance are warranted in this vulnerable population. Future longitudinal studies can further investigate predictive factors and effective strategies to improve medication-taking behaviors and subsequent cardiovascular health among non-adherent elderly individuals.

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