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Review

Prevalence, Incidence, Diagnosis and Management of Myocardial Infarction in Saudi Arabia

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Abstract

Cardiovascular disease (CVD) affects a third of the global population, with myocardial infarction (MI) being a severe form primarily caused by coronary artery disease (CAD). Saudi Arabia's urbanization has led to an increase in CAD cases, driven by risk factors like obesity, hypercholesterolemia, diabetes, hypertension, and dyslipidemia. Family history also plays a role, especially in younger myocardial infarction (MI) patients. Diagnostic tools include electrocardiography, cardiac biomarkers, and imaging. Telemedicine aids in remote diagnosis. Recent studies in Saudi Arabia show chest pain as a common MI symptom, with younger patients more likely to have ST-segment elevation MI. Management follows international guidelines, emphasizing early recognition, emergency medical services intervention, and reperfusion therapy. Medications, including antiplatelets and statins, are used, but gender disparities exist. Cardiac rehabilitation programs and public health initiatives contribute to post-MI care. Despite advancements, challenges like door-to-balloon time persist, requiring further improvements in MI care in Saudi Arabia.

Keywords: *cardiovascular disease, myocardial infarction, coronary artery disease, risk factors, diagnosis, Saudi Arabia*

Introduction

The World Health Organization estimates that roughly a third of all people worldwide suffer from cardiovascular disease (CVD), which also has a significant mortality rate (46% in 2014) (1-3). One of the more severe forms of CVD, myocardial infarction (MI), occurs primarily due to coronary artery disease (CAD). A major contributor to death and disability globally, CAD is a chronic condition characterized by damage to arterial endothelial cells and the build-up of lipid-dense atheroma in the sub-endothelial layer (2, 3). The prevalence of coronary artery disease, which contributes significantly to MI-related mortality, is 5.5% in Saudi Arabia (4). Globally, an MI incident is estimated to occur once every 40 seconds, and each year, about 130,974 Saudis suffer an MI episode (5, 6).

Saudi Arabia has made enormous advancements in society and economy over the last five decades, and it's social, nutritional, and lifestyle practices now have similarities to those of Western nations. The proportion of coronary heart disease patients seen at large hospitals has significantly increased in tandem with these changes (7). However, there are not sufficient epidemiological records available to determine the condition's true prevalence and established risk factors (8). Globally, numerous risk factors have been identified to have a role in the development of CAD and MI. These include abdominal obesity, hypercholesterolemia, diabetes mellitus (DM), hypertension (HTN), and dyslipidemia. It has been unequivocally demonstrated that the modification of a single risk factor can yield a notably positive influence on patient outcomes (9). The high frequency of modifiable risk factors for CAD is partially attributable to urbanization. Prior to 1950, coronary artery disease was uncommon in people under 30 (10), but it is now more frequently diagnosed in younger patients (11). Family history is a significant risk factor for the development of MI in these young patients. According to one study, younger MI patients are more likely than older patients to have a family history of CAD (12) **(Table 1)**.

Table 1. Risk factors for myocardial infarction

Risk Factors	Description
Age	Risk increases with advancing age.
Gender	Men are generally at higher risk than women.
Family History	A family history of MI or heart disease increases risk.
Smoking	Cigarette smoking is a major risk factor for MI.
HTN	High blood pressure contributes to MI risk.
Hypercholesterolemia	Elevated cholesterol levels, particularly LDL, are a risk factor.
DM	Individuals with diabetes are at higher risk of MI.
Obesity	Excess body weight, especially abdominal obesity, increases risk.
Physical Inactivity	Lack of regular exercise is a risk factor.
Diet	A diet high in saturated fats and low in fruits and vegetables increases risk.
Stress	Chronic stress can contribute to MI risk.
Alcohol Consumption	Excessive alcohol intake can increase risk.
Drug Abuse	Illicit drug use, especially stimulants, can be a risk factor.

According to earlier research in other countries, the most prevalent risk factors for patients below 45 were smoking, family history, and hypercholesterolemia; for patients over 45, the most common risk factors were DM and HTN (13). According to a recent study, the two risk factors that are most prevalent in both age groups are smoking and dyslipidemia (14). Research has demonstrated that older patients have a higher mortality rate from MI (15, 16). Nonetheless, a recent study observed comparable mortality in elderly and young people but comparatively lower morbidity in the latter (14). This review aims to provide an overview of the current state of MI in Saudi Arabia, shedding light on its incidence, diagnostic approaches, and management strategies.

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Methodology

This study is based on a comprehensive literature search conducted on October 25, 2023, in the Medline and Cochrane databases, utilizing the medical topic headings (MeSH) and a combination of all available related terms, according to the database. To prevent missing any possible research, a manual search for publications was conducted through Google Scholar, using the reference lists of the previously listed papers as a starting point. We looked for valuable information in papers that discussed the prevalence, incidence, diagnosis, and management of myocardial infarction in Saudi Arabia. There were no restrictions on date, language, participant age, or type of publication.

Discussion

Early recognition and diagnosis are paramount in the case of MI. The process begins with the prompt recognition of MI symptoms, such as chest pain, breathlessness, and other warning signs. Patients are strongly encouraged to seek medical attention immediately upon experiencing these symptoms. Established on international guidelines, the diagnosis of MI in Saudi Arabia is a comprehensive process that involves clinical assessment and a battery of diagnostic tests. Healthcare providers in the country adhere to established protocols for MI diagnosis (17).

Patients presenting with symptoms such as chest pain or discomfort, shortness of breath, and nausea are evaluated promptly (18). Medical history, including risk factors like DM and HTN, is carefully recorded to aid in risk assessment (17). Electrocardiography (ECG or EKG) is a standard diagnostic tool used to record the heart's electrical activity and identify characteristic changes indicative of MI (19). Most cases base the diagnosis of acute MI on 12-lead ECG reports. The cases are then classified as non-ST segment elevation MI (NSTEMI) or ST-segment elevation MI (STEMI) according to the 2004 American College of Cardiology/American Heart Association (ACA/AHA) guidelines. Additionally, cardiac biomarkers such as high-sensitivity troponin called cardiac troponin T, creatine kinase-MB (CK-MB), myoglobin, pro-brain natriuretic peptide and pro-calcitonin are measured serially to detect myocardial injury (20). Advanced imaging techniques, including coronary angiography and echocardiography, help assess the extent of coronary artery involvement and the impact of MI on heart function, including post-MI complications such as mitral regurgitation and congestive heart failure (CHF) (18). In some cases, computed tomography (CT) angiography is used as a non-invasive alternative. Accurate diagnosis is crucial, and healthcare professionals are trained to differentiate MI from other conditions with similar symptoms. Telemedicine and remote consultations have also become valuable tools, ensuring that even in remote or underserved areas, patients receive timely evaluation and diagnosis (21). Saudi Arabia's healthcare system is well-equipped to provide early and precise MI diagnosis, facilitating prompt and appropriate treatment initiation to improve patient outcomes **(Table 2)**.

Table 2. Diagnostic methods and tests used for diagnosing myocardial infarction

Diagnostic Method/Test	Description
Clinical Assessment	Evaluation of patient history, symptoms, and risk factors.
ECG	Recording of the heart's electrical activity; ST-segment changes are indicative of MI.
Cardiac Biomarkers	Measurement of cardiac troponin T, CK-MB, myoglobin, pro-brain natriuretic peptide, and pro-calcitonin to detect myocardial injury.
Imaging (e.g. Echocardiography)	Assessment of heart function and post-MI complications such as mitral regurgitation and congestive heart failure.
Coronary Angiography	Invasive procedure to visualize coronary arteries and identify blockages.
CT Angiography	Non-invasive imaging to assess coronary artery involvement.
Telemedicine and Remote Consultations	Virtual consultations to facilitate timely evaluation in remote areas.
Differential Diagnosis	Distinguishing MI from conditions with similar symptoms such as angina pectoris or gastrointestinal issues.

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One study by Jabali et al. focused on the clinical profile of acute MI in Saudi patients (both citizens and residents) and observed that chest pain was the most widespread symptom, with nearly 85% of patients presenting with it (22). Further, younger patients (>45 years) showed a greater likelihood of experiencing it (91% vs. 84%). Breathlessness was the next most prevalent manifestation, and it was more prevalent in the older subjects (25% vs. 19%). The older individuals (≤45 years) also experienced alterations in consciousness, pain in their epigastric region, and dizziness more frequently. The ECG findings in the same study found NSTEMI to be the most prevalent pattern in general, appearing in a little more than half the patients. The younger individuals showed a considerably greater frequency of ST-segment elevation MI than the older age group. The most prevalent type of MI was an anterior wall in nearly 52% of cases. Further, younger patients had a considerably greater family history of CAD than older individuals did. Additionally, younger patients had a significantly greater likelihood of smoking (57% vs. 26%; $P < 0.05$). Among the elderly individuals, DM, HTN, and a previous diagnosis of CVD were more prevalent in this study. The study found mitral regurgitation and CHF to be the most prevalent post-MI complications (60% and 20%, respectively), with the observation of greater number of deaths in the older subjects.

Likewise, Alhabib et al. conducted a survey in 2019 based on the Saudi Acute Myocardial Infarction Registry (STARS), where they studied the clinical features, treatment strategies, and outcomes of a representative sample of acute MI patients in Saudi Arabia (23). This was a multicenter study of 50 hospitals, including various health sectors present in the Kingdom. The study showed that patients were comparatively young at diagnosis, had a substantial amount of CAD risk factors, and rarely used emergency medical services (EMS). In contrast to other registries in advanced economies, such as 43.6% within the Myocardial Ischemia National Audit Project UK (MINAP), nearly two-thirds (66%) of those diagnosed with acute MI had STEMI (24). The young average age of acute MI presentation—the patients were almost ten years younger than those studied in developed nations—was most likely the cause of the large number of cases of STEMI. Remarkably, STARS had an even greater prevalence of STEMI than previously investigated local registries; this is probably because a larger percentage of the population in STARS was non-Saudi (45% vs. 15%, respectively).

The management of MI in Saudi Arabia aligns with international guidelines and best practices, with healthcare facilities across the country offering advanced cardiac care. Firstly, the Saudi Arabian healthcare system boasts well-established EMSs that play a crucial role in MI management (23, 25). EMS teams are trained to recognize the signs of MI and provide initial care, including oxygen therapy and administering aspirin, which helps prevent further clot formation. Upon admission to the hospital, patients suspected of having an MI are admitted for further evaluation and treatment. Hospitals across Saudi Arabia, including major cities like Riyadh, Jeddah, and Dammam, are equipped with specialized cardiac care units and catheterization labs for immediate intervention. Reperfusion therapy is a key focus of MI management (26). The primary goal is to restore blood flow to the blocked coronary artery as quickly as possible to salvage heart muscle. Two common methods are employed: Percutaneous Coronary Intervention (PCI), including angioplasty and stent placement, is the preferred method when available and can be performed in numerous cardiac centers across the country (27). Compared to rates reported in prior Saudi registry studies (about 20%), the rate of primary PCIs for patients with STEMI (42.5%) was found to be significantly higher [2-4] in the most recent study on the subject by Alhabib et al. (23). The researchers attributed this discrepancy to a number of factors, such as the increase in the Kingdom's Cath Lab and interventional cardiology numbers, as well as the cardiac community's increasing recognition of the advantages of primary PCI. Even so, Saudi Arabia's primary PCI rate was observed to be lower than that of Western European nations. According to data from the Stent for Life

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initiative, Saudi Arabia has a primary PCI rate of 23 per million people, while Germany and the Netherlands have rates of 638 and 884 per million people, respectively (28). This study also demonstrated the necessity of further advancements in STEMI care, as approximately 40% of STEMI patients were unable to meet the benchmark of a door-to-balloon time of fewer than 90 minutes; female patients were much more likely than their male counterparts to fall short of this goal. Female patients had lesser primary PCI rates than their male patients, according to Swiss and French registry statistics (31% vs. 40% and 47% vs. 55%, respectively) (29, 30). These gender disparities were probably caused by a number of variables, such as unusual symptoms, delaying seeking medical attention, and underreferring women for PCIs and acute cardiac care (31-33). Thrombolytic therapy, which involves the administration of clot-busting medications, may be used when PCI is not immediately available. Medications are a crucial part of MI management in Saudi Arabia, as elsewhere. Patients receive a combination of medications to manage the condition and prevent complications. These commonly include antiplatelet drugs, beta-blockers, ACE inhibitors or angiotensin receptor blockers (ARBs), statins to lower cholesterol levels, and pain relievers or anti-anginal medications as needed. Alhabib et al.'s study found that compared to males, females had a lower likelihood of receiving thrombolytic therapy (23). Further, in both hospitalized patients and those with AMI after a year, it was observed that compared to clopidogrel, ticagrelor was used more sparingly. The American College of Cardiology and the European Society of Cardiology have recommended Ticagrelor for use in AMI in class-I (34, 35). The more expensive cost, the requirement for daily two-dose dosing, and the side effects—dyspnea in particular—were attributed to the low level of Ticagrelor use in this study. Al-Khadra et al. conducted a study on the in-hospital mortality of acute MI in Saudi Arabia in 2015 (36). According to their research, the only medication that significantly positively affected MI-related mortality was nitroglycerin. By decreasing infarct size, infarct expansion, and complications associated with infarcts, nitroglycerin lowered mortality. Because the study group's overall mortality rate was low, other critical medications—such as aspirin, betablockers, and streptokinase—were excluded from their derived multivariate model even though they were statistically significant in univariate analysis.

In conjunction with acute cardiac care, cardiac rehabilitation programs are available throughout Saudi Arabia to aid patients in their recovery and improve their heart health (37). These programs encompass exercise training, dietary counseling, and education on lifestyle modifications. Secondary prevention measures are a long-term focus, aiming to reduce the risk of future cardiac events. This includes ongoing medication management, regular follow-up appointments with healthcare providers, and the monitoring of cardiovascular risk factors, such as blood pressure and cholesterol levels (38).

Public health initiatives, often led by the Ministry of Health in Saudi Arabia and in collaboration with healthcare organizations, play a vital role in raising awareness of cardiovascular risk factors and promoting healthy lifestyles among the population (39). Moreover, ongoing research and data collection efforts help monitor trends, assess the effectiveness of interventions, and guide healthcare policies related to MI management in Saudi Arabia. The diagnosis and management of MI across the healthcare sectors in the Kingdom is comprehensive, well-structured, and continuously evolving to align with global best practices. The healthcare system is equipped to provide timely and effective care, ultimately improving patient outcomes and reducing the burden of MI in the country.

Conclusion

Saudi Arabia has made substantial progress in the comprehensive management of myocardial infarction (MI). The nation's healthcare system effectively identifies and treats MI cases, emphasizing early recognition, prompt diagnosis, and advanced therapies. Public health initiatives and cardiac rehabilitation programs contribute to secondary prevention and healthier lifestyles.

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Nevertheless, challenges such as gender disparities in treatment and timely acute care persist and require attention. Continuous research and data collection efforts are vital to monitor trends and refine healthcare policies.

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Conflict of interest

There is no conflict of interest

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Ethical consideration

Non applicable

Data availability

Data that support the findings of this study are embedded within the manuscript.

Author contribution

All authors contributed to conceptualizing, data drafting, collection and final writing of the manuscript.

References

1. McAloon CJ, Boylan LM, Hamborg T, Stallard N, Osman F, Lim PB, et al. The changing face of cardiovascular disease 2000–2012: An analysis of the world health organisation global health estimates data. International journal of cardiology. 2016;224:256-64.

2. Saeedi M, Alsafi Y, Afghan Y, Al-Khudair S, Al-Dhwailea S, Badawi A. Cardiovascular risk assessment in general population at primary health care centers in Saudi Arabia: Using the World Health Organization/International Society of Hypertension risk prediction charts. Int J Env Res Pub He. 2018;5(3):46-51.

3. Benjamin EJ, Virani SS, Callaway CW, Chamberlain AM, Chang AR, Cheng S, et al. Heart disease and stroke statistics—2018 update: a report from the American Heart Association. Circulation. 2018;137(12):e67-e492.

4. Al-Nozha MM, Arafah MR, Al-Mazrou YY. Coronary artery disease in Saudi Arabia. Saudi med J. 2004;25(9):1165-71.

5. Benjamin EJ, Muntner P, Alonso A, Bittencourt MS, Callaway CW, Carson AP, et al. Heart disease and stroke statistics—2019 update: a report from the American Heart Association. Circulation. 2019;139(10):e56-e528.

6. Aldoori NM. Prevalence of obesity among female adolescents in al-hillah city: future risk of cardiovascular diseases. Research Journal of Pharmacy and Technology. 2017;10(7):2127-31.

7. Al-Gindan YM, Al-Qurain A, Ibrahim EM, Al-Freihi HM, Al-Mohsen MF, Hussein A, et al. Acute myocardial infarction in the Eastern Province of Saudi Arabia: retrospective analysis of 264 patients. Annals of Saudi medicine. 1990;10(2):129-36.

8. Madkour MM, Kudwah AJ. Saudi medical bibliography: volume 3, 1983 and 1984: Churchill Livingstone; 1986.

9. Yusuf S, Hawken S, Ôunpuu S, Dans T, Avezum A, Lanas F, et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. The lancet. 2004;364(9438):937-52.

10. Kaplan AS. Acute myocardial infarction in patients thirty-five years of age and under. Diseases of the Chest. 1967;51(2):137-47.

11. Jneid H, Fonarow GC, Cannon CP, Hernandez AF, Palacios IF, Maree AO, et al. Sex differences in medical care and early death after acute myocardial infarction. Circulation. 2008;118(25):2803-10.

12. Doughty M, Mehta R, Bruckman D, Das S, Karavite D, Tsai T, et al. Acute myocardial infarction in the young—The University of Michigan experience. American heart journal. 2002;143(1):56-62.

13. Garoufalis S, Kouvaras G, Vitsias G, Perdikouris K, Markatou P, Hatzisavas J, et al. Comparison of angiographic findings, risk factors, and long term follow-up between young and old patients with a history of myocardial infarction.

http://dx.doi.org/10.52533/JOHS.2023.31113

International journal of cardiology. 1998;67(1):75-80.

14. Shiraishi J, Kohno Y, Yamaguchi S, Arihara M, Hadase M, Hyogo M, et al. Acute myocardial infarction in young Japanese adults clinical manifestations and in-hospital outcome. Circulation Journal. 2005;69(12):1454-8.

15. Tresch DD, Brady WJ, Aufderheide TP, Lawrence SW, Williams KJ. Comparison of elderly and younger patients with out-of-hospital chest pain. Archives of internal medicine. 1996;156(10):1089-93.

16. Daya J, Bayer AJ, Pathy M, Chadha J. Acute myocardial infarction: diagnostic difficulties and outcome in advanced old age. Age and ageing. 1987;16(4):239-43.

17. Alpert JS, Thygesen K, Jaffe A, White HD. The universal definition of myocardial infarction: a consensus document. Heart. 2008;94(10):1335-41.

18. Vafaie M. State-of-the-art diagnosis of myocardial infarction. Diagnosis. 2016;3(4):137-42.

19. Sgarbossa EB, Birnbaum Y, Parrillo JE. Electrocardiographic diagnosis of acute myocardial infarction: current concepts for the clinician. American heart journal. 2001;141(4):507-17.

20. Aldous SJ. Cardiac biomarkers in acute myocardial infarction. International journal of cardiology. 2013;164(3):282-94.

21. Marcolino MS, Maia LM, Oliveira JAQ, Melo LDR, Pereira BLD, Andrade-Junior DF, et al. Impact of telemedicine interventions on mortality in patients with acute myocardial infarction: a systematic review and meta-analysis. Heart. 2019;105(19):1479-86.

22. Jabali M, Nabalawi R, Alsahabi I, Almutairi M, Alsannat F, Jahhaf J, et al. Clinical profile of acute myocardial infarction at King Abdulaziz University Hospital, Jeddah, Saudi Arabia. Saudi J Intern Med. 2019; 9 (2): 19-26. 1998.

23. Alhabib KF, Kinsara AJ, Alghamdi S, Al-Murayeh M, Hussein GA, AlSaif S, et al. The first survey of the Saudi Acute Myocardial Infarction Registry Program: Main results and long-term outcomes (STARS-1 Program). PLoS One. 2019;14(5):e0216551.

24. Zaman MJ, Stirling S, Shepstone L, Ryding A, Flather M, Bachmann M, et al. The association between older age and receipt of care and outcomes in patients with acute coronary syndromes: a cohort study of the Myocardial Ischaemia National Audit Project (MINAP). European Heart Journal. 2014;35(23):1551-8.

25. Alsomali NH. Early Detection of Myocardial Infarction and Management of Door-To-Balloon Time in Patients with Acute Myocardial Infarction in Saudi Arabia: A Retrospective Cross-Sectional Study.

26. Ibáñez B, Heusch G, Ovize M, Van de Werf F. Evolving therapies for myocardial ischemia/reperfusion injury. Journal of the American College of Cardiology. 2015;65(14):1454-71.

27. Bugami S, Neyaz A, Alabbadi M. In hospital outcomes of primary percutaneous intervention in patients presenting with acute myocardial infarction in Saudi Arabia–A single center study. Chest.75:97.

28. Kristensen SD, Laut KG, Fajadet J, Kaifoszova Z, Kala P, Di Mario C, et al. Reperfusion therapy for ST elevation acute myocardial infarction 2010/2011: current status in 37 ESC countries. European heart journal. 2014;35(29):1957-70.

29. Schiele F, Meneveau N, Seronde M-F, Descotes-Genon V, Chopard R, Janin S, et al. Propensity score-matched analysis of effects of clinical characteristics and treatment on gender difference in outcomes after acute myocardial infarction. The American journal of cardiology. 2011;108(6):789-98.

30. Radovanovic D, Erne P, Urban P, Bertel O, Rickli H, Gaspoz J-M. Gender differences in management and outcomes in patients with acute coronary syndromes: results on 20 290 patients from the AMIS Plus Registry. Heart. 2007;93(11):1369-75.

http://dx.doi.org/10.52533/JOHS.2023.31113

31. Leurent G, Garlantezec R, Auffret V, Hacot JP, Coudert I, Filippi E, et al. Gender differences in presentation, management and inhospital outcome in patients with ST-segment elevation myocardial infarction: data from 5000 patients included in the ORBI prospective French regional registry. Archives of cardiovascular diseases. 2014;107(5):291-8.

32. Chieffo A, Buchanan GL, Mauri F, Mehilli J, Vaquerizo B, Moynagh A, et al. ACS and STEMI treatment: gender-related issues. EuroIntervention. 2012;8(Suppl P):P27-P35.

33. Shehab A, AlHabib KF, Bhagavathula AS, Hersi A, Alfaleh H, Alshamiri MQ, et al. Clinical presentation, quality of care, risk factors and outcomes in women with acute ST-elevation myocardial infarction (STEMI): an observational report from six middle Eastern countries. Current vascular pharmacology. 2019;17(4):388-95.

34. Ibanez B, James S, Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation: The Task Force for the management of acute myocardial infarction in patients presenting with ST-segment elevation of the European Society of Cardiology (ESC). European heart journal. 2018;39(2):119-77.

35. Levine GN, Bates ER, Bittl JA, Brindis RG, Fihn SD, Fleisher LA, et al. 2016 ACC/AHA guideline focused update on duration of dual antiplatelet therapy in patients with coronary artery disease: a report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines: an update of the 2011 ACCF/AHA/SCAI guideline for percutaneous coronary intervention, 2011 ACCF/AHA guideline for coronary artery bypass graft surgery, 2012 ACC/AHA/ACP/AATS/PCNA/SCAI/STS guideline for the diagnosis and management of patients with stable ischemic heart disease, 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction, 2014 AHA/ACC guideline for the management of patients with non–ST-elevation acute coronary syndromes, and 2014 ACC/AHA guideline on perioperative cardiovascular evaluation and management of patients undergoing noncardiac surgery. Circulation. 2016;134(10):e123-e55.

36. Al-Khadra A, Ladlpo G. Inhospital mortality of acute myocardial infarction in Saudi Arabia. Journal of the Saudi Heart Association. 1994;6(2):123-7.

37. Rashed M, Theruvan N, Gad A, Shaheen H, Mosbah S. Cardiac rehabilitation: future of heart health in Saudi Arabia, a perceptual view. World Journal of Cardiovascular Diseases. 2020;10(9):666-77.

38. Moghei M, Turk-Adawi K, Isaranuwatchai W, Sarrafzadegan N, Oh P, Chessex C, et al. Cardiac rehabilitation costs. International Journal of Cardiology. 2017;244:322-8.

39. Tunsi AYB. An Exploration of the Factors that Influence the Adoption of Healthy Lifestyles Among Saudis Living with Cardiovascular Disease (CVD): University of Edinburgh; 2019.

http://dx.doi.org/10.52533/JOHS.2023.31113