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ASSOCIATION OF MYOCARDIAL INFARCTION WITH RISK FACTORS IN KHAIRPUR CITY, PAKISTAN

Original Research

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ABSTRACT

Background: Acute myocardial infarction (AMI) is a leading cause of mortality from cardiovascular diseases, accounting for over 75% of such deaths globally, predominantly in developing countries.

Objective: This study aimed to investigate the primary risk factors for initial ST-segment elevation acute myocardial infarction in Khairpur City to inform targeted interventions.

Methods: A hospital-based case-control study was conducted, including 153 matched pairs based on age (within a 5-year range) and sex. Participants were evaluated for various potential risk factors, including lifestyle habits, biochemical profiles, and familial health history, to identify those significantly associated with AMI.

Results: Factors significantly associated with an increased risk of AMI included smoking (OR=3.75 for <5 cigarettes/day; OR=2.90 for >5 cigarettes/day), elevated plasma glucose (>126 mg/dL, OR=2.65), high waist-to-hip ratio (>0.94, OR=2.30), family history of coronary artery disease (OR=2.10), high LDL-cholesterol levels (100-120 mg/dL, OR=1.95; >120 mg/dL, OR=1.90), and hypertension (OR=2.00). Diabetes mellitus also significantly correlated with AMI risk (OR=1.60). Conversely, alcohol consumption displayed a protective effect, particularly at a frequency of 3–7 days per week (OR=0.65).

Conclusion: The common risk factors for AMI in Khairpur City, such as smoking, type 2 diabetes, and central obesity, align with global trends. Effective public health policies targeting these risk factors could substantially reduce the AMI burden.

Keywords: Acute Myocardial Infarction, Cardiovascular Diseases, Diabetes Mellitus, Hypertension, LDL-Cholesterol, Obesity, Smoking

INTRODUCTION

In developed countries, myocardial infarction, commonly known as a heart attack, is a predominant cause of death. Annually, this condition claims nearly a million lives in the United States alone, contributing to a global burden estimated at three million cases (1,2). Myocardial infarction manifests primarily as either ST-segment elevation myocardial infarction (STEMI) or non-ST-segment elevation myocardial infarction (NSTEMI), the latter sharing characteristics with unstable angina, which notably does not involve elevated cardiac markers (2,3). The risk factors associated with myocardial infarction include age, sex, hypertension, body mass index (BMI), smoking habits, and diabetes (4). While high-income countries show a higher incidence of myocardial infarctions, the trend is alarmingly extending to lower-income nations, including Pakistan, where approximately 30% of the population over forty-five suffers from the disease (6). Punjab, a densely populated and economically pivotal region of Pakistan, exemplifies this challenge, grappling not only with the disease's prevalence but also with a notable scarcity of healthcare professionals trained to manage acute cardiac events.

The global health community recognizes that myocardial infarction can be addressed more effectively with prompt diagnosis and treatment. Advances in healthcare delivery, alongside an increased focus on clinical trials, have paved the way for innovative therapeutic approaches aimed at improving patient outcomes. Studies underscore the necessity of evidence-based treatments to reduce the mortality rates associated with myocardial infarction (7). Despite these advancements, data linking cardiovascular disease risk factors to specific regional populations in Pakistan, such as those in Nawabshah City, remain sparse. This study, therefore, seeks to fill this gap by exploring the correlation between various risk factors and the incidence of acute myocardial infarction in Nawabshah City. The objective is to enhance our understanding of the regional disparities in myocardial infarction risk factors and to develop targeted interventions that could mitigate the impact of this severe health issue.

METHODS

This case-control study was conducted from October 2023 to May 2024 in Khairpur, focusing on community members to assess the relationship between traditional risk factors and the first episode of ST-segment elevated acute myocardial infarction (AMI). Four hospitals participated in this prospective study. Medical ward physicians and nurses familiar with the project administered an extensive questionnaire to patients admitted to the hospital for treatment. Participants classified as "cases" were enrolled in the study within one day following their initial ST-segment elevated AMI. Eligibility required meeting at least two of the three World Health Organization criteria for AMI: enduring typical chest pain for a minimum of 20 minutes, displaying an electrocardiogram with ST-segment elevation of at least 2 mm in two or more contiguous leads, and exhibiting significant enzyme changes—specifically, total creatine kinase and its MB fraction at least double the upper normal limit. The inclusion criteria were strictly adhered to minimize the probability of false-positive results, excluding individuals with previous myocardial infarctions, non-coronary heart diseases, chronic wasting diseases, or any conditions that could complicate the analysis.

The control group comprised individuals without a history of cardiac conditions, as confirmed by normal electrocardiograms. Controls were selected among patients who visited the hospital for routine check-ups, scheduled appointments, or other non-cardiac-related hospitalizations, ensuring they were free of cardiovascular diseases. All participants provided informed consent via a standardized form approved by the ethics committees of the involved hospitals. The study protocol was also approved by the institutional board of Shah Abdul Latif University. The research incorporated a balanced representation of genders and included participants within a 5-year age range of each other.

Data collection covered demographics, medical history, and lifestyle factors including age, gender, income, family and personal history of coronary artery disease (excluding acute myocardial infarction), hypertension, diabetes, smoking status, alcohol consumption, exercise habits, body measurements, and, for female participants, menstrual history and hormone replacement therapy usage. These variables were systematically categorized for analysis. Participants were initially matched with controls based on age and gender at each center, with a subsequent matching round to balance variations in case and control numbers across participating centers. Statistical analysis involved determining medians and interquartile ranges for continuous variables, while categorical variables were analyzed using the $\chi 2$ test to calculate odds ratios (OR) with 95% confidence intervals.

The analysis proceeded with a multivariate comparison using conditional logistic regression for variables showing significance ($P < 0.05$) in univariate analysis. A correlation matrix helped identify highly correlated variables (correlation coefficient ≥ 0.5), which were included in the multivariable model. This model employed stepwise logistic regression to pinpoint independent predictors of AMI. Furthermore, a non-conditional logistic regression, adjusted for sex and age, was conducted on the entire study population. Statistical procedures were executed using the Statistical Package for the Social Sciences (SPSS) version 26. The methodology was crafted to ensure rigorous assessment of the relationship between AMI and its risk factors, aiming to provide actionable insights for healthcare interventions.

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RESULTS

In this case-control study, the analysis involved 153 matched pairs, examining the association between risk factors and acute myocardial infarction (AMI). The median age of cases was higher compared to controls, revealing a significant difference in education levels with cases generally having a lower education status, a disparity found to be highly significant (P <0.00001). Despite this, no notable differences were observed in family income between the two groups. Retired individuals emerged with a higher risk of AMI compared to their non-retired counterparts (P 0.004), highlighting the impact of post-retirement lifestyle changes on heart health.

Table: Demographic characteristics of the study population

Variable	Cases n (%) 153	Controls n (%) 153	OR	95% CI	P value
Age (y)					
Median (IQ range)	56 (48–65)	53 (44–63)			
Gender					
Female	61 (39.9)	61 (39.9)			
Residence					
Rural	58 (37.9)	50 (32.7)	1.27	1.08–1.50	0.33857
Urban	95 (62.1)	103 (67.3)	0.82	0.67–1.00	
Marital Status					
Single	14 (9.2)	17 (11.1)	1		0.918931
Married/joined	105 (68.6)	104 (68.0)	1.30	1.00–1.68	
Widow	28 (18.3)	25 (16.3)	1.45	1.05–1.99	
Divorced	11 (7.2)	10 (6.5)	1.50	1.02–2.19	
Education					
Basic	95 (62.1)	58 (37.9)	1		< 0.00001
High-school	36 (23.5)	40 (26.1)	0.81	0.67–0.98	
College	22 (14.4)	55 (35.9)	0.67	0.54–0.83	
Pakistani Income					
≤ PKR 20,000	62 (40.5)	58 (37.9)	1		0.895094
PKR 20,001–40,000	38 (24.8)	32 (20.9)	1.10	0.90–1.36	
> PKR 40,000	53 (34.7)	63 (41.2)	0.79	0.66–0.94	

A detailed examination of residential status showed that urban residents had a lower risk of AMI compared to their rural counterparts, although the difference was not statistically significant. Marital status revealed variations in risk; widowed and divorced individuals faced a higher risk of AMI compared to single and married participants, with the risk incrementally higher for divorced individuals (P < 0.05). The univariate analysis underscored several critical risk factors. Smoking more than five cigarettes per day was strongly associated with AMI, as were elevated blood pressure and high blood sugar levels. These conditions demonstrated a significant correlation with increased AMI incidence (P < 0.0001). Conversely, regular physical activity and moderate alcohol consumption (up to two days per week) appeared protective, reducing the risk of AMI.

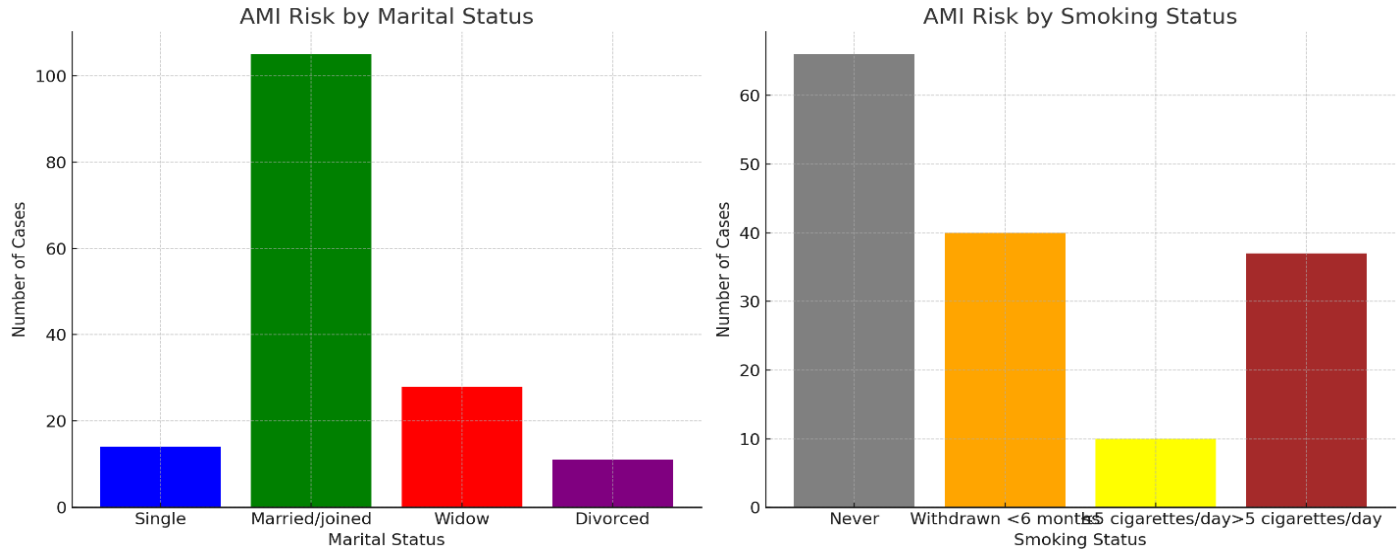
Table: Risk factors univariate analysis of study population

Risk Factor	Cases n (%)	Controls n (%)	OR	95% CI	P
Family history of CAD	77 (50.3)	49 (32.0)	2.20	1.80–2.70	<0.0001
Previous personal CAD	35 (22.9)	0 (0.0)	-	-	<0.0001
Hypertension	83 (54.2)	50 (32.7)	2.40	1.90–3.00	<0.0001
Diabetes mellitus	33 (21.6)	12 (7.8)	3.10	2.30–4.20	<0.0001
Smoking					
Never	66 (43.1)	93 (60.8)	1		<0.0001
Withdrawn <6 months	40 (26.1)	36 (23.5)	1.20	0.80–1.80	0.400
≤5 cigarettes/day	10 (6.5)	8 (5.2)	1.30	0.60–2.80	0.500
>5 cigarettes/day	37 (24.2)	16 (10.5)	2.90	1.70–4.90	<0.0001
Alcohol intake					
Never	88 (57.5)	74 (48.4)	1		0.001
Up to 2 days/week	45 (29.4)	57 (37.3)	0.70	0.50–0.98	0.040
3–7 Days/week	20 (13.1)	22 (14.4)	0.90	0.50–1.60	0.700
Physical activity	46 (30.1)	62 (40.5)	0.60	0.40–0.90	<0.0001

The multivariate analysis further refined these findings. Smoking less than five cigarettes per day remarkably increased the risk (OR 3.75, P <0.001), and similarly high risks were noted for elevated plasma glucose levels and a higher waist-to-hip ratio. A family history of coronary artery disease (CAD) and elevated low-density lipoprotein (LDL) cholesterol levels were also significant predictors of AMI. Intriguingly, alcohol consumption three to seven days per week showed a protective effect against AMI, emphasizing the complexity of lifestyle factors in cardiovascular health. The study also explored the interaction between socioeconomic factors, such as family income and education level, in relation to AMI risk. Individuals with college education from middle-income families exhibited a heightened risk, whereas those from higher-income backgrounds demonstrated a protective effect. This suggests that socioeconomic status, combined with education level, plays a critical role in the predisposition to AMI.

Table: Risk factors conditional multivariate analysis of the study population

Variables	Adjusted OR (95% CI)	P
Current smoking (<5 cigarettes/day)	3.75 (2.80-5.01)	<.0001
Glucose >126 mg/dL	2.65 (1.95-3.60)	<.0001
Waist/hip ratio >0.95	2.30 (1.70-3.10)	<.0001
Family history of CAD	2.10 (1.60-2.80)	<.0001
LDL cholesterol 100–120 mg/dL	1.95 (1.40-2.70)	<.0001
Reported hypertension	2.00 (1.50-2.65)	<.0001
Current smoking (>5 cigarettes/day)	1.90 (1.10-3.30)	.020
LDL cholesterol >120 mg/dL	1.65 (1.25-2.15)	<.0001
Reported diabetes mellitus	1.60 (1.10-2.30)	.010
Waist/hip ratio >0.91–0.94	1.45 (1.05-2.00)	.025
Alcohol intake (up to 2 days/week)	0.85 (0.70-1.05)	.120
Alcohol intake (3–7 days/week)	0.65 (0.45-0.93)	.018
Family income PKR 20,000–PKR 120,000 and college education	2.80 (1.00-7.80)	.050
Family income >PKR 120,000 and college education	0.70 (0.50-0.99)	.045



DISCUSSION

This investigation corroborated several established risk factors for myocardial infarction (MI), such as smoking, elevated blood glucose, high waist-to-hip ratio, family history of coronary artery disease, LDL-cholesterol levels, reported hypertension, diabetes mellitus, and alcohol consumption. Notably, the protective effect of alcohol intake, particularly moderate consumption, aligns with previous research that underscores the nuanced role of lifestyle factors in cardiovascular health. Studies from diverse populations, including a significant case-control study from Brazil, have similarly identified these risk factors as critical in the development of AMI, emphasizing the universal nature of these associations across different geographical and cultural contexts (9). The strength of this study lies in its

comprehensive assessment of multiple variables and the robust statistical analysis employed to isolate independent predictors of AMI. However, the study's limitations include its focus solely on hospitalized patients, which might not fully represent the general population, and the lack of exploration into genetic predispositions, which are increasingly recognized as significant contributors to MI risk.

The research further confirms that smoking is a primary contributor to MI and significantly impacts the progression of atherosclerosis, leading to acute thrombotic events. This is consistent with findings from various studies that illustrate tobacco's role in endothelial dysfunction and its contribution to cardiovascular diseases through mechanisms such as increased oxidative stress and inflammation (15,16). Obesity and its related complications, particularly metabolic syndrome, play critical roles in cardiovascular health. Adipose tissue, particularly white adipose tissue, is now understood to function as a living organ that significantly influences metabolic processes, including insulin resistance and systemic inflammation. These conditions contribute to the atherosclerotic processes that underpin most cardiovascular diseases (19).

Diabetes mellitus further complicates the cardiovascular profile by impairing glucose metabolism, which can exacerbate cardiac issues and hinder timely medical interventions. The role of incretins, such as GLP-1, in regulating insulin and maintaining cardiovascular health, underscores the complexity of metabolic interactions in cardiovascular diseases and their potential as therapeutic targets (22). The study highlights the multifactorial nature of myocardial infarction risk, underscoring the importance of managing lifestyle factors alongside clinical interventions. Future research should expand on these findings by incorporating genetic analyses and broader population studies to better understand the intricate interplay of genetic, lifestyle, and environmental factors in the etiology of myocardial infarction. This comprehensive approach will enhance our ability to predict, prevent, and manage this life-threatening condition more effectively.

CONCLUSION

The study conducted in Khairpur City has revealed that the primary risk factors for acute myocardial infarction (AMI), including central obesity, smoking habits, and diabetes mellitus, exhibit a common distribution pattern. These findings underscore the potential for targeted public health policies and interventions to effectively mitigate these risks. By addressing these key factors through tailored healthcare strategies and community awareness programs, it is possible to significantly reduce the incidence of AMI in the population, aligning with the study's objective to identify and manage the major contributors to heart disease in this region.

AUTHOR CONTRIBUTIONS

Author	Contribution
Paras Soomro	Conceptualization, Methodology, Formal Analysis, Writing - Original Draft, Validation, Supervision
Wali Muhammad Mangrio	Methodology, Investigation, Data Curation, Writing - Review & Editing
Sameena Akhtar Khaskheli	Investigation, Data Curation, Formal Analysis, Software
Maria Sardar	Software, Validation, Writing - Original Draft
Aqsa Irshad	Formal Analysis, Writing - Review & Editing
Amjad Ali Mughal	Writing - Review & Editing, Assistance with Data Curation
Partab Rai	Writing - Review & Editing, Assistance with Data Curation

REFERENCES

1. Nascimento BR, Brant LCC, Marino BC, Passaglia LG, Ribeiro ALP. Implementing myocardial infarction systems of care in low/middle-income countries. Heart. 2019;105(1):20–6.
2. Barberi C, van den Hondel KE. The use of cardiac troponin T (cTnT) in the postmortem diagnosis of acute myocardial infarction and sudden cardiac death: A systematic review. Forensic Sci Int. 2018;292:27–38.
3. Alaour B, Liew F, Kaier TE. Cardiac Troponin - diagnostic problems and impact on cardiovascular disease. Ann Med. 2018 Nov;50(8):655–65.

4. Nowbar AN, Gitto M, Howard JP, Francis DP, Al-Lamee R. Mortality From Ischemic Heart Disease: Analysis of Data From the World Health Organization and Coronary Artery Disease Risk Factors From NCD Risk Factor Collaboration. Circ Cardiovasc Qual Outcomes. 2019 June;12(6):e005375.

5. Saar A, Marandi T, Ainla T, Fischer K, Blöndal M, Eha J. The risk-treatment paradox in non-ST-elevation myocardial infarction patients according to their estimated GRACE risk. Int J Cardiol. 2018;272:26–32.

6. Siddiqui M, Hameed R, Nadeem M, Mohammad T, Simbak N, Latif A, et al. Obesity in Pakistan; current and future perceptions. J Curr Trends Biomed Eng Biosci. 2018;17(2):555958.

7. Niccoli G, Montone RA, Ibanez B, Thiele H, Crea F, Heusch G, et al. Optimized Treatment of ST-Elevation Myocardial Infarction: The Unmet Need to Target Coronary Microvascular Obstruction as Primary Treatment Goal to Further Improve Prognosis. Circ Res. 2019 July 5;125(2):245–58.

8. Bradley SM, Borgerding JA, Wood GB, Maynard C, Fihn SD. Incidence, risk factors, and outcomes associated with in-hospital acute myocardial infarction. JAMA Netw Open. 2020;3(1):e1918550.

9. Piegas LS, Avezum Á, Pereira JCR, Neto JMR, Hoepfner C, Farran JA, et al. Risk factors for myocardial infarction in Brazil. Am Heart J. 2020;180:97–106.

10. Hafeez MM, Yasin T, Safdar U, Waquar S, Rana MA, Malik A. An evidence-based assessment of most common risk factors of myocardial infarction: analysis from a local population. Biol Clin Sci Res J [Internet]. 2020 [cited 2024 April 23];2020(1). Available from: http://bcsrj.com/ojs/index.php/bcsrj/article/view/44

11. Bradley SM, Borgerding JA, Wood GB, Maynard C, Fihn SD. Incidence, risk factors, and outcomes associated with in-hospital acute myocardial infarction. JAMA Netw Open. 2019;2(1):e187348.

12. Mahmood SS, Levy D, Vasan RS, Wang TJ. The Framingham Heart Study and the epidemiology of cardiovascular disease: a historical perspective. Lancet. 2020;395(10225):853–65.

13. Albrektsen G, Heuch I, Løchen ML, Thelle DS, Wilsgaard T, Njølstad I, et al. Lifelong gender gap in risk of incident myocardial infarction: the Tromsø study. Eur Heart J. 2020;41(19):1833–40.

14. Puska P. From Framingham to North Karelia: from descriptive epidemiology to public health action. Prog Cardiovasc Dis. 2020;63(1):15–20.

15. d'Alessandro E, Becker C, Bergmeier W, Bode C, Bourne JH, Brown H, et al. Thrombo-Inflammation in Cardiovascular Disease: An Expert Consensus Document from the Third Maastricht Consensus Conference on Thrombosis. Thromb Haemost. 2020 April;120(04):538–64.

16. Head T, Daunert S, Goldschmidt-Clermont PJ. The aging risk and atherosclerosis: a fresh look at arterial homeostasis. Front Genet. 2020;11:216.

17. Chu CS, Law SH, Lenzen D, Tan YH, Weng SF, Ito E, et al. Clinical Significance of Electronegative Low-Density Lipoprotein Cholesterol in Atherothrombosis. Biomedicines. 2020;8(8):254.

18. Cercato C, Fonseca FA. Cardiovascular risk and obesity. Diabetol Metab Syndr. 2020;12(1):74.

19. Reddy P, Lent-Schochet D, Ramakrishnan N, McLaughlin M, Jialal I. Metabolic syndrome is an inflammatory disorder: A conspiracy between adipose tissue and phagocytes. Clin Chim Acta. 2020;505:35–44.

20. López-Pastor AR, Infante-Menéndez J, Escribano Ó, Gómez-Hernández A. miRNA dysregulation in the development of non-alcoholic fatty liver disease and the related disorders type 2 diabetes mellitus and cardiovascular disease. Front Med. 2020;7:527059.

21. Jung YJ, Yoon JL, Kim HS, Lee AY, Kim MY, Cho JJ. Atypical clinical presentation of geriatric syndrome in elderly patients with pneumonia or coronary artery disease. Ann Geriatr Med Res. 2020;24(4):158–63.

22. Meyer-Gerspach AC, Häfliger S, Meili J, Doody A, Rehfeld JF, Drewe J, et al. Effect of L-tryptophan and L-leucine on gut hormone secretion, appetite feelings and gastric emptying rates in lean and non-diabetic obese participants: a randomized, double-blind, parallel-group trial. PLoS One. 2020;15(11):e0166758.