Risk Management and Healthcare Policy

Dovepress
open access to scientific and medical research

Open Access Full Text Article

ORIGINAL RESEARCH

Mortality and Discharge Outcome in Acute Myocardial Infarction Patients: A Study Based on Korean National Hospital Discharge In-Depth Injury Survey Data

Jieun Hwang[1,2], Kyunghee Lee[3]

[1]Department of Health Administration, College of Health Science, Dankook University, Cheonan City, Chungcheongnam-do, South Korea; [2]Institute of Convergence Healthcare, Dankook University, Cheonan City, Chungcheongnam-do, South Korea; [3]Department of Healthcare Management, Eulji University of Korea, Seongnam City, Kyeonggi-do, South Korea

Correspondence: Kyunghee Lee, Department of Healthcare Management, Eulji University of Korea, 553 Sanseongdaero, Sujeong-Gu, Seongnam City, Kyeonggi-do, 13135, South Korea, Tel +821072428346, Email rose1294@hanmail.net

Purpose: The aim of this study was to analyze hospital-discharged acute myocardial infarction (AMI) patients in Korea (2006–2020) to understand how pre-existing conditions affect mortality rates.

Participants and Methods: This study utilized the 2006–2020 Korean National Hospital Discharge In-depth Injury Survey data. A weighted frequency analysis estimated discharged AMI patients and calculated age-standardized discharge and mortality rates, Charlson Comorbidity Index (CCI) score distribution, and general patient characteristics. Weighted logistic regression analysis examined influencing mortality factors.

Results: There were 486,464 AMI patients (143,751 female), with AMI-related mortality rates at 7.5% (36,312): 5.7% for males (19,190) and 11.8% for females (17,122). The highest mortality rate was among individuals aged 70–79 years (25%). Factors influencing mortality included sex, insurance type, admission route, hospital bed count, region, operation status, and CCI score. Mortality risk at discharge was 1.151 times higher in females than males (95% CI: 1.002–1.322), 0.787 times lower among those with national health insurance than Medicaid recipients (95% CI 0.64–0.967), 2.182 times higher among those admitted via the emergency department than the outpatient department (95% CI 1.747–2.725), and 3.402 times higher in patients with a CCI score of 3 points than those with 0 points (95% CI 1.263–9.162).

Conclusion: The number of discharged AMI patients and related mortality rates increased, underscoring the need for proactive management of chronic diseases, particularly for those with higher CCI scores.

Keywords: acute myocardial infarction, mortality, Charlson Comorbidity Index (CCI), chronic diseases, Korean National Hospital Discharge In-depth Injury Survey data

Introduction

As of 2019, cardiovascular disease (CVD), which includes coronary artery disease, myocardial infarction (MI), stroke, heart failure, and hypertension (HT), was the number one cause of death around the world.[1] While advances in modern medical technology and improved sanitary conditions have led to a decrease in the global mortality rate associated with infectious diseases, an increase in average life expectancy, unhealthy diets, lack of physical activity, drinking, and smoking have caused an increase in chronic diseases such as HT, diabetes, and hyperlipidemia, which are major factors in the etiology of CVD.[2] Consequently, CVD has continued to be the number one cause of mortality since 1990.[3]

Among CVDs, acute myocardial infarction (AMI) refers to a situation where blood flow to the heart vessels is suddenly obstructed, causing an interruption in the supply of oxygen and nutrients to the myocardial tissues that lead to myocardial tissue damage and cardiac dysfunction. Particularly, once cardiac tissues become damaged, it is difficult for

Received: 8 April 2024
Accepted: 22 August 2024
Published: 29 August 2024

such tissues to regain their normal function, requiring timely emergency care. Therefore, early detection and proper treatment of MI play an important role in minimizing cardiac damage and increasing the survival rate.[4]

Mortality among patients with AMI is associated with a combination of various factors. Currently, factors such as age, sex, smoking, drinking, obesity, lack of exercise, emergency healthcare services, healthcare facilities, and infrastructure have been identified as major influencing factors of mortality among patients with AMI. In particular, the presence of pre-existing conditions such as diabetes, HT, and hyperlipidemia are known to be factors that increase the risk of mortality.[5]

In fact, indices such as Charlson Comorbidity Index (CCI) or Elixhauser Comorbidity Index (ECI) are often used to assess pre-existing conditions of patients with AMI. CCI and ECI were developed for the purpose of assessing survival rates or predicting in-hospital mortality rates of patients based on comorbidities, but they are also being used for assessing pre-existing conditions of patients and establishing treatment and management strategies with consideration of existing disease burden. However, previous studies have predominantly focused on evaluating mortality risk based on comorbidities in patients with other cardiovascular diseases, such as congestive heart failure and stroke, rather than specifically on AMI.[6] The prognosis of AMI patients can differ significantly from that of other cardiovascular diseases. Factors influencing prognosis, such as comorbidities, lifestyle habits, and immediate medical response, may affect AMI patients differently compared to those with heart failure or stroke.[7,8] Therefore, AMI-specific research can provide critical insights for the prevention and effective management of this condition.

In Korea, AMI accounts for approximately 40% of all heart disease-related mortalities, while the prevalence of AMI is also showing an increasing trend.[9,10] While the level of treatment has reached that of other developed countries owing to advances in medical technology in the past several decades, the 30-day in-hospital mortality rate among patients with AMI in Korea is higher than the Organization for Economic Co-operation and Development average, which causes difficulties with advanced prevention and treatment.

Against this backdrop, this study aimed to examine the trend in hospital-discharged patients with AMI in Korea and determine the influencing factors of mortality among hospital-discharged patients with AMI based on pre-existing conditions for the purpose of presenting basic data for establishing policies related to the prevention and management of AMI.

Materials and Methods

Study Population

This study utilized the Korean National Hospital Discharge In-depth Injury Survey data to analyze hospital-discharged patients over a 15-year period between 2006 and 2020. The Korean National Hospital Discharge In-depth Injury Survey is a survey that the Korea Disease Control and Prevention Agency has been conducting annually since 2005 for the purpose of establishing cost-effective health policies at the national level by identifying the size and characteristics of hospital-discharged patients. We obtained the data by submitting an application to use raw data through the National Injury Information Portal (https://www.kdca.go.kr/injury/biz/injury/main/mainPage.do).

The population of the Korean National Hospital Discharge In-depth Injury Survey includes all patients discharged from general hospitals throughout Korea, with the sample consisting of approximately 9% of all patients discharged from 170 hospitals selected according to the number of hospital beds and survey method. In this study, raw data were downloaded from the portal mentioned above, and "hospital-discharged patient with AMI" was defined as a patient with the principal diagnosis of I21 (acute myocardial infarction) according to the International Classification of Diseases, Tenth Revision (ICD-10). The Korean National Hospital Discharge In-depth Injury Survey uses two-stage stratified cluster sampling, and thus, complex sampling can be applied to calculate the weighted total number of hospital-discharged patients. Accordingly, a total of 486,464 hospital-discharged patients with AMI were selected for this study.

Study Variables

The Korean National Hospital Discharge In-depth Injury Survey data include demographic, hospitalization, disease, treatment, and non-injury information of hospital-discharged patients based on their medical records. Accordingly, sex (male and female), age group (20–29, 30–39, 40–49, 50–59, 60–69, 70–79, and ≥ 80 years), admission route (emergency department and outpatient department), insurance type (national health insurance and Medicaid), number of hospital beds (100–299, 300–499, 500–999, and ≥ 1000 beds), and length of hospital stay were used in this study as variables for identifying the characteristics of hospital-discharged patients with AMI.

Moreover, CCI was applied for severity adjustment of hospital-discharged patients with AMI. CCI uses the method of adjusting the sum of weighted values after assigning a certain weight (from 1 to 6 points) to 19 major diseases, including ischemic heart disease, diabetes, and HT, to generally categorize them by scores of 0, 1, 2, and 3 points. The Korean National Hospital Discharge In-depth Injury Survey data include one primary diagnosis and information about 20 other diagnoses. Accordingly, this study defined other diagnoses as pre-existing conditions, and CCI diseases were analyzed after converting them to the ICD-10 algorithm.

Statistical Analysis

A weighted frequency analysis was performed to estimate the number of hospital-discharged patients with AMI, while the discharge and mortality rates of hospital-discharged patients with AMI were calculated as age-standardized discharge and mortality rates based on the population size of South Korea in 2015, and the results were presented together with the average annual percent change. Moreover, frequency analysis was also performed to identify the distribution of CCI scores and general characteristics of patients. Furthermore, weighted logistic regression analysis was performed to analyze the influencing factors of mortality as a treatment outcome, and the results were presented with adjusted odds ratio (aOR) and 95% confidence interval (CI). All analyses in this study were performed using SAS 9.4 version, and a significance probability of $p < 0.05$ was considered statistically significant.

Results

The Number of Hospital-Discharged Patients with AMI by Year

In 2005, the number of hospital-discharged patients with AMI was 22,877 (15,084 males and 7794 females). After a repeating pattern of increase and decrease, the number of hospital-discharged patients with AMI reached 36,964 (27,577 males and 9387 females) in 2020, indicating an average annual percent change of 3.6% (4.5% for males and 1.7% for females; Figure 1).

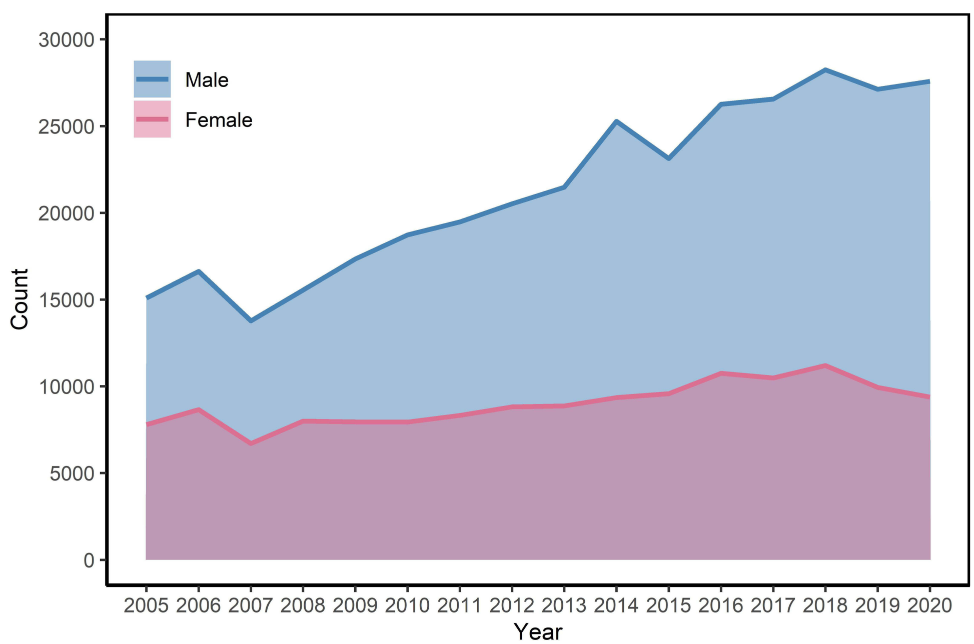

Figure 1 Number of hospital-discharged patients with AMI by year and sex.

The Number of Hospital-Discharged Patients with AMI and Mortality Rate by Year

Among patients who were discharged with a primary diagnosis of AMI, the total number of mortalities was 36,312, with 19,190 among males and 17,122 among females, resulting in an average annual mortality rate of 5.7% and 11.8%, respectively (Figure 2).

The Characteristics of Hospital-Discharged Patients with AMI

The general characteristics of hospital-discharged patients with AMI are shown in Table 1. Hospital-discharged patients with AMI comprised 70.4% males and 29.6% females, with the highest percentage of patients aged 70–79 years (25%), followed by 60–69 years (24.2%), 50–59 years (21.8%), ≥ 80 years (15.0%), 40–49 years (11.3%), 30–39 years (2.5%), and 20–29 years (0.2%). With respect to insurance type, national health insurance (91.5%) was more common than Medicaid (8.5%), while admission via the emergency department (81.0%) was more common than via the outpatient department (19.0%). Regarding the number of hospital beds, 500–999 beds (53.4%) were most common, followed by 300–499 beds (19.7%), 100–299 beds (15.1%), and ≥ 1000 beds (11.9%). In terms of the treatment outcome at discharge, survival (92.5%) was more common than mortality (7.5%), while operation during hospitalization was 96.7%. The CCI scores of hospital-discharged patients with AMI appeared in the order of 2 points (45.0%), 1 point (26.9%), ≥ 3 points (25.5%), and 0 points (2.6%).

Influencing Factors of Mortality Among Hospital-Discharged Patients with AMI

The influencing factors of mortality among hospital-discharged patients with AMI were identified as sex, insurance type, admission route, number of hospital beds, region, operation status, and CCI score (Table 2). In other words, the risk of mortality at discharge was 1.151 times higher among females than males (95% CI 1.002–1.322), 0.787 times lower among those with national health insurance than Medicaid recipients (95% CI 0.64–0.967), and 2.182 times higher among those admitted via the emergency department than the outpatient department (95% CI 1.747–2.725). Moreover, the risk of mortality at discharge increased gradually as the number of hospital beds decreased relative to 1000 hospital beds, with risks 1.327 times higher for 500–999 beds (95% CI 1.333–1.555), 1.617 times higher for 300–499 beds (95% CI 1.298–2.014), and 2.413 times higher for 100–299 beds (95% CI 1.887–3.084). Furthermore, the risk of mortality at discharge was 1.216 times higher among patients from hospitals in the capital area than in other rural areas (95% CI 1.043–1.417), 2.515 times higher in patients with a history of receiving an operation (95% CI 1.936–3.268), and 3.402 times higher in patients with a CCI score of 3 points than in those with 0 points (95% CI 1.263–9.162).

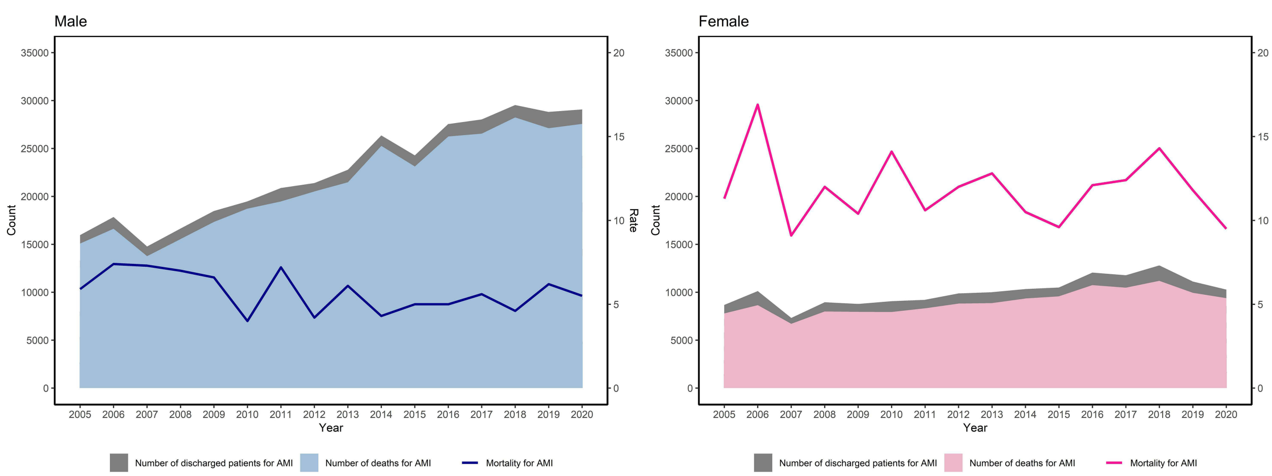

Figure 2 Number of hospital-discharged patients with AMI and mortality rate by year.

Table 1 Characteristics of Hospital-Discharged Patients with AMI (N=486,464)

Category		**Weighted n**	**Weighted %**
Sex	Males	342,712	70.4
	Females	143,752	29.6
Age group	20–29	887	0.2
	30–39	12,076	2.5
	40–49	55,118	11.3
	50–59	105,916	21.8
	60–69	117,859	24.2
	70–79	121,525	25.0
	≥80	73,083	15.0
Insurance type	National health insurance	445,171	91.5
	Medicaid	41,293	8.5
Admission route	Emergency department	394,049	81.0
	Outpatient department	92,415	19.0
Number of hospital beds	100–299	73,216	15.1
	300–499	95,842	19.7
	500–999	259,593	53.4
	≥1000	57,814	11.9
Region	Capital	173,813	35.7
	Metropolitan	144,545	29.7
	Others	168,107	34.6
Outcomes	Survival	450,154	92.5
	Death	36,312	7.5
Operation	Yes	16,107	96.7
	No	470,358	3.3
CCI	0	12,495	2.6
	1	130,904	26.9
	2	218,810	45.0
	≥3	124,255	25.5

Abbreviation: CCI, Charlson Comorbidity Index.

Table 2 Influencing Factors of Mortality Among Hospital-Discharged Patients with Acute Myocardial Infarction

Category		**aOR**	**(95% CI)**
Sex	Females	1.151*	(1.002, 1.322)
	Males	1(ref.)	
Age group	≥80	1.443	(0.345, 6.031)
	70–79	0.787	(0.189, 3.279)
	60–69	0.439	(0.106, 1.807)
	50–59	0.396	(0.097, 1.609)
	40–49	0.332	(0.079, 1.39)
	30–39	0.663	(0.163, 2.701)
	20–29	1(ref.)	
Insurance type	National health insurance	0.787*	(0.64, 0.967)
	Medicaid	1(ref.)	
Admission route	Emergency department	2.182***	(1.747, 2.725)
	Outpatient department	1(ref.)	

(*Continued*)

Table 2 (Continued).

Category		aOR	(95% CI)
Number of hospital beds	100–299	2.413***	(1.887, 3.084)
	300–499	1.617*	(1.298, 2.014)
	500–999	1.327**	(1.133, 1.555)
	≥1000	1(ref.)	
Region	Capital	1.216***	(1.043, 1.417)
	Metropolitan	0.836	(0.695, 1.005)
	Others	1(ref.)	
Operation	Yes	2.515***	(1.936, 3.268)
	No	1(ref.)	
CCI	≥3	3.402***	(1.263, 9.162)
	2	1.944	(0.72, 5.251)
	1	0.922	(0.346, 2.459)
	0	1(ref.)	

Notes: *p<0.05; **p<0.01; ***p<0.001.
Abbreviations: aOR, adjusted odds ratio; CI, confidence interval; ref, reference; CCI, Charlson Comorbidity Index.

Discussion

Despite significant improvements in diagnostic technologies, therapeutic modalities, and pharmaceuticals to date, AMI remains a leading cause of death and a major contributor to the healthcare burden worldwide.[11,12] In particular, the prevalence of AMI is expected to continue to increase due to prolonged average life expectancy and increased health risk factors. In that context, this study used the 2006–2020 Korean National Hospital Discharge In-depth Injury Survey data to examine the trend in hospital-discharged patients with AMI in Korea and the association between pre-existing conditions and mortality among patients with AMI.

First, an increasing trend in the number of hospital-discharged patients with AMI in Korea was found.[13] In fact, the average annual percent change was 3.6%, meaning the number of patients increased by approximately 60% in 2020 compared to 2006. Such an increase in the number of patients with AMI is a phenomenon found not only in Korea, but also in Japan[3] and China.[14] In particular, such increase in the number of patients with MI is interpreted to be associated with a gradual increase in Non-ST-elevation myocardial infarction (NSTEMI), more so than ST-elevation myocardial infarction (STEMI).[15] This is because NSTEMI is known to be more strongly associated with hypertension, diabetes, and dyslipidemia compared to STEMI. In fact, the prevalence rates of hypertension, diabetes, and dyslipidemia among patients in Korea are showing an increasing trend, and during the COVID-19 pandemic period, the health status of males has worsened.[16] Ultimately, it is inferred that the increase in chronic diseases in Korea is significantly associated with the increase in discharged patients with acute myocardial infarction.

In contrast to the United States[17] and Japan where the incidence of AMI is steadily increasing but the AMI-related mortality rate is decreasing, South Korea has not shown any decreasing trend in the AMI-related mortality rate. In Japan, increased use of ambulances and primary percutaneous coronary intervention (PCI) is believed to have had a significant impact on the decrease in the mortality rate. Korea already has a high rate of using PCI, but it appears that such factors have not had an impact on reducing the mortality rate. On the other hand, the increased incidence of MI among individuals aged < 65 years may have contributed to the increase in mortality rate.[18] Despite the fact that age is a key variable associated with mortality among patients with MI, age was not found to be a major cause in this study. This is because the prevalence of AMI is increasing in younger patients under the age of 65, while at the same time, chronic diseases such as hypertension and diabetes are increasing among this age group. Consequently, such findings suggest that there are limitations in reducing the incidence of AMI without improving chronic disease in Korea, and thus, there is a need for more active intervention and efforts for managing chronic diseases.

https://doi.org/10.2147/RMHP.S472822

Even though AMI is more common among males, females showed a higher AMI-related mortality rate, and females also had a higher risk of mortality than males. A similar tendency was also found in the United States[19] and Japan.[3] Such sex-based differences in mortality may be attributed to females with AMI being relatively older, which may have limited their access to various therapeutic modalities, including PCI.[20] In addition, females may have had a longer period between onset and hospitalization, and vascular or bleeding complications are more common among females, all of which may have influenced mortality. Therefore, the findings in this study suggest the need for greater attention when treating female patients, since being female was identified to be a major risk factor of mortality among patients with AMI.

Genetic predisposition and lifestyle factors significantly contribute to the risk of AMI.[21,22] Behaviors such as smoking, physical inactivity, poor diet, and excessive alcohol consumption increase AMI risk. Psychological factors like chronic stress, depression, and social isolation also elevate MI risk through mechanisms involving autonomic dysregulation and inflammation.[23] These risks are exacerbated in individuals with lower socioeconomic status (SES).[24] This study highlights that insurance type, a proxy for SES, significantly impacts cardiovascular mortality. Lower SES individuals face higher stress, poorer diets, higher smoking rates, and limited healthcare access, all contributing to increased MI incidence and poorer outcomes.[22,24] Therefore, managing acute myocardial infarction effectively requires strategies that address both lifestyle factors and socioeconomic status.

The findings in this study also confirmed that the presence of pre-existing conditions is a key indicator for assessing the risk of mortality among patients with AMI. The risk of mortality was found to be more than 3 times higher among patients with a CCI score of ≥ 3 points than those without any pre-existing conditions, indicating a significant increase in the risk of mortality with higher CCI scores. Such findings suggest that CCI can be used as an important indicator for predicting the risk of mortality by considering the comorbidities of patients, and thus, it would be reasonable to establish treatment and management strategies with consideration for the pre-existing conditions of patients.

This study was significant in that it focused on pre-existing conditions to examine trends in hospital-discharged patients with AMI and influencing factors of AMI-related mortality in Korea over the past 15 years. Nonetheless, this study had some limitations. Firstly, because this study was a secondary data analysis study that used data from the Korean National Hospital Discharge In-depth Injury Survey conducted annually by the Korea Disease Control and Prevention Agency, only the variables already contained in the data could be considered. With respect to MI, there are various risk factors, such as smoking, drinking, and physical activity, besides pre-existing conditions, but such factors could not be controlled. Because the raw data consisted of information collected from medical records of patients, relevant information can be obtained based on the medical history of patients. Therefore, it is expected that the Korea Disease Control and Prevention Agency should be able to provide such information in the future.[25] Secondly, this study included only patients with AMI whose primary diagnosis was I21, whereas patients with I21 included as other diagnoses were excluded from the study. Therefore, the actual number of patients with MI may have been underestimated, because the primary diagnosis is the final diagnosis made during the course of a treatment and refers to the pathology with the greatest need for treatment or testing. In Korea, where a single pathology that requires the most medical resources must be selected, it is unknown whether diseases are being classified under consistent criteria.[26] Therefore, it is necessary to consider other treatments or care, in addition to the primary diagnosis, when admitting patients with AMI. Thirdly, the data used in this study were from cross-sectional surveys, which means that only associations with influencing factors of mortality among patients with AMI can be identified, and determining causality is challenging. Therefore, caution is needed when interpreting the results. Over the past decades, significant advancements in the treatment of acute myocardial infarction (AMI) have contributed to a reduction in overall mortality rates. However, this study focuses on the absolute increase in the number of patients and deaths related to AMI, without considering the advancements in treatment approaches during this period, representing a limitation of the study. Future research should aim to establish the causal relationship between pre-existing conditions and AMI-related mortality through longitudinal studies.[22,27] Additionally, improving data collection practices to include more detailed patient information, such as smoking status, alcohol consumption, and physical activity, would enable more robust analyses and enhance the understanding of factors influencing AMI outcomes. Furthermore, it is essential to consider advancements in treatment approaches when evaluating these outcomes to ensure a comprehensive understanding of the factors affecting AMI mortality.

Conclusion

Over the past 15 years, the number of hospital-discharged patients with AMI in Korea has increased, and the AMI-related mortality rate has also risen. To prevent this, more active management of chronic diseases must be prioritized, including the development of preventive interventions targeting major risk factors such as smoking, alcohol consumption, and physical activity. The risk of mortality among hospital-discharged patients with AMI was found to be higher among those with higher CCI scores, indicating the need for treatment and management strategies that consider the presence of comorbidities in AMI patients. Future research should focus on longitudinal studies to establish causality and improve data collection practices to include detailed patient information, enabling more robust analyses and a better understanding of the factor influencing AMI outcomes.

Data Sharing Statement

The datasets analyzed during the current study are available from the Korea Disease Control and Prevention Agency on reasonable request [http://www.kdca.go.kr/contents.es?mid=a20303010502]. The data used in this study were accessed and processed in full compliance with relevant data protection and privacy regulations. All necessary approvals were obtained, and appropriate measures were taken to ensure the confidentiality and security of the data.

Ethics approval and consent to participate

This study complied with the Helsinki Declaration and was approved by the Institutional Review Board of Eulji University of South Korea (IRB no. EUIRB2023-088). The requirement for informed consent was waived by the IRB.

Acknowledgments

The authors thank the Korean Disease Control and Prevention Agency.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Funding

No funding was received for conducting this study.

Disclosure

The authors report no conflicts of interest in this work.

References

1. Kim S-Y. Statistics on causes of death in 2019 (Korean). Statistics Korea. Available from: https://www.korea.kr/briefing/policyBriefingView.do?newsId=156412129. Accessed January 15, 2023.
2. Oluyombo R, Olamoyegun MA, Olaifa O, Iwuala SO, Babatunde OA. Cardiovascular risk factors in semi-urban communities in southwest Nigeria: patterns and prevalence. *J Epidemiol Glob Health*. 2015;5(2):167–174. doi:10.1016/j.jegh.2014.07.002
3. Takii T, Yasuda S, Takahashi J, et al. on behalf of the MIYAGI-AMI study investigators. trends in acute myocardial infarction incidence and mortality over 30 years in Japan: report from the MIYAGI-AMI registry study. *Circulation J*. 2010;74(1):93–100. doi:10.1253/circj.CJ-09-0619
4. Korea Disease Control and Prevention Agency. Acute myocardial infarction (Korean). Available from: https://health.kdca.go.kr/healthinfo/biz/health/gnrlzHealthInfo/gnrlzHealthInfo/gnrlzHealthInfoView.do?cntnts_sn=5243. Accessed January 15, 2023.
5. Kim HJ, Kim Y, Cho Y, Jun B, Oh KW. Trends in the prevalence of major cardiovascular disease risk factors among Korean adults: results from the Korea national health and nutrition examination survey, 1998–2012. *Int J Cardiol*. 2014;174(1):64–72. doi:10.1016/j.ijcard.2014.03.163
6. Bonnesen K, Heide-Jørgensen U, Albertsen LW, Schmidt SAJ, Sørensen HT, Schmidt M. Validation of the Danish comorbidity index for acute myocardial infarction for predicting one-year mortality in patients with venous thromboembolism. *Thromb Res*. 2022;212:9–18. doi:10.1016/j.thromres.2022.02.013
7. Hwang SY, Kim SH, Uhm IA, Shin J-H, Lim Y-H. Prognostic implications for patients after myocardial infarction: an integrative literature review and in-depth interviews with patients and experts. *BMC Cardiovasc Disord*. 2022;22(1):348. doi:10.1186/s12872-022-02753-z

8. Sia C-H, Ko J, Zheng H, et al. Comparison of mortality outcomes in acute myocardial infarction patients with or without standard modifiable cardiovascular risk factors. *Front Cardiovasc Med*. 2022;9:876465. doi:10.3389/fcvm.2022.876465
9. Lee SW, Kim HC, Lee HS, Suh I. Thirty-year trends in mortality from cardiovascular diseases in Korea. *Korean Circ J*. 2015;45(3):202–209. doi:10.4070/kcj.2015.45.3.202
10. Shin JH, Jung MH, Kwon CH, et al. Disparities in mortality and cardiovascular events by income and blood pressure levels among patients with hypertension in South Korea. *J Am Heart Assoc*. 2021;10(7):e018446. doi:10.1161/JAHA.120.018446
11. Ralapanawa U, Sivakanesan R. Epidemiology and the magnitude of coronary artery disease and acute coronary syndrome: a narrative review. *J Epidemiol Glob Health*. 2021;11(2):169–177. doi:10.2991/jegh.k.201217.001
12. Myers L, Mendis S. Cardiovascular disease research output in WHO priority areas between 2002 and 2011. *J Epidemiol Glob Health*. 2014;4 (1):23–28. doi:10.1016/j.jegh.2013.09.007
13. Kim RB, Kim JR, Hwang JY. Epidemiology of myocardial infarction in Korea: hospitalization incidence, prevalence, and mortality. *Epidemiol Health*. 2022;44:e2022057 doi:10.4178/epih.e2022057.
14. Li J, Li X, Wang Q, et al. China PEACE Collaborative Group. ST-segment elevation myocardial infarction in China from 2001 to 2011 (the China PEACE-retrospective acute myocardial infarction study): a retrospective analysis of hospital data. *Lancet*. 2015;385(9966):441–451. doi:10.1016/S0140-6736(14)60921-1
15. Kook HY, Jeong MH, Oh S, et al. Korea Acute myocardial infarction registry investigators. current trend of acute myocardial infarction in Korea (from the Korea acute myocardial infarction registry from 2006 to 2013). *Am J Cardiol*. 2014;114(12):1817–1822. doi:10.1016/j.amjcard.2014.09.019
16. Lee GB, Kim Y, Park S, Kim HC, Oh K. Obesity, hypertension, diabetes mellitus, and hypercholesterolemia in Korean adults before and during the COVID-19 pandemic: a special report of the 2020 Korea national health and nutrition examination survey. *Epidemiol health*. 2022;44 doi:10.4178/epih.e2022041.
17. Dani SS, Lone AN, Javed Z, et al. Trends in premature mortality from acute myocardial infarction in the United States, 1999 to 2019. *J Am Heart Assoc*. 2022;11:e021682 doi:10.1161/JAHA.121.021682.
18. Roever L, Tse G, Biondi-Zoccai G. Trends in cardiovascular disease in Australia and in the world. *Eur J Prev Cardiol*. 2018;25(12):1278–1279. doi:10.1177/2047487318778339
19. Thom T, Haase N, Rosamond, W, et al. Heart disease and stroke statistics—2006 update: a report from the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. *Circ*. 2006;113(6):e85–e151 doi:10.1161/CIRCULATIONAHA.105.171600
20. Gan SC, Beaver SK, Houck PM, MacLehose RF, Lawson HW, Chan L. Treatment of acute myocardial infarction and 30-day mortality among women and men. *N Engl J Med*. 2000;343(1):8–15. doi:10.1056/NEJM200007063430102
21. Sardu C, Santamaria M, Rizzo MR, et al. Telemonitoring in heart failure patients treated by cardiac resynchronisation therapy with defibrillator (CRT-D): the TELECART Study. *Int J Clin Pract*. 2016;70(7):569–576. doi:10.1111/ijcp.12823
22. Sachdeva P, Kaur K, Fatima S, et al. Advancements in myocardial infarction management: exploring novel approaches and strategies. *Cureus*. 2023;15(9).
23. Thygesen K, Alpert JS, Jaffe AS, et al. Fourth universal definition of myocardial infarction (2018). *Eur Heart J*. 2019;40(3):237–269. doi:10.1093/eurheartj/ehy462
24. Lynch JW, Kaplan GA, Cohen RD, Tuomilehto J, Salonen JT. Do cardiovascular risk factors explain the relation between socioeconomic status, risk of all-cause mortality, cardiovascular mortality, and acute myocardial infarction? *Am J Epidemiol*. 1996;144(10):934–942. doi:10.1093/oxfordjournals.aje.a008863
25. Lee Y-K, Hong SO, Park S-J, et al. Data resource profile: the Korea national hospital discharge in-depth injury survey. *Epidemiol Health*. 2021;43 doi:10.4178/epih.e2021052.
26. Seo SW, Kim GH, Boo YK, et al. Evaluation of current coding practices in 3 university hospitals (Korean). *J Korean Soc Qual Assur Health Care*. 2002;9(1):52–64.
27. Reddy K, Khaliq A, Henning RJ. Recent advances in the diagnosis and treatment of acute myocardial infarction. *World J Cardiol*. 2015;7(5):243. doi:10.4330/wjc.v7.i5.243