ORIGINAL ARTICLE

Observed and relative survival and 5-year outcomes of patients discharged after acute myocardial infarction: the nationwide AMI-PL database

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KEY WORDS
long-term outcomes, non–ST-segment elevation myocardial infarction, population-based registry, relative survival, ST-segment elevation myocardial infarction

ABSTRACT

BACKGROUND Long-term follow-up data from a large Polish acute myocardial infarction (AMI-PL) database are still unavailable.

AIMS This study aimed to assess the 5-year outcomes of patients discharged after hospitalization for AMI in Poland in relation to age.

METHODS The study was based on the nationwide AMI-PL registry including data on the management and long-term outcomes of all patients admitted to hospitals with AMI (codes I21–I22 according to the *International Classification of Diseases and Related Health Problems, 10th Revision* [*ICD-10*]), derived from the database of the obligatory healthcare payer in Poland. The current analysis included all patients after AMI who were discharged alive between the years 2009 and 2010 (n = 134 602).

RESULTS The median age of the study patients was 66.8 years, 62.8% of them were male, and 57.1% had ST-segment elevation myocardial infarction. Older patients, especially those at age ≥80 years, were less likely to receive invasive treatment during the index hospitalization and follow-up. There were 37 437 deaths during the follow-up, and the observed 5-year survival ranged from 0.921 in women at the age below 55 years to 0.383 in men older than 80 years. Relative survival, however, ranged from 0.94 to 0.68 in these age-sex groups. The mortality risk increased with age, was higher in men, in patients treated noninvasively, hospitalized for non–ST-segment elevation myocardial infarction, and discharged from non-cardiology wards. Patients were rehospitalized due to cardiovascular reasons in 63% of cases, heart failure in 17.9%, and AMI in 12.8%.

CONCLUSIONS More than 1 in 4 patients discharged after hospitalization for AMI died within 5 years. Age strongly affects the treatment and long-term outcomes of AMI patients. Our findings indicate the need for improvement in secondary prevention after AMI.

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INTRODUCTION Evaluating the quality of care in patients treated for acute myocardial infarction (AMI) is challenging owing to its multidimensional concept. Randomized controlled trials have extensively studied the mid- and long-term efficacy of AMI treatment.

WHAT'S NEW?

For the first time, we present the 5-year outcomes and postdischarge management of patients after acute myocardial infarction in relation to particular age groups in the whole Polish population. Additionally, we show unique relative survival indices, which were not reported elsewhere. Our study demonstrated that the observed survival in the analyzed cohort was significantly decreasing with age. However, this relationship was substantially attenuated when the overall mortality of the entire Polish population was considered. We also observed a strongly decreased impact of age on relative survival rates at the 5-year follow-up.

However, patient outcomes in the real-life setting depend on healthcare system organization, including both the quality of pre- and in-hospital care as well as that of outpatient care, comprehensive rehabilitation, and secondary prevention programs in the postdischarge period. The latter are usually not assessed in randomized controlled trials, being far from everyday clinical practice because of protocol requirements, and this might significantly influence the outcomes. Therefore, there is a need for population-based observational studies, which would enable us to assess the implementation of new guidelines and treatment methods, as well as long-term outcomes in a particular population.

Several countries, including France, Sweden, the United Kingdom, Republic of Korea, and Poland, have presented nationwide population-based studies.[1-6] The previously published results of the Acute Myocardial Infarction Database in Poland (AMI-PL) have shown care standards similar to those observed in Western countries and early outcomes in AMI patients with a relatively high 1-year mortality.[1] Other large databases have also reported only mid-term data, and real-world statistics on long-term treatment and outcomes are scarce.[7-9]

Although population-based studies have shown a decrease in the in-hospital and mid-term mortality of patients hospitalized for AMI, the available data mainly concern patients with either ST-segment elevation myocardial infarction (STEMI) or non–STEMI (NSTEMI) and do not provide a detailed analysis of age subgroups. There is still lack of long-term follow-up data from a large nationwide database regarding management, outcomes, and relative survival after discharge. Therefore, in the present analysis, we aimed to assess the 5-year outcomes of all patients discharged within 2 years (2009–2010) following hospitalization for AMI in Poland in relation to age.

METHODS

Study design The nationwide AMI-PL database was developed to gather comprehensive data on the management and long-term outcomes of all patients with AMI in Poland. The detailed description of the AMI-PL database has been published elsewhere.[1] Briefly, the ongoing AMI-PL database comprises data from the National Health Fund (Narodowy Fundusz Zdrowia [NFZ]), the major healthcare payer in Poland for public and private healthcare providers, obligatory for all Polish citizens. The fund collects unified, nationwide, electronic data on disease incidence and healthcare delivery based on the diagnosis-related group system. This system enables one to identify patients hospitalized for AMI, as well as their concomitant diseases and received in-hospital treatment. Patients with AMI were selected based on the primary diagnosis with *International Classification of Diseases and Related Health Problems, 10th Revision* (*ICD-10*) codes I21–I22 assigned at discharge from the first ward. The index AMI hospitalization meant continuous hospital stay, including all possible transfers between wards or hospitals for any reasons, until discharge home or death. It is of particular importance for the proper determination of in-hospital mortality and the analysis of events that occurred after discharge. The AMI-PL database also provides information on subsequent deaths and hospitalizations reported to NFZ within the surveillance period after the index AMI hospitalization. Mortality data include only the exact date of death.

Study population and group selection The current analysis was based on hospitalization data gathered over the years 2009 and 2010 and during the subsequent 5-year follow-up period. The AMI category included patients with STEMI, NSTEMI, and unspecified AMI. The study population consisted of patients who experienced AMI for the first time during the study period, irrespective of a history of AMI in the past. The final analysis included only patients discharged alive after the index hospitalization due to AMI. No specific exclusion criteria were applied.

During the 5-year follow-up, data on all-cause mortality, hospitalizations for cardiovascular reasons, and procedures performed after hospital discharge were recorded. To show differences related to the age of patients hospitalized due to AMI in Poland, baseline characteristics, in-hospital management, and long-term outcomes were assessed with regard to 4 age groups: below 55, 55–64, 65–79, and above 80 years. No ethics approval was required for this study, as it was a retrospective analysis of anonymous administrative data.

Statistical analysis Continuous variables were expressed as median (interquartile range). Categorical data were presented as the percentage of patients. Associations between study parameters and age were tested in 4 predefined age groups using the Jonckheere–Terpstra test for

TABLE 1 Baseline characteristics and management during the index hospitalization of the discharged study patients after acute myocardial infarction

Variable		All patients (n = 134 602)	Age groups				*P* value
			<55 y (n = 24 957)	55–64 y (n = 37 212)	65–79 y (n = 51 109)	≥80 y (n = 21 324)	
Demographics and the type of AMI							
Age, y, median (IQR)		66.8 (57.4–76.6)	50.5 (46.5–52.9)	59.9 (57.6–62.3)	73.0 (69.4–76.5)	83.7 (81.6–86.4)	–
Female sex		37.2	20.2	26.9	43.4	60.4	<0.001
Male sex		62.8	78.8	73.1	56.6	39.6	<0.001
NSTEMI		40.3	32.1	36.8	44.2	46.4	<0.001
STEMI		57.1	65.2	60.6	53	51.7	<0.001
Unspecified AMI		2.6	2.6	2.8	2.8	1.8	<0.001
Management during the index AMI hospitalization							
Treatment in the cardiology ward	Overall	87.8	94.7	93.1	87.1	72.3	<0.001
	NSTEMI	82.7	90.7	89.1	83.1	66.7	
	STEMI	91.2	96.8	95.6	90.1	76.9	
Treatment in the ICU	Overall	1.7	1.7	2	1.8	0.9	<0.001
	NSTEMI	1.3	1.3	1.5	1.4	0.7	
	STEMI	1.3	1.3	1.5	1.4	0.7	
Thrombolysis	Overall	0.7	0.9	0.7	0.6	0.5	<0.001
	NSTEMI	0.3	0.4	0.3	0.2	0.2	0.008
	STEMI	0.9	1.1	0.9	0.9	0.8	0.009
Glycoprotein IIb/IIIa inhibitor	Overall	17.4	26.5	22.7	14	5.9	<0.001
	NSTEMI	8.2	12.7	11.2	7	3	
	STEMI	24.3	33.7	30.1	20.3	8.6	
Coronary angiography	Overall	78	88.9	86.6	77.1	52.4	<0.001
	NSTEMI	70.8	83.4	81.4	71.2	45.1	
	STEMI	82.9	91.8	89.8	81.6	58.6	
PCI	Overall	59.6	70.6	68.4	56.5	38.9	<0.001
	NSTEMI	47.5	56.5	56.7	46.3	30.3	
	STEMI	68.8	78.5	76.4	65.8	46.6	
CABG	Overall	2.2	1.5	2.6	2.8	0.7	0.002
	NSTEMI	2.5	2.1	3.1	3	0.7	<0.001
	STEMI	1.2	0.8	1.5	1.5	0.3	0.092
Pacemaker	Overall	0.6	0.1	0.3	0.8	1.4	<0.001
	NSTEMI	0.7	0.1	0.3	0.8	1.5	
	STEMI	0.5	0.1	0.3	0.7	1.2	
ICD or CRT-D	Overall	0.3	0.3	0.4	0.4	0.1	0.01
	NSTEMI	0.3	0.3	0.4	0.4	0.1	0.037
	STEMI	0.3	0.2	0.3	0.3	0.1	0.21
Hospitalization length, d, median (IQR)	Overall	6 (4–9)	5 (4–7)	6 (4–8)	7 (5–10)	8 (6–12)	<0.001
	NSTEMI	6 (4–10)	5 (4–7)	6 (4–8)	7 (5–10)	8 (6–12)	
	STEMI	6 (5–9)	5 (4–7)	6 (4–8)	7 (5–10)	8 (6–12)	

Data are presented as the percentage of patients unless otherwise indicated.

Abbreviations: AMI, acute myocardial infarction; CABG, coronary artery bypass grafting; CRT-D, cardiac resynchronization therapy with a cardioverter-defibrillator; ICD, implantable cardioverter-defibrillator; ICU, intensive care unit; IQR, interquartile range; NSTEMI, non–ST-segment elevation myocardial infarction; PCI, percutaneous coronary intervention; STEMI, ST-segment elevation myocardial infarction continuous variables and the Cochran–Armitage test for categorical variables. The observed survival was analyzed using the Kaplan–Meier estimates, whereas the relative survival (with 95% CIs) was calculated using the Hakulinen method,[10] employing single age-, year-, and sex-specific life tables for the general Polish population, published by Statistics Poland.[11] To identify the predictors of 5-year mortality, a multivariate Cox proportional hazards regression model was developed. A *P* value less than 0.05 was considered significant. All tests were 2-tailed. Statistical analysis was carried out using NCSS 12 (NCSS, LLC, Kaysville, Utah, United States), IBM SPSS Statistics, version 22 (SPSS, Chicago, Illinois, United States), and R 3.6.0 (R Core Team, Foundation for Statistical Computing, Vienna, Austria) statistical software (the relsurv package was used to calculate relative survival).[12]

RESULTS During the 2-year period (2009–2010), a total of 149 646 patients were hospitalized due to AMI in Poland, 15 044 (10.1%) of whom died during the index hospitalization. Thus, the final study group included 134 602 (89.9%) patients who survived and were discharged home.

Baseline characteristics of acute myocardial infarction survivors The median (interquartile range) age of patients who survived the in-hospital phase of AMI was 66.8 (57.4–76.6) years and 62.8% of them (84 478 out of 134 602 patients) were male. However, the proportion of men decreased significantly with age: from 78.8% in patients aged below 55 years to only 39.6% in those aged 80 years and older. More patients were hospitalized for STEMI (76 922 [57.1%]), while the diagnosis of NSTEMI and unspecified AMI related to 54 227 (40.3%) and 3453 (2.6%) patients, respectively. The proportion of patients with STEMI significantly decreased with age (from 65.2% in those aged below 55 years to 51.7% in those aged 80 years and older), yet an increase in the rate of NSTEMI cases was observed with age (from 32.1% to 46.4%, respectively). Older patients (aged 65 years or older) required longer hospital stays and were less likely to be hospitalized in a cardiology ward than those who were younger. Older patients also less frequently received invasive treatment during the index hospitalization, including coronary angiography and percutaneous coronary intervention, as well as thrombolysis and glycoprotein IIb/IIIa inhibitors, than patients aged below 65 years. The detailed characteristics of the study patients are presented in TABLE 1.

Five-year survival after discharge During the follow-up period, 37 447 deaths were recorded in the study group. Postdischarge observed and relative survival rates in relation to sex and age at 5-year follow-up are shown in TABLE 2, and FIGURE 1 shows observed and relative 5-year survival curves. The observed 5-year survival ranged from 0.921 in women aged below 55 years to 0.383 in

TABLE 2 Observed and relative survival by sex and age

Sex		Death at the 5-year follow-up, n			
		<55 y	55–64 y	65–79 y	≥80 y
Male		1694	4588	9973	5174
Female		399	1398	6689	7532
Observed survival					
Male	1 year	0.976 (0.974–0.978)	0.948 (0.945–0.951)	0.880 (0.876–0.884)	0.752 (0.742–0.761)
	3 years	0.945 (0.942–0.948)	0.889 (0.886–0.893)	0.758 (0.753–0.763)	0.538 (0.527–0.549)
	5 years	0.915 (0.911–0.919)	0.831 (0.827–0.836)	0.654 (0.649–0.660)	0.383 (0.373–0.394)
Female	1 year	0.977 (0.973–0.981)	0.955 (0.951–0.959)	0.895 (0.891–0.899)	0.764 (0.756–0.771)
	3 years	0.949 (0.943–0.955)	0.907 (0.901–0.913)	0.791 (0.786–0.796)	0.563 (0.555–0.572)
	5 years	0.921 (0.913–0.928)	0.860 (0.853–0.867)	0.698 (0.692–0.704)	0.412 (0.404–0.421)
Relative survival					
Male	1 year	0.979 (0.977–0.981)	0.955 (0.953–0.958)	0.902 (0.899–0.906)	0.825 (0.815–0.835)
	3 years	0.955 (0.951–0.958)	0.912 (0.908–0.916)	0.824 (0.819–0.830)	0.733 (0.719–0.748)
	5 years	0.933 (0.929–0.937)	0.869 (0.865–0.874)	0.765 (0.758–0.771)	0.680 (0.661–0.699)
Female	1 year	0.980 (0.976–0.984)	0.963 (0.959–0.967)	0.920 (0.916–0.925)	0.847 (0.839–0.855)
	3 years	0.959 (0.953–0.966)	0.931 (0.925–0.936)	0.869 (0.863–0.875)	0.793 (0.781–0.805)
	5 years	0.940 (0.932–0.947)	0.901 (0.893–0.908)	0.832 (0.825–0.840)	0.778 (0.761–0.795)

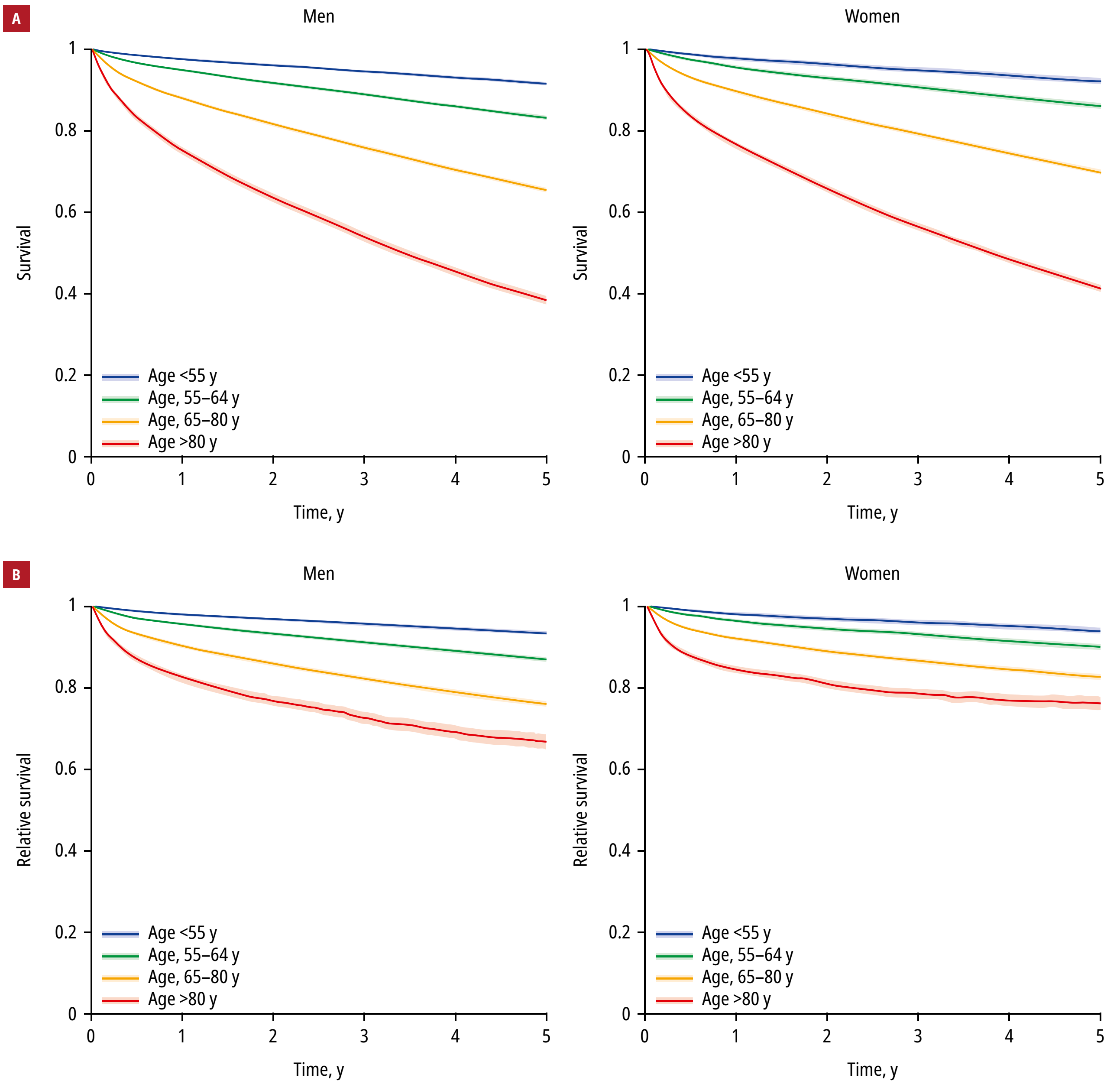

FIGURE 1 Observed (**A**; Kaplan–Meier estimates) and relative (**B**; the Hakulinen method) 5-year survival (with 95% CIs) of patients discharged after hospitalization for acute myocardial infarction in relation to sex and age
Abbreviations: see TABLE 1

men at the age of 80 years and older. Relative survival, however, ranged from 0.94 to 0.68 in the same age-sex groups. A decline with age and follow-up time in both observed and relative survival rates was greater in women than in men, and the difference increased with age and time. Relative survival is substantially less affected by the patient's age than observed survival.

The mortality risk at 5-year follow-up, estimated in the multivariate Cox regression analysis, significantly increased with age and was lower in women than in men, in patients treated invasively, and those hospitalized for STEMI (as a reason for the index AMI hospitalization), but it was higher in individuals who were discharged from noncardiology wards (FIGURE 2).

Hospitalizations and medical procedures at the 5-year follow-up The proportions of patients rehospitalized for various reasons and having medical procedures performed within the 5-year follow-up after the index hospitalization for AMI are shown in TABLE 3, and their cumulative distribution in time is presented in FIGURE 3. Approximately 83% of the study patients required rehospitalization for any cause, and the median number of hospitalizations per patient was 2 within the 5 years. Most rehospitalizations occurred during the first 6 months after the index AMI hospitalization. During the 5-year follow-up, 63% of patients required hospitalization due to cardiovascular causes (*ICD-10* codes I00–I99). The most frequent reasons

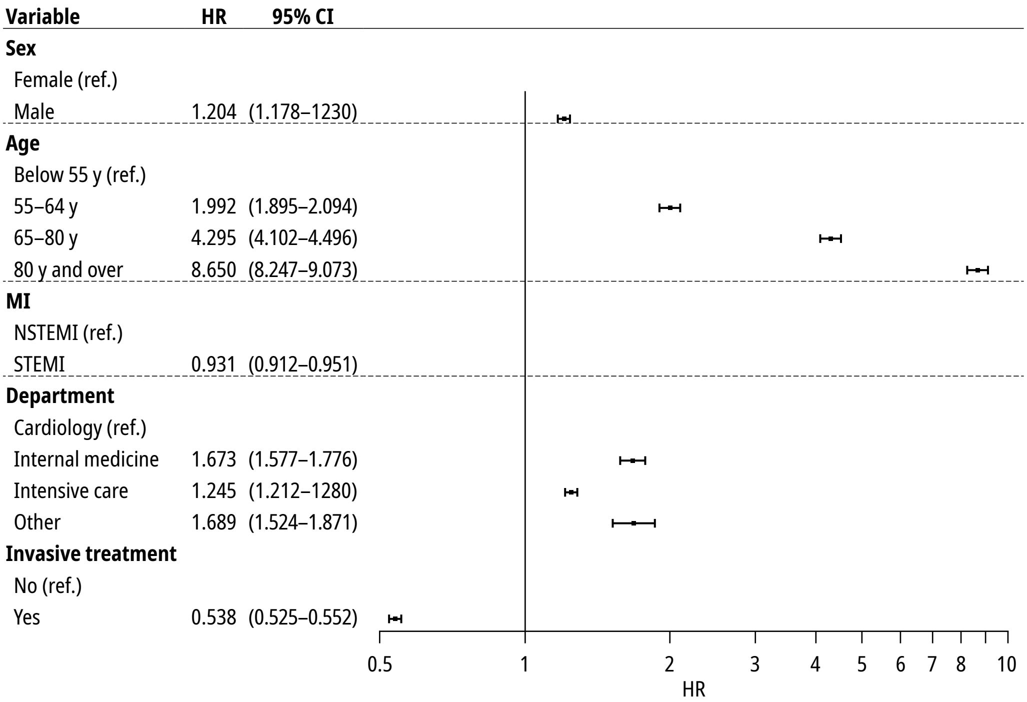

FIGURE 2 Multivariate Cox proportional hazards model for 5-year all-cause mortality in patients discharged after the acute myocardial infarction index hospitalization
Abbreviations: HR, hazard ratio; ref., reference; others, see TABLE 1

for readmission included: ischemic heart disease (47.2%), heart failure (17.9%), and recurrent AMI (12.8%). Most readmissions occurred more frequently in older patients compared with the younger ones. Particularly, as a result of heart failure, almost 1 in 3 patients aged 80 years or older and 1 in 4 aged between 65 and 79 years were hospitalized within the 5 years, compared with 6.4% and 11.5% of patients aged below 55 and between 55 and 64 years, respectively.

During the 5-year follow-up after discharge, the following procedures were performed: coronary angiography in 47 561 patients (35.3%), percutaneous coronary intervention (PCI) in 33 433 (24.8%), coronary artery bypass grafting (CABG) in 8801 (8.5%), pacemaker implantation in 3350 (2.5%), and implantable cardioverter-defibrillator (ICD) or cardiac resynchronization therapy with a cardioverter-defibrillator (CRT-D) placement in 4399 (3.3%) (TABLE 3). Older patients, especially those aged 80 years or older, were less likely to undergo coronary angiography, PCI, CABG, and ICD or CRT-D placement than younger patients during the 5-year follow-up. However, pacemaker implantation procedures were more frequent in the older patient groups. A high number of patients were rehospitalized and had some procedures performed during the first 6 months of follow-up after discharge (TABLE 3).

DISCUSSION This community-wide analysis included data of all patients who survived hospitalization for AMI in Poland. In each year, patients with AMI have worse clinical status than their counterparts in the general population. Their survival substantially decreased during the first year since AMI and, after that period, the decline was constant year by year. The main strength of our study is the fact that it assessed the 5-year outcomes and postdischarge management of AMI patients in relation to age groups. Our study demonstrated that the observed survival of patients significantly decreases with age. However, this relationship was substantially attenuated when the overall mortality of the entire Polish population was considered. The cumulative 5-year observed survival rates of men aged below 55 years and those at the age of 80 years and older were 0.915 and 0.383, respectively, while the relative survival rates in this group were 0.933 and 0.68, respectively. An even stronger reduction in the impact of age was observed in women. Other authors reported similar observations with regard to a decline in relative survival with increasing age.[13] In their study, 5-year relative survival estimates for patients aged below 55, 56–65, 66–75, and above 75 years were 95.4%, 92.8%, 88.3%, and 79.0%, respectively.

Data obtained from the population of Norwegian patients admitted to hospitals for AMI in the years 2008 to 2010, followed up for 5 years, have shown that relative survival also depended on the education level and was 72.4% in the primary versus 80.8% in the tertiary education groups.[14] Unfortunately, there is no information on the education level in the Polish patient data sets. Data from the SWEDEHEART registry have demonstrated that relative survival at the 5-year follow-up was lower in women with

TABLE 3 Reasons for rehospitalization and procedural treatment at the 5-year follow-up after the index acute myocardial infarction discharge by age

Variable	Total (n = 111 370)	Age				*P* value
		<55 y (n = 18 788)	55–64 y (n = 30 195)	65–79 y (n = 44 478)	≥80 y (n = 17 909)	
Rehospitalizations, n, median (IQR)	2 (1–5)	2 (1–4)	2 (1–4)	3 (1–5)	2 (1–4)	<0.001
Reason for rehospitalization						
Any	82.7	75.3	81.1	87	84	<0.001
Cardiovascular disease	63	54.8	61.6	67.2	65	<0.001
AMI	12.8	10.1	11	14.3	15.5	<0.001
Ischemic heart disease	47.2	48.1	51.8	49	33.7	<0.001
Heart failure	17.9	6.4	11.5	22.6	31.4	<0.001
Ventricular arrhythmia	1.1	1	1.2	1.2	0.5	0.002
Atrial fibrillation	4.4	1.7	3.8	5.9	4.7	<0.001
Valvular disease	3.4	1.4	2.6	4.4	4.5	<0.001
Arterial hypertension	4.8	3.6	4.5	5.7	4.4	<0.001
Stroke	5.6	2.6	4.1	6.8	8.8	<0.001
Hemorrhagic stroke	0.5	0.3	0.5	0.7	0.7	<0.001
Ischemic stroke	4.9	2.2	3.6	5.9	7.7	<0.001
Acute kidney injury	1.5	0.5	0.9	2	3	<0.001
Chronic kidney disease	2.2	0.9	1.5	2.9	3.3	<0.001
Renal insufficiency	3.5	1.4	2.2	4.6	6	<0.001
Procedures						
Coronary angiography	35.3	39.5	41.7	35.9	18.2	<0.001
PCI	24.8	27.4	29.4	25.1	13.4	<0.001
CABG	8.5	6.0	8.7	7.4	1.2	<0.001
Valve surgery	1.0	0.5	1.2	1.4	0.3	0.66
Pacemaker implantation	2.5	0.5	1.2	3.5	4.7	<0.001
ICD placement	2.7	3.1	3.7	2.6	0.6	<0.001
ICD or CRT-D placement	3.3	3.5	4.5	3.3	0.8	<0.001

Data are presented as the percentage of patients unless otherwise indicated.

Abbreviations: see TABLE 1

STEMI than in men (75.1% versus 82.4%). For NSTEMI, the difference in relative survival between men and women was not evident, however, women with NSTEMI had lower relative survival at 5 years than men (73.1% versus 76.0%).[15]

In the Polish population, we observed that both absolute and relative survival was higher in women than in men. This finding differs from the Swedish experience. A lower survival in women is a well-known observation and was reported in numerous studies.[16-19] It is attributed to differences in age, comorbidities, time to treatment, and secondary prevention. The observed discrepancies between Poland and Sweden regarding the relative survival rate of women and men may result from differences in the adherence to clinical practice guidelines, the prevalence of cardiovascular risk factors, and the education level.

Importantly, the AMI-PL database also enabled us to analyze all-cause hospitalizations and procedures performed after the initial AMI hospitalization at the 5-year follow-up. In our study, during the follow-up, like during the hospital stay, older patients (mainly those aged 80 years or older) were also less likely to undergo any invasive procedures (including coronary angiography, PCI, CABG, and ICD or CRT-D placement, except for pacemaker implantation) than younger patients. Regardless of the age group, most patients required further hospitalizations due to cardiovascular reasons. In older patients, a substantially higher rate of hospitalizations for heart failure (up to 31.4% in those aged over 80 years) was observed compared with younger patients. Heart failure is a frequent complication and consequence of AMI, especially when the infarction has not been treated early after the onset of symptoms. The known

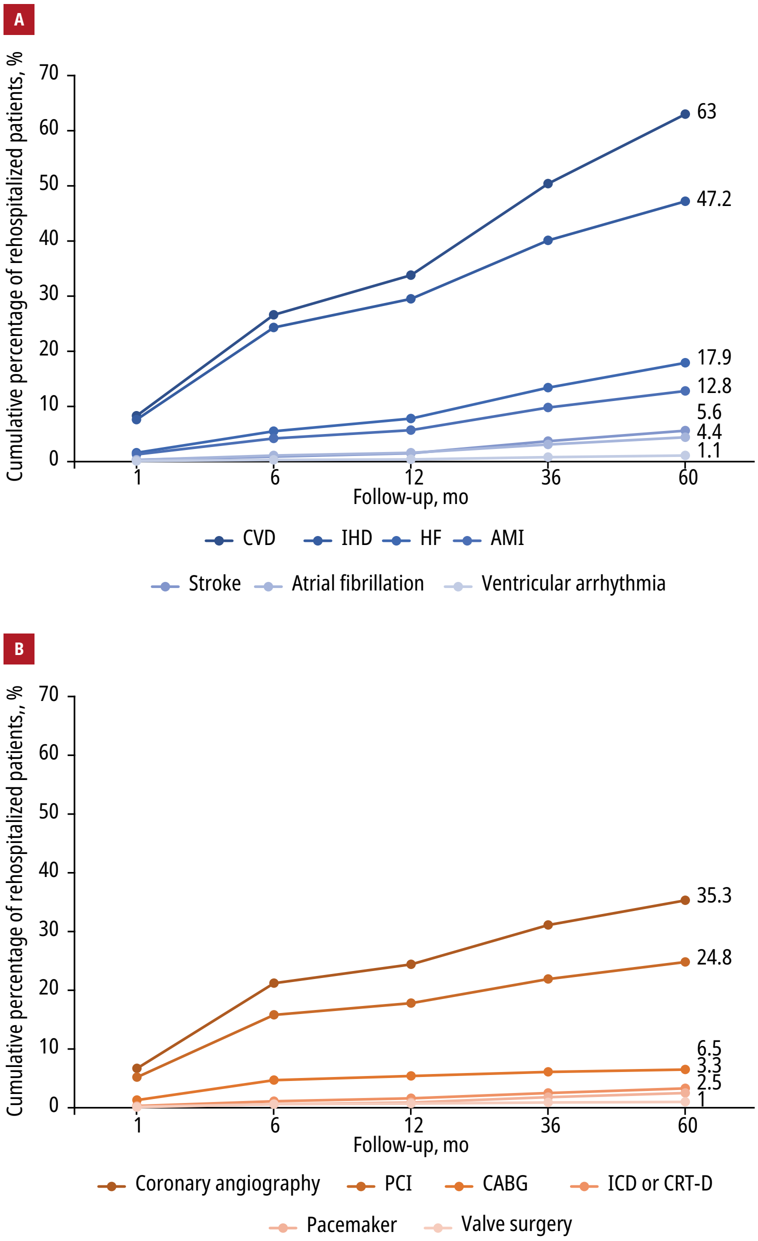

FIGURE 3 Main reasons for rehospitalization (**A**) and procedural treatment (**B**) within 5 years following discharge after the index hospitalization for acute myocardial infarction
Abbreviations: CVD, cardiovascular disease; HF, heart failure; IHD, ischemic heart disease; others, see TABLE 1

predictors of developing left ventricular dysfunction after AMI are diabetes, recurrent myocardial ischemia, infarct size, mechanical complications, and ventricular remodeling.[20,21] Heart failure after AMI leads to a 3- to 4-fold higher risk of death.[21] Although the improvement of AMI treatment in the last decades contributed to a decreased number of hospitalizations due to heart failure, survival after heart failure following AMI is still poor.[22-24]

Despite relevant advances in the diagnosis and treatment of AMI in recent decades, long-term mortality remains excessively high.[25-27] In the light of these data, more emphasis should be placed on improving secondary prevention. Cardiac rehabilitation programs after AMI are safe and effective in increasing exercise tolerance, quality of life, and left ventricular ejection fraction, but they require a close cooperation between cardiologists, general practitioners, and rehabilitation physicians.[28,29] An analysis by Kampfer et al[30] performed in 3 tertiary hospitals in Switzerland, Poland, and Ukraine (high-, middle-, and low-income countries, respectively) showed essential differences in the application of evidence-based treatment and secondary prevention after AMI. The total mortality rate was inversely related to the proportions of patients participating in cardiac rehabilitation programs and the socioeconomic status of these countries. The key discrepancies between these countries were also seen in the total number of patients treated with PCI during AMI hospitalization and lack of insurance coverage during follow-up. Cardiac rehabilitation in Poland is still highly underused.[31] As presented in the previous report from the AMI-PL database, only 22% of the Polish patients participated in a cardiac rehabilitation program in 2009 within a year after AMI hospitalization.[1] However, it seems that age does not have a significant impact on the use of cardiac rehabilitation in Poland. In another study that analyzed only young AMI patients (aged below 40 years) from the PL-ACS registry, less than 1/3 of the study participants underwent cardiac rehabilitation.[7]

There is a pressing need to take steps that would facilitate the implementation of secondary prevention guidelines, including cardiac rehabilitation. Recently, in 2018, a coordinated specialist care system for patients after AMI was introduced in Poland.[32,33] That program endorses a 12-month treatment plan developed by a cardiologist and a rehabilitation physician for patients leaving the hospital. These plans should also consider patients' age, comorbidities, and suspected treatment compliance to effectively manage the therapeutic process. Such programs also provide a possibility to properly design studies in order to monitor and evaluate the quality of care and its long-term effects.

Limitations Several limitations of our study need to be acknowledged. The main limitation is the fact that the database used in this study was an administrative registry, which provided a limited number of clinical variables available for analysis. Furthermore, AMI categorization was based on *ICD-10* codes and was not additionally verified. Therefore, some mistakes could have occurred. The collected data set did not contain the medical history of AMI patients, eg, data on prior AMI, evidence-based pharmacotherapy at discharge, and cause of death during the follow-up. Also, we had no information about a possible out-migration of some patients from Poland and their loss to follow-up.

Conclusions In conclusion, more than 1 in 4 Polish patients discharged home after hospitalization for AMI died within 5 years. Age strongly affected the treatment and long-term outcomes of patients after AMI. The study findings highlighted the need for improvement in secondary prevention after AMI.

ARTICLE INFORMATION

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