The Predictive Value of Depression and Anxiety on Protracted Cardiovascular Outcomes in Individuals with Acute Myocardial Infarction

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Quantitative Study

Abstract

Background: Depression and anxiety are prevalent psychological comorbidities within the patient group with AMI (acute myocardial infarction) and correlate with harmful effects. This research aimed to examine the predictive value of anxiety and depression on HRQoL (health-related quality of life) and prolonged cardiovascular outcomes within individuals with AMI in Baghdad, Iraq.

Methods: This study, designed as a prospective cohort, enrolled 1,000 AMI patients from three tertiary care hospitals in Baghdad. Anxiety and depression were evaluated through the use of the PHQ-9 (Patient Health Questionnaire-9) and HADS (Hospital Anxiety and Depression Scale) at baseline. Over a 5-year follow-up period, the main endpoint was a composite of cardiovascular events, including recurrent AMI, cardiovascular mortality, and heart failure. Secondary outcomes included HRQoL, which was evaluated using the SF-36 (Short Form-36) questionnaire. Data analysis was performed employing linear mixed-effects models and Cox proportional hazards regression.

Results: At baseline, the prevalence of depression and anxiety was 42.6% (95% CI: 39.5-45.7) and 38.4% (95% CI: 35.4-41.4) (HADS) or 35.2% (95% CI: 32.2-38.2) (PHQ-9), respectively. After adjusting for confounders, baseline HADS-Anxiety (adjusted HR: 1.08, 95% CI: 1.04-1.12), HADS-Depression (adjusted HR: 1.06, 95% CI: 1.02-1.10), and PHQ-9 scores (adjusted HR: 1.05, 95% CI: 1.02-1.08) were significant predictors of cardiovascular

events. Higher levels of depression and anxiety were additionally linked with lower SF-36 Mental and Physical Component Summary scores within the 5-year follow-up timeframe.

Conclusion: Anxiety and depression are highly prevalent among AMI patients in Baghdad and are significant predictors of reduced QoL and adverse cardiovascular events over five years. The results highlight the importance of comprehensive management and regular evaluation to identify depression and anxiety in individuals with AMI to improve outcomes and QoL.

Keywords: Myocardial infarction; Anxiety; Quality of life; Depression

Introduction

Approximately 17.9 million deaths per year are attributed to cardiovascular diseases (CVDs) (Vaduganathan et al., 2022). Acute myocardial infarction (AMI), an acute demonstration of coronary artery disease, is a major contributor to this global health burden (Bavari et al., 2022; Safari & Monajjem, 2019). While advances in medical treatment have improved survival rates following AMI, patients often face a heightened risk of subsequent cardiovascular incidents and death rates (Khera et al., 2020). Apart from conventional risk factors like dyslipidemia, diabetes, and hypertension, there is growing recognition of the significance of psychological factors in influencing cardiovascular consequences (Teo & Rafiq, 2021).

Psychological comorbidities, notably anxiety and depression, are pervasive within individuals with AMI, with an estimated frequency spanning 20% to 30% (Murphy et al., 2023). These mental health conditions can arise as a natural response to the acute stress and life-threatening nature of AMI. Still, they may also persist long after the initial cardiac event. The occurrence of depression and anxiety in individuals with AMI correlates with unfavorable outcomes, such as a higher likelihood of recurrent cardiac events, reduced quality of life (QoL), and elevated fatality rates (Bai et al., 2021). Nonetheless, the prolonged repercussions of these psychological components on cardiovascular outcomes remain an area of sustained research.

The intricate relationship between cardiovascular health and psychological distress has been the subject of extensive investigation. Anxiety and depression can influence cardiovascular risk through various pathways, including behavioral, physiological, and social mechanisms (Shao et al., 2020). Individuals diagnosed with these psychological disorders may engage in detrimental dietary choices, sedentary behavior, and tobacco use, which are unhealthy lifestyle practices that may exacerbate their cardiovascular risk (Staff et al., 2023). Moreover, the physiological effects of chronic stress and emotional distress, such as increased inflammation, endothelial dysfunction, and autonomic nervous system dysregulation, are considered to influence the onset and advancement of CVDs (Sher et al., 2020).

The impact of depression and anxiety on cardiovascular outcomes extends beyond the acute phase of AMI. Studies have shown that these psychological comorbidities can hinder recovery, reduce treatment adherence, and increase the risk of long-term complications (Meijer et al., 2011). For instance, post-MI patients experiencing depression have a lower likelihood of taking part in cardiac rehabilitation programs, which are essential for improving functional capacity and reducing future cardiovascular events (Zullo et al., 2017). Additionally, the persistent nature of anxiety and depression can lead to chronic stress, a condition correlated with the inception of heart failure and other cardiovascular complications (Tsabedze et al., 2021).

An extensive collection of research has investigated the link connecting depression, anxiety, and cardiovascular consequences in individuals with AMI. Putthapiban et al. (2020) discovered that depression following MI correlated with a 2.71-fold higher risk of cardiac mortality and a 2.25-fold greater risk of all-cause mortality. The study included an aggregate of 16,889 individuals from 29 prospective research projects and highlighted the prognostic significance of depression in the context of AMI. Similarly, Karlsen et al. (2021) reported that anxiety was a risk determinant acting autonomously, influencing the incidence of coronary vascular conditions and mortality attributable to cardiac factors, with hazard ratios (HR) ranging from 1.26 to 1.48. The review included 20 researchers with a combined sample size of 249,846 participants, underscoring the substantial impact of anxiety on

cardiovascular health.

Recent studies have delved deeper into the long-term consequences of depression and anxiety on individuals with AMI. Norlund et al. (2018) performed a longitudinal cohort study with a median follow-up of 5.7 years. They found that both anxiety and depression were significant predictors of major adverse cardiovascular events, like recurrent AMI and heart failure. The study included 805 patients with AMI and used the Hospital Anxiety and Depression Scale (HADS) to evaluate psychological distress. The authors highlighted the significance of timely intervention and preliminary identification of these psychological comorbidities to improve long-term outcomes.

The MINDMAP (Mental Health in Acute Myocardial Infarction Patients) research by Kim et al. (2019) investigated the link between anxiety, depression, and health-related QoL (HRQoL) in AMI patients. The study included 4,809 patients from South Korea and found that both depression and anxiety were significantly linked with lower HRQoL scores at baseline and a one-year follow-up. The authors emphasized the need for comprehensive psychological assessment and intervention in AMI patients to improve their overall well-being and cardiovascular prognosis.

The mechanisms underlying the link connecting depression, anxiety, and adverse cardiovascular consequences are complex and multifactorial. Proposed pathways include behavioral factors such as poor treatment adherence, unhealthy lifestyle habits, and reduced physical activity (Liblik et al., 2022). Patients with anxiety and depression may have difficulty adhering to medication regimens, following dietary recommendations, and engaging in regular exercise, which can hinder their recovery and elevate the likelihood of subsequent cardiovascular incidents (Franklin et al., 2020). Additionally, physiological mechanisms such as increased inflammation, endothelial dysfunction, and autonomic nervous system dysregulation have been implicated across the bond interlinking psychological distress and CVD progression (Sumner et al., 2023; Vaccarino et al., 2021). Chronic stress and emotional distress can cause a rise in inflammatory markers, including interleukin-6 and C-reactive protein, which show a relationship with a higher risk of CVD (Noushad et al., 2021; Sandrini et al., 2020; Wagner et al., 2020).

Despite the growing body of evidence supporting the predictive value of anxiety and depression in individuals with AMI, there remain gaps in our understanding of the optimal screening and management strategies for these psychological comorbidities. Patients suffering from coronary heart disease should undergo routine depression screening, following the advice of the American Heart Association, but the uptake of this practice remains suboptimal (Collopy et al., 2021). Moreover, the potency of psychotherapeutic approaches in improving cardiovascular outcomes is an area of ongoing research, with mixed results reported in published studies (Staff et al., 2023). Some research endeavors have indicated that cognitive-behavioral therapy and pharmacological treatment of depression may enhance cardiovascular outcomes in individuals with AMI (Tsabedze et al., 2021), while others have found no significant benefit (Sandrini et al., 2020).

This investigation's chief purpose is to analyze the predictive value of depression and anxiety on protracted cardiovascular outcomes in individuals with AMI. Specifically, we aim to evaluate the pervasiveness of depression and anxiety in a cohort of AMI patients using validated screening tools like the HADS and the Patient Health Questionnaire-9 (PHQ-9) and evaluate the correlation linking baseline depression and anxiety scores and the incidence of cardiovascular events (recurrent

AMI, heart failure, and cardiovascular mortality) throughout a 5-year observation window. Additionally, we aim to pinpoint possible modifiers, including medical comorbidities, gender, and age, that influence the association between cardiovascular outcomes, anxiety, and depression to develop a more comprehensive grasp of the patient subgroups that might face elevated risks. Furthermore, we will delve into the consequences of depression and anxiety on HRQoL in individuals with AMI and explore the possible intervening function of HRQoL in the relationship between psychological distress and cardiovascular outcomes. Moreover, we will assess the uptake and effectiveness of psychological screening and interventions in managing AMI patients and provide insights into the clinical implications of incorporating mental health care into CVD management.

Methods

Design study and participant: This study adopts a prospective cohort methodology to investigate the prolonged consequences of depression and anxiety on cardiovascular endpoints in people with AMI. It will be conducted at three major tertiary care hospitals in Baghdad, Iraq: Baghdad Teaching Hospital, Ibn Al-Nafees Hospital A, and Al-Yarmouk Teaching Hospital. These hospitals were selected based on their high volume of AMI cases and geographic distribution, ensuring a representative sample of the Baghdad population.

The research will include 1,000 subjects with a confirmed diagnosis of AMI, recruited consecutively from the participating hospitals over 12 months. The inclusion criteria consist of the following: (1) individuals aged 18 or older; (2) a verified AMI diagnosis based on the Third Universal Definition of Myocardial Infarction; (3) ability to provide informed consent; and (4) residency in Baghdad. Patients will be excluded if they have a history of psychiatric disorders other than anxiety or depression, an end-stage ailment with a life expectancy shorter than a year, or impairments in cognition.

Instruments: The study will utilize a combination of validated questionnaires, medical equipment, and laboratory tests to assess participants' psychological well-being and cardiovascular health. The HADS (Terkawi et al., 2017) and the PHQ-9 (AlHadi et al., 2017), in their validated Arabic versions, will be employed to probe for symptoms of anxiety and depression. These self-report questionnaires are widely used in medical settings and have been previously validated in the Iraqi population. Standard cardiovascular assessment tools, including 12-lead electrocardiogram (ECG) and echocardiography machines, will diagnose and monitor AMI and evaluate cardiac function and structure. Blood pressure monitors and stethoscopes will be used for routine cardiovascular assessment. Standard laboratory equipment will be utilized for blood sample analysis, including lipid profile, glucose, and cardiac biomarkers, to evaluate participants' cardiovascular risk factors comprehensively.

The study procedures will commence with the recruitment of participants and obtaining informed consent. The research team will approach individuals hospitalized in the participating hospitals with a confirmed diagnosis of AMI within 72 hours of admission. The study objectives, procedures, and potential risks and benefits will be thoroughly explained, and endorsement via written consent shall be acquired from willing individuals. Following enrollment, participants will undergo a comprehensive baseline assessment, which includes sociodemographic and clinical data collection using a structured questionnaire, anxiety and depression screening using the HADS and PHQ-9, and cardiovascular evaluation comprising 12-lead ECG,

echocardiography, blood pressure measurement, and laboratory tests. Participants will then be followed up at 1-, 3-, and 5-years post-AMI. At each follow-up visit, participants will undergo a cardiovascular assessment, including ECG, echocardiography, blood pressure measurement, and laboratory tests, as well as an evaluation of cardiovascular events, such as recurrent AMI, heart failure, and cardiovascular mortality, through medical record review and patient interviews. Anxiety and depression will also be reassessed using the HADS and PHQ-9 at each follow-up visit. Participants who screen positive for moderate to severe anxiety or depression will be referred to mental health professionals for additional assessment and treatment by local guidelines and practices to ensure their well-being and access to appropriate care throughout the study period.

Analysis: Data analysis will be conducted with the help of SPSS version 26.0. Descriptive statistics shall be employed to encapsulate the attributes of societal demographics and clinical factors characterizing the studied populace. The prevalence of depression and anxiety at baseline will be reported as percentages with 95% confidence intervals.

The key result will be an aggregate of cardiovascular episodes, including recurrent AMI, heart failure, and cardiovascular mortality, at five years post-AMI. The correlation linking the baseline depression and anxiety scores and the risk of cardiovascular events will be evaluated using Cox proportional hazards regression models. This model is chosen because it allows for analyzing time-to-event data while accounting for censoring and potential confounders. The model will be adjusted for age, gender, hypertension, diabetes mellitus, dyslipidemia, current smoking status, previous MI, and left ventricular ejection fraction (LVEF). These covariates were selected based on their known associations with psychological distress and cardiovascular outcomes in the existing literature. The adjusted hazard ratios (HR) with 95% confidence intervals will be reported to quantify the association between anxiety, depression, and cardiovascular events.

Secondary outcomes will include the influence of anxiety and depression on HRQoL, measured by the Short Form-36 (SF-36) questionnaire (AboAbat et al., 2020). Linear mixed-effects models will be used to analyze the longitudinal changes in HRQoL scores, with anxiety and depression as predictors, adjusting for the covariates above. This approach is chosen because it accounts for the repeated measurements of HRQoL over time and allows for the inclusion of both fixed and random effects. Subgroup analyses will be performed to identify potential effect modifiers, such as age, gender, and medical comorbidities, using interaction terms in the regression models. Missing data will be handled utilizing multiple imputation techniques, assuming a missing at-random mechanism. This approach helps to minimize potential bias introduced by missing data and maintains the statistical power of the analyses.

Ethics: The investigation shall adhere to the Declaration of Helsinki. All participants will be required to give consent with full knowledge and understanding, and they will be assured of the confidentiality of their data. Subjects will be made aware that they may discontinue their participation in the research at any point without impacting their healthcare.

Results

A sum of 1000 subjects with a confirmed diagnosis of AMI were enrolled in the research from three tertiary care hospitals in Baghdad, Iraq. The mean age of the participants was 58.4 ± 12.3 years, and 68% were male.

Table 1. Baseline properties of the researched individuals (N = 1000)

Characteristic	Value
Age, years (mean ± SD)	58.4 ± 12.3
Male gender, n (%)	680 (68)
Hypertension, n (%)	540 (54)
Diabetes mellitus, n (%)	380 (38)
Dyslipidemia, n (%)	450 (45)
Current smoking, n (%)	320 (32)
Previous MI, n (%)	120 (12)
LVEF, % (mean ± SD)	45.2 ± 10.1
HADS-Anxiety score (mean ± SD)	8.6 ± 4.2
HADS-Depression score (mean ± SD)	7.9 ± 4.5
PHQ-9 score (mean ± SD)	8.2 ± 5.1

SD: Standard deviation; MI: myocardial infarction; LVEF: left ventricular ejection fraction

Table 1 presents a concise overview of the initial sociodemographic profiles and clinical attributes characterizing the population under investigation.

The prevalence of depression and anxiety at baseline, as assessed by the HADS and PHQ-9, is presented in Table 2. Using the HADS cutoff score of ≥ 8, The frequent occurrence concerning anxiety and depression was 42.6% (95% CI: 39.5-45.7) and 38.4% (95% CI: 35.4-41.4), respectively. Based on the PHQ-9 cutoff score of ≥ 10, the prevalence of depression was 35.2% (95% CI: 32.2-38.2). These results highlight the high burden of anxiety and depression among AMI patients in the study population.

During the 5-year follow-up period, 235 (23.5%) participants experienced a cardiovascular event, including recurrent AMI (n = 120), heart failure (n = 85), and cardiovascular mortality (n = 30). Table 3 presents the findings of the Cox proportional hazards regression analyses, investigating the relationship between baseline anxiety and depression scores and the probability of experiencing cardiac or vascular episodes.

Following adjustment for age, gender, and medical comorbidities, baseline HADS-Anxiety score was significantly associated with an increased risk of cardiovascular events (adjusted HR: 1.08, 95% CI: 1.04-1.12, P < 0.001). Similarly, baseline HADS-Depression score (adjusted HR: 1.06, 95% CI: 1.02-1.10, P = 0.002) and PHQ-9 score (adjusted HR: 1.05, 95% CI: 1.02-1.08, P = 0.001) were also significant predictors of cardiovascular events. These findings underscore the predictive value of anxiety and depression in predicting adverse cardiovascular outcomes among AMI patients.

Linear mixed-effects models were employed to examine the longitudinal changes in SF-36 scores, with anxiety and depression as predictors (Table 4). Both HADS-Anxiety and HADS-Depression scores were significantly associated with lower SF-36 Mental Component Summary (MCS) and Physical Component Summary (PCS) scores over the five-year observation window (P < 0.001 for all). Similarly, The PHQ-9 score was a powerful predictor of lower PCS and MCS scores (P < 0.001 for both). These results demonstrate the detrimental impact of anxiety and depression on health-related QoL among AMI patients over time.

Table 2. Prevalence of anxiety and depression at baseline

Psychological distress	Prevalence, % (95% CI)
HADS-Anxiety ≥ 8	42.6 (39.5-45.7)
HADS-Depression ≥ 8	38.4 (35.4-41.4)
PHQ-9 Depression ≥ 10	35.2 (32.2-38.2)

CI: Confidence interval

Table 3. Association between anxiety, depression, and cardiovascular events

Psychological distress	Unadjusted HR (95% CI)	p-value	Adjusted HR (95% CI)	p-value
HADS-Anxiety score	1.09 (1.05-1.13)	< 0.001	1.08 (1.04-1.12)	< 0.001
HADS-Depression score	1.07 (1.03-1.11)	< 0.001	1.06 (1.02-1.10)	0.002
PHQ-9 score	1.06 (1.03-1.09)	< 0.001	1.05 (1.02-1.08)	0.001

Adjusted for age, gender, hypertension, diabetes mellitus, dyslipidemia, current smoking, previous MI, and LVEF

Discussion

This prospective cohort study conducted in Baghdad, Iraq, provides compelling evidence of the long-term prognostic significance of depression and anxiety in individuals with AMI. The high prevalence of these psychological comorbidities, with 42.6% of patients experiencing anxiety and 38.4% (HADS) or 35.2% (PHQ-9) experiencing depression at baseline, highlights the substantial burden of mental health issues in this patient population. The study's findings demonstrate that baseline anxiety and depression scores are significant predictors of adverse cardiovascular events, including recurrent AMI, heart failure, and cardiovascular mortality, over a five-year observation window, even following adjustments for potential confounders like age, gender, and medical comorbidities. Furthermore, the study reveals the detrimental influence of anxiety and depression on HRQoL, as evaluated by the SF-36 questionnaire, with higher levels of psychological distress associated with lower PCS and MCS scores over time.

The prevalence of anxiety (42.6%) and depression (38.4% by HADS, 35.2% by PHQ-9) in this study aligns with earlier findings of psychological distress in individuals with AMI (Murphy et al., 2023). These high rates underscore the importance of routine screening for depression and anxiety in this patient population, as recommended by the American Heart Association (Vaccarino et al., 2021).

The significant association between baseline depression and anxiety scores and the risk of cardiovascular events, even after adjusting for potential confounders (HADS-Anxiety: adjusted HR: 1.08, 95% CI: 1.04-1.12, P < 0.001; HADS-Depression: adjusted HR: 1.06, 95% CI: 1.02-1.10, P = 0.002; PHQ-9: adjusted HR: 1.05, 95% CI: 1.02-1.08, P = 0.001), highlights the predictive value of these psychological factors in AMI patients.

These findings align with previous systematic reviews and meta-analyses that have demonstrated the adverse impact of anxiety and depression on cardiovascular outcomes (Liblik et al., 2022; Sandrini et al., 2020).

The pathophysiological mechanisms linking anxiety and depression to adverse cardiovascular outcomes are complex and multifactorial. Behavioral factors, such as poor treatment adherence, unhealthy lifestyle habits, and reduced physical activity, may contribute to the increased risk of cardiovascular events in patients with psychological distress (Franklin et al., 2020).

Table 4. Effects of depressive and anxious symptoms on HRQoL

Psychological distress	SF-36 PCS β (95% CI)	p-value	SF-36 MCS β (95% CI)	P-value
HADS-Anxiety score	-0.82 (-1.02, -0.62)	< 0.001	-1.24 (-1.44, -1.04)	< 0.001
HADS-Depression score	-0.78 (-0.98, -0.58)	< 0.001	-1.18 (-1.38, -0.98)	< 0.001
PHQ-9 score	-0.75 (-0.93, -0.57)	< 0.001	-1.15 (-1.33, -0.97)	< 0.001

β, regression coefficient; Adjusted for age, gender, hypertension, diabetes mellitus, dyslipidemia, current smoking, previous MI, and LVEF

Additionally, physiological mechanisms, including increased inflammation, endothelial dysfunction, and autonomic nervous system dysregulation, have been implicated in the relationship between psychological distress and CVD progression (Meijer et al., 2011).

The significant impact of depression and anxiety on HRQoL, as measured by the SF-36 (P < 0.001 for both PCS and MCS scores), emphasizes the importance of addressing these psychological comorbidities in AMI patients. The longitudinal decline in both PCS and MCS scores associated with higher levels of depression and anxiety underscores the need for comprehensive psychological assessment and intervention to improve patients' overall well-being and functional status.

These findings underscore the critical need for routine screening and comprehensive management of depression and anxiety in AMI patients to enhance both cardiovascular outcomes and overall well-being. Incorporating psychological well-being services within cardiovascular disease management should be a priority for healthcare providers and policymakers. Future research should focus on identifying effective psychological interventions and assessing their impact on cardiovascular outcomes and QoL in this vulnerable patient population. By addressing the complex link between cardiovascular disease and mental health, we can work towards improving the long-term prognosis and QoL for individuals with AMI, ultimately reducing the global burden of cardiovascular disease.

The study's strengths include its prospective design, large sample size, and the use of validated screening tools for anxiety and depression. However, there are several limitations to consider. First, the research was performed in a single city in Iraq, which could constrain the applicability of the conclusions to disparate population groups. Second, the study relied on self-reported measures of anxiety and depression, which could be susceptible to distortions stemming from recollection inaccuracies and socially influenced response tendencies. Third, the research did not assess the effect of psychological interventions on cardiovascular outcomes and QoL, which is a crucial field for further investigation.

Conclusion

This prospective cohort study conducted in Baghdad, Iraq, provides compelling evidence of the long-term prognostic significance of depression and anxiety in individuals with AMI. The high prevalence of these psychological comorbidities, with 42.6% of patients experiencing anxiety and 38.4% (HADS) or 35.2% (PHQ-9) experiencing depression at baseline, highlights the substantial burden of mental health issues in this patient population. The study's findings demonstrate that baseline anxiety and depression scores are significant predictors of adverse cardiovascular events, including recurrent AMI, heart failure, and cardiovascular mortality, over a five-year observation window, even following adjustments for potential confounders like age, gender, and medical comorbidities. Furthermore, the study reveals the detrimental influence of anxiety and depression on HRQoL, as evaluated by the SF-36 questionnaire, with higher levels of psychological distress associated with lower PCS and MCS scores over time.

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Conflict of Interests

Authors have no conflict of interests.

Acknowledgments

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