Health Promotion Board

Singapore Myocardial Infarction Registry

Annual Report 2023

National Registry of Diseases Office
October 2025

Staff of the Singapore Myocardial Infarction Registry, Health Promotion Board

Director, Research, Evaluation & Monitoring Division	Dr Karen Cheong
Deputy Director, National Registry of Diseases Office	Dr Foo Ling Li
Data Manager	Mr Eric Lee
Epidemiologist	Ms Lydia Liu
Quality Assurance	Ms Cai Mingshi
Registry Coordinators	Ms Lee Bee Guat (Team Leader) Ms Halimahton Abdul Kadir Ms Ng Keat Siew Ms Ong Jin Ting Ms Vivian Ho Mr Win Nyunt

With inputs from

Ministry of Health, Singapore	Disease Policy and Strategy Division Hospital Services Division
Singapore Civil Defence Force	Emergency Medical Services Department

Approved by

NRD Registrar	Dr Ruth Lim
Deputy Director-General of Health (Public Health)	Dr Derrick Heng

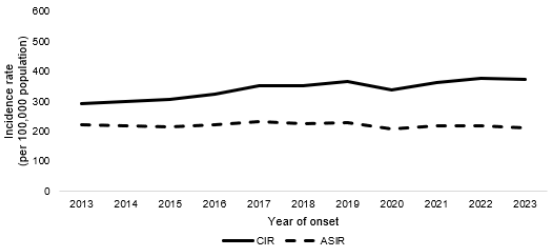
TABLE OF CONTENTS

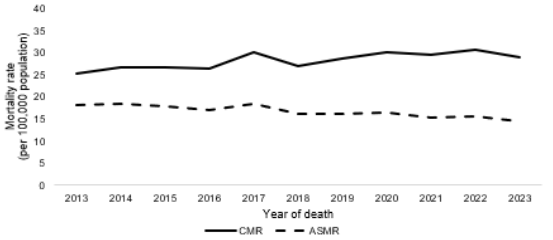
1. GLOSSARY

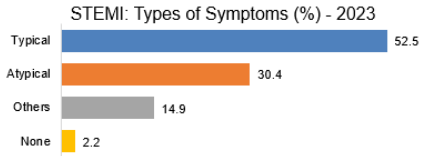
AMI	Acute myocardial infarction
ASIR	Age-standardised incidence rate
ASMR	Age-standardised mortality rate
ASPIR	Age-specific incidence rate
ASPMR	Age-specific mortality rate
BMI	Body mass index
CFR	Case fatality rate
CI	Confidence interval
CIR	Crude incidence rate
CMR	Crude mortality rate
DTB	Door-to-balloon
ECG	Electrocardiogram
ED	Emergency Department
ICD	International Classification of Diseases
IQR	Interquartile range
MHA	Ministry of Home Affairs
MOH	Ministry of Health
MONICA	Monitoring Trends and Determinants in Cardiovascular Disease
NRDO	National Registry of Diseases Office
NRIC	National Registration Identity Card
NSTEMI	Non-ST-segment elevation myocardial infarction
SCDF	Singapore Civil Defence Force
SMIR	Singapore Myocardial Infarction Registry
STEMI	ST-segment elevation myocardial infarction

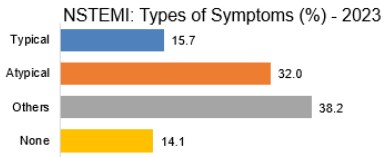
2. EXECUTIVE SUMMARY

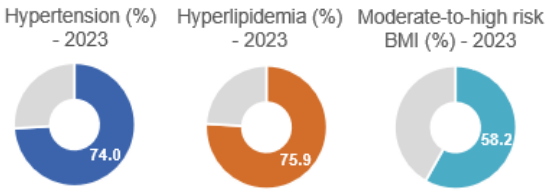
This annual report presents data on trends in incidence, mortality, 30-day case fatality, presenting symptoms, risk factors, time to treatment, and length of hospitalisation among Singapore residents with acute myocardial infarction (AMI) over the latest 10-year period, from 2013 to 2023.

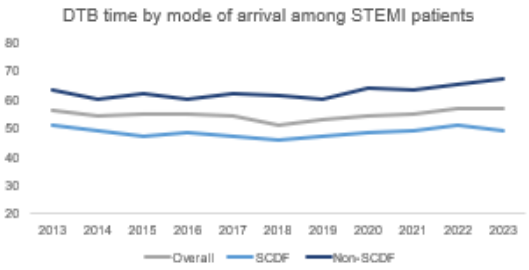












AMI INCIDENCE

- The number of acute myocardial infarction (AMI) episodes increased by 40%, from 9,532 episodes in 2013 to 13,392 episodes in 2023.
- The age-standardised incidence rate (ASIR) remained relatively stable, at 222.8 and 212.9 per 100,000 population in 2013 and 2023 respectively.

AMI MORTALITY & 30-DAY CASE FATALITY

- AMI deaths rose by 26%, from 817 in 2013 to 1,032 in 2023.
- However, the age-standardised mortality rate (ASMR) declined significantly, from 18.2 to 14.3 per 100,000 population over the same period.
- The 30-day case fatality rate (CFR) remained stable, at 9.0% in 2013 and 7.9% in 2023.

SYMPTOMS

- In 2023, about 52% of ST-segment elevation myocardial infarction (STEMI) patients had typical symptoms, while most non-ST-segment elevation myocardial infarction (NSTEMI) patients presented with non-typical or other symptoms.
- Overall, the two most common presenting symptoms remained consistent for AMI patients – chest pain (52%) and breathlessness (48%).

RISK FACTORS

- Hypertension, hyperlipidaemia and moderate-to-high risk BMI were consistently the three most common risk factors among AMI patients in the past decade.
- In 2023, about 3 in 4 AMI patients had hypertension or hyperlipidaemia, and about 58% of AMI patients had moderate-to-high risk BMI.

TIME TO TREATMENT

- The median door-to-balloon (DTB) time remained stable, at 56 minutes in 2013 and 57 minutes in 2023.
- DTB time was consistently shorter for patients arriving by Singapore Civil Defence Force (SCDF) ambulance (49 minutes in 2023) compared to those using other transport modes (67 minutes in 2023).

LENGTH OF HOSPITALISATION

- Between 2013 and 2023, the average length of hospitalisation for AMI remained largely unchanged, ranging between 7.6 and 8.4 days annually.

3. INTRODUCTION

Ischaemic heart disease was the third most common cause of death in Singapore in 2023, accounting for 19.7% of all deaths[1]. AMI, commonly known as a heart attack, is one of the most severe manifestations of ischaemic heart disease.

The most common cause of AMI is atherosclerosis – the narrowing of arteries caused by the build-up of cholesterol deposits within the arterial walls, forming plaques that restrict blood flow. Restoration of blood flow through revascularisation of the blocked arteries, together with pharmacotherapy, remains the recommended treatment for AMI.

There are two main types of AMI: STEMI and NSTEMI. STEMI is typically more severe and associated with a higher 30-day case fatality rate, whereas NSTEMI is more common, accounting for about-70-75% of cases in the past decade.

The common risk factors for AMI include hypertension, hyperlipidaemia, diabetes, obesity, smoking and older age. The proportion of Singapore residents aged 65 years and above increased from 10.5% (about 1 in 10) in 2013 to 17.3% (about 1 in 6) in 2023[2], and this figure is projected to reach 1 in 4 by 2030[3]. With Singapore's rapidly ageing population, the incidence of AMI is expected to rise. To mitigate its impact, preventive measures to reduce cardiovascular risk, alongside post-AMI interventions to improve prognosis and reduce recurrence risk, are essential.

[1] Principal Causes of Death. Ministry of Health, Singapore. www.moh.gov.sg/resources-statistics/singapore-health-facts/principal-causes-of-death Accessed 6 October 2025.
[2] SingStat Table Builder, Population and Population Structure, Annual Population, Singapore Residents by age group, ethnic group and sex. Department of Statistics, Singapore. https://tablebuilder.singstat.gov.sg/table/TS/M810011. Accessed 23 April 2025.
[3] Action Plan for Successful Ageing 2023. Ministry of Health, Singapore. ACTION PLAN FOR SUCCESSFUL AGEING 2023 | Ministry of Health. Accessed 6 October 2025.

4. METHODOLOGY

The National Registry of Diseases Office (NRDO) collects and analyses epidemiological data to support health policy planning, programme evaluation, and policy review.

The Acute Myocardial Infarction Registry was established in 1988 and was initially managed by the Ministry of Health (MOH). In 2002, management of the Registry was transferred to the Singapore Cardiac Databank. Subsequently, in April 2007, the NRDO, under the purview of the Health Promotion Board (HPB), took over management of the Registry, which was renamed the Singapore Myocardial Infarction Registry (SMIR).

The SMIR collects epidemiological data on AMI cases diagnosed in all public and private hospitals, as well as a small number of AMI deaths occurring at home, certified by general practitioners in Singapore. Mandatory notification from all healthcare institutions has been in effect since September 2012, as required under the National Registry of Diseases Act.

Data sources

The SMIR receives AMI case notifications from the following sources:

1. Healthcare institutions via the Hospital In-patient Discharge Summary, cardiac biomarkers list and other clinical reports.
2. MOH via the MediClaim list and Casemix and Subvention list.
3. Death Registry of the Ministry of Home Affairs (MHA) via the national death list.

The International Classification of Diseases, 9th Revision (ICD-9) Clinical Modification code 410 was used to identify AMI cases from the data sources prior to 2012, while the ICD-10 Australian Modification (ICD-10-AM) codes I21 and I22 were used for AMI cases diagnosed from 2012 onwards. A master patient list was created by merging data from these sources using the patients' unique National Registration Identity Card (NRIC) number.

Registry coordinators confirmed the diagnosis of AMI by reviewing patients' medical records and extracting the relevant clinical information. All cases collected by the SMIR were diagnosed as AMI by a certified doctor, accompanied by symptoms of AMI, elevated cardiac biomarkers, and/or abnormal electrocardiogram (ECG) findings.

AMIs are broadly classified into STEMI and NSTEMI, based on documentation in the patients' medical records. A small group of patients (<10%) lacked documentation of STEMI or NSTEMI; these patients usually died out-of-hospital or soon after arrival at the hospitals, before doctors could determine the subtype.

From 2011 onwards, AMI cases have also been classified into types 1, 2, 3, 4A, 4B and 5, following the recommendations of the American Heart Association (AHA)[4]. For

[4] American College of Cardiology Foundation. Universal definition of myocardial infarction. Journal of the American College of Cardiology 2007; 50(22): 2173-2195.

type 2 myocardial infarction (MI), cases were combined with NSTEMI in this report, as their clinical characteristics are similar[5].

Cases that were transferred between hospitals were merged to avoid multiple counting of the same AMI episode. As the Registry transitioned towards automated data collection and ceased the collection of ECG data from 2019 onwards, recurrent AMI episodes occurring within 28 days of a preceding event were no longer merged with the earlier episode, unlike in previous years. In each year prior to 2019, fewer than 2% of AMI patients experienced another AMI within 28 days of the preceding episode.

The death status of all patients registered in the SMIR was updated up to 30 September 2024 by matching patients' NRIC numbers with the death information obtained from the MHA.

Population estimates

The Singapore population estimates used to calculate incidence and mortality rates in this report were obtained from the Singapore Department of Statistics, which releases mid-year population estimates of Singapore residents (i.e. Singapore citizens and permanent residents) annually[6]. The Segi World Standard Population used for age standardisation was obtained from the World Health Organization (WHO) website[7].

Incidence rate

The incidence rate for each year was calculated by dividing the number of AMI episodes that occurred among Singapore residents in that year by the total number of Singapore residents in the same year. Patients were categorised into 5-year age groups, and age standardisation was performed using the direct method, with the Segi World Standard Population as the standard population weights.

Mortality rate

The mortality rate for each year was calculated by dividing the number of deaths with AMI as the primary cause of death among Singapore residents in that year by the total number of Singapore residents in the same year. Patients were categorised into 5-year age groups, and age standardisation was performed using the direct method, with the Segi World Standard Population as the standard population weights.

Case fatality rate

The case fatality rate for each year was calculated by dividing the number of deaths with AMI as the primary cause of death that occurred within 30 days of AMI onset by the number of AMI patients in the same year. This indicator reflects the severity of AMI, the timeliness of healthcare delivery, and the effectiveness of AMI treatment.

This report focuses on Singapore residents aged 15 years and above, diagnosed with AMI between 2013 and 2023, as at 30 May 2025. All findings in this report, except mortality and case fatality, are based on AMI episodes.

[5] Stein YG et al. Type-II myocardial infarction – patient characteristics, management and outcomes. PLoS One 2014; 9(1): e84285.
[6] SingStat Table Builder, Population and Population Structure, Annual Population, Singapore Residents by age group, ethnic group and sex. Department of Statistics, Singapore. https://tablebuilder.singstat.gov.sg/table/TS/M810011.
[7] Omar BA et al. Age standardization of rates: a new WHO standard. GPE discussion paper series: no. 31. EIP.GPE/EBD World Health Organization 2001.

5. FINDINGS

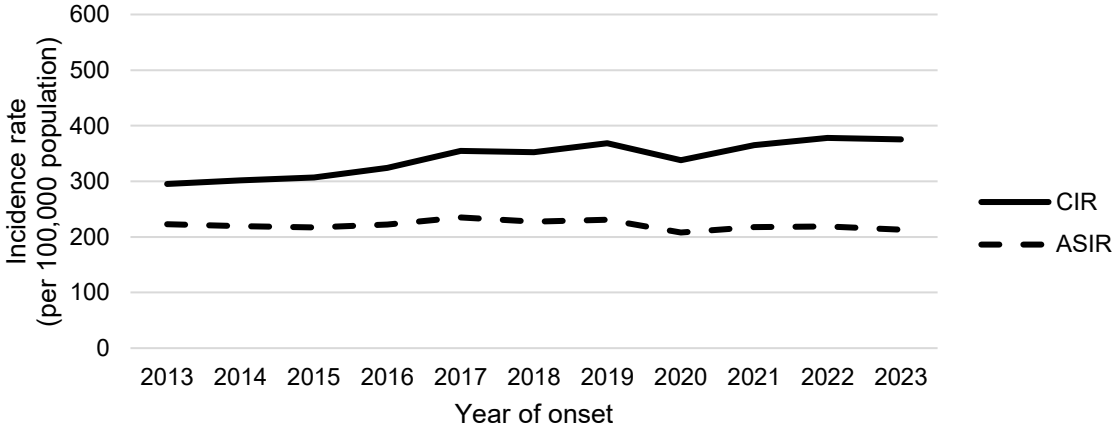
5.1 Incidence

The number of AMI episodes increased by 40%, from 9,532 in 2013 to 13,392 in 2023, with the corresponding crude incidence rates (CIR) rising significantly from 295.2 to 375.4 per 100,000 population (Table 5.1.1 and Figure 5.1.1). However, after accounting for Singapore's ageing population, there was little overall change in the ASIR (p=0.329). Notably, there was a decline in both the AMI incidence number and rate in 2020, which was likely due to the corollary effects of the COVID-19 pandemic, as patients avoided going to hospitals, particularly the elderly with NSTEMI[8]. Similarly, declines in hospital admissions for AMI during the peak of the pandemic were also observed in many other countries, such as China, Italy, Spain, the United States, the United Kingdom, France, Greece, and Sweden[9]. From 2021 onwards, however, the ASIR returned to levels similar to those observed prior to the COVID-19 pandemic.

Table 5.1.1: Incidence number and rate of AMI (per 100,000 population)

Year of onset	Number	CIR	95% CI	ASIR	95% CI
2013	9532	295.2	289.3-301.1	222.8	218.3-227.3
2014	9835	301.4	295.5-307.4	219.3	214.9-223.7
2015	10132	307.0	301.0-313.0	217.2	212.9-221.5
2016	10815	324.1	317.9-330.2	222.5	218.2-226.8
2017	11949	354.4	348.1-360.8	235.0	230.7-239.3
2018	11983	352.1	345.8-358.4	227.5	223.3-231.6
2019	12651	368.3	361.9-374.7	230.9	226.7-235.0
2020	11680	338.0	331.8-344.1	207.9	204.0-211.8
2021	12448	365.1	358.7-371.5	217.9	213.9-221.9
2022	13197	378.0	371.5-384.4	218.8	214.9-222.6
2023	13392	375.4	369.0-381.7	212.9	209.1-216.7
P for trend	-	<0.001**	-	0.329	-

Figure 5.1.1: Incidence rate of AMI (per 100,000 population)



[8] Tern P. et al. Impact of COVID-19 on Acute MI and Percutaneous Coronary Intervention Rates and Outcomes in Southeast Asia and the Middle East. Journal of Asia Pacific Society of Cardiology: 2022.
[9] Toscano et al. Acute Myocardial Infarction During the COVID-19 Pandemic: An Update on Clinical Characteristics and Outcomes. Front. Cardiovasc. Med. 2021; 8.

The median age at onset of AMI increased from 69.2 years in 2013 to 71.6 years in 2023 (p<0.001) (Table 5.1.2). In 2023, 80% of AMI patients were aged 60 years and above at onset (increase from about 70% in 2013), while about 54% were aged 70 years and above (increase from about 48% in 2013) (Table 5.1.2 and Figure 5.1.2). In comparison, the American Heart Association (AHA) reported in 2023 that 30-40% of Americans hospitalised with acute coronary syndrome were aged 75 years and above[10].

Table 5.1.2: Age distribution at onset of AMI

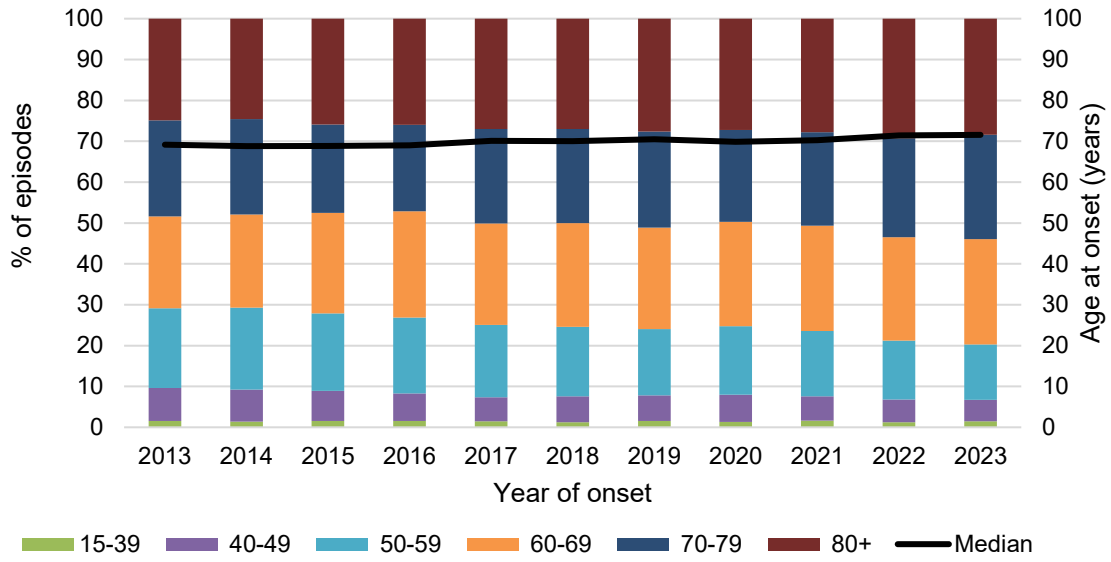
Year of onset	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2013	69.2	13	0.1	139	1.5	765	8.0
2014	68.8	11	0.1	127	1.3	768	7.8
2015	68.8	13	0.1	148	1.5	742	7.3
2016	69.0	16	0.1	155	1.4	727	6.7
2017	70.1	16	0.1	162	1.4	700	5.9
2018	70.0	15	0.1	132	1.1	765	6.4
2019	70.5	22	0.2	179	1.4	785	6.2
2020	69.9	15	0.1	143	1.2	774	6.6
2021	70.3	12	0.1	190	1.5	747	6.0
2022	71.4	10	0.1	158	1.2	734	5.6
2023	71.6	17	0.1	181	1.4	704	5.3

Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2013	1859	19.5	2146	22.5	2241	23.5	2369	24.9
2014	1972	20.1	2241	22.8	2297	23.4	2419	24.6
2015	1923	19.0	2489	24.6	2189	21.6	2628	25.9
2016	2004	18.5	2814	26.0	2285	21.1	2814	26.0
2017	2116	17.7	2963	24.8	2768	23.2	3224	27.0
2018	2036	17.0	3040	25.4	2762	23.0	3233	27.0
2019	2057	16.3	3136	24.8	2978	23.5	3494	27.6
2020	1960	16.8	2984	25.5	2624	22.5	3180	27.2
2021	1988	16.0	3203	25.7	2849	22.9	3459	27.8
2022	1894	14.4	3348	25.4	3193	24.2	3860	29.2
2023	1815	13.6	3445	25.7	3420	25.5	3810	28.4

[10] Damluji et al. Management of Acute Coronary Syndrome in the Older Adult Population: A Scientific Statement From the American Heart Association. Circulation. 2023;147:e32–e62.

Figure 5.1.2: Age distribution at onset of AMI

(Age groups 15-29 and 30-39 are combined for ease of visualisation.)



The age-specific incidence rate (ASPIR) of AMI increased with age, with the oldest age group (80 years and above) having the highest incidence rate – about 4.5 and 2.5 times that of those aged 60-69 and 70-79 years respectively in 2023. Over the years, only those aged 70-79 years showed a significant decline in the ASPIR of AMI, while those aged 30-39 and 60-69 years showed a significant increase. The trends in the remaining age groups were not statistically significant (Table 5.1.3 and Figure 5.1.3b).

Table 5.1.3: Age-specific incidence rate of AMI (per 100,000 population)

Year of onset	Overall		Age 15-29		Age 30-39		Age 40-49	
	CIR	95% CI	CIR	95% CI	CIR	95% CI	CIR	95% CI
2013	295.2	289.3-301.1	1.7	0.8-2.6	23.1	19.2-26.9	121.7	113.0-130.3
2014	301.4	295.5-307.4	1.4	0.6-2.3	21.4	17.7-25.1	123.0	114.3-131.7
2015	307.0	301.0-313.0	1.7	0.8-2.6	25.0	21.0-29.0	119.6	111.0-128.3
2016	324.1	317.9-330.2	2.0	1.0-3.1	26.4	22.2-30.5	118.3	109.7-126.9
2017	354.4	348.1-360.8	2.0	1.0-3.0	27.9	23.6-32.2	113.8	105.4-122.3
2018	352.1	345.8-358.4	1.9	1.0-2.9	22.6	18.7-26.4	125.1	116.2-134.0
2019	368.3	361.9-374.7	2.9	1.7-4.1	30.1	25.7-34.5	128.2	119.2-137.1
2020	338.0	331.8-344.1	2.0	1.0-3.0	23.9	20.0-27.9	126.7	117.7-135.6
2021	365.1	358.7-371.5	1.7	0.7-2.6	32.2	27.6-36.8	126.0	117.0-135.0
2022	378.0	371.5-384.4	1.4	0.5-2.2	26.0	21.9-30.0	121.5	112.7-130.3
2023	375.4	369.0-381.7	2.4	1.2-3.5	29.0	24.8-33.3	114.9	106.4-123.4
P for trend	<0.001**	-	0.381	-	0.051*	-	0.864	-
Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	CIR	95% CI	CIR	95% CI	CIR	95% CI	CIR	95% CI
2013	313.0	298.8-327.2	583.0	558.3-607.7	1272.6	1219.9-1325.3	2885.5	2769.3-3001.7
2014	326.5	312.1-341.0	570.7	547.0-594.3	1254.4	1203.1-1305.7	2771.1	2660.7-2881.5
2015	315.2	301.1-329.3	588.5	565.4-611.7	1190.7	1140.8-1240.6	2812.3	2704.7-2919.8
2016	325.8	311.5-340.0	625.5	602.4-648.6	1191.6	1142.8-1240.5	2877.3	2771.0-2983.6
2017	344.3	329.7-359.0	635.0	612.1-657.9	1309.1	1260.3-1357.8	3183.4	3073.5-3293.3
2018	331.9	317.5-346.4	628.4	606.0-650.7	1206.8	1161.8-1251.8	3024.9	2920.6-3129.2
2019	338.1	323.5-352.7	627.0	605.1-649.0	1216.9	1173.2-1260.6	3021.0	2920.8-3121.2
2020	325.6	311.2-340.1	580.5	559.7-601.3	1005.4	966.9-1043.8	2565.1	2475.9-2654.2
2021	340.3	325.3-355.3	618.3	596.9-639.8	1046.3	1007.8-1084.7	2634.2	2546.4-2721.9
2022	319.5	305.1-333.9	624.7	603.5-645.9	1084.7	1047.0-1122.3	2841.9	2752.2-2931.5
2023	301.0	287.1-314.8	623.2	602.3-644.0	1072.5	1036.5-1108.4	2723.2	2636.7-2809.7
P for trend	0.875	-	0.097	-	0.005**	-	0.339	-

Figure 5.1.3a: Age-specific incidence rate of AMI (per 100,000 population), 2013 vs 2023

(For ease of visualisation, the graph shows only the ASPIR trend for 2013 and 2023 only. For detailed ASPIR information across years, please refer to Table 5.1.3.)

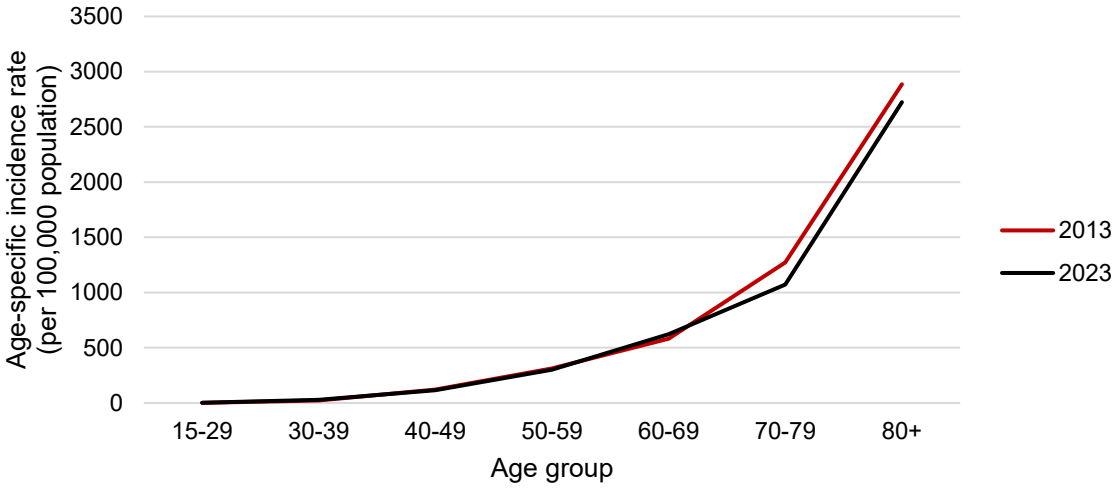
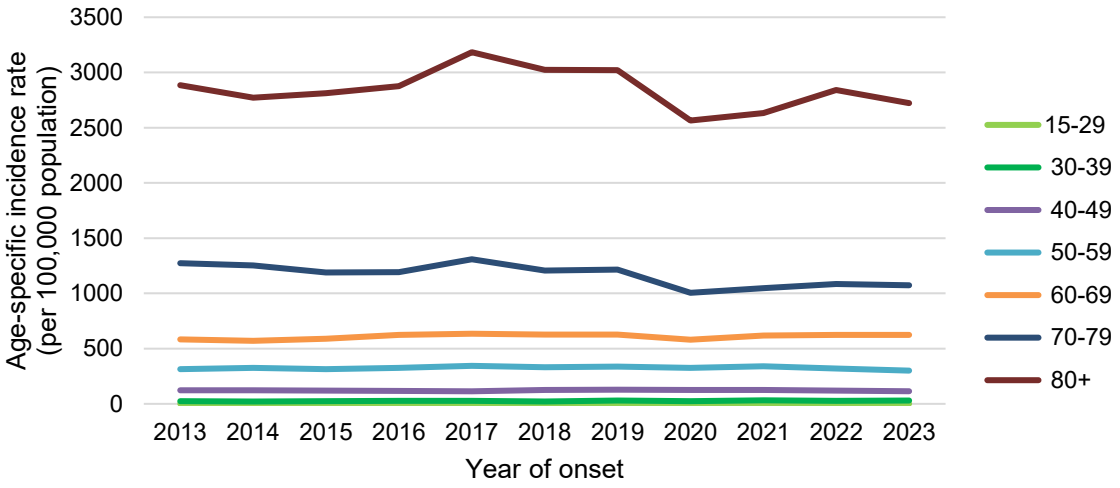


Figure 5.1.3b: Age-specific incidence rate of AMI (per 100,000 population) across age groups



Although the sex distribution was almost equal in the general population, there were about twice as many males diagnosed with AMI each year (Table 5.1.4). The ASIRs for males were consistently higher than those for females (Figure 5.1.4). In 2023, males had an ASIR of 315.5 per 100,000, while females had an ASIR of 119.1 per 100,000. Although the CIRs increased significantly for both sexes, after accounting for population ageing, the change in the ASIR of AMI among males was not significant (p=0.610), whereas that for females decreased significantly (p=0.005).

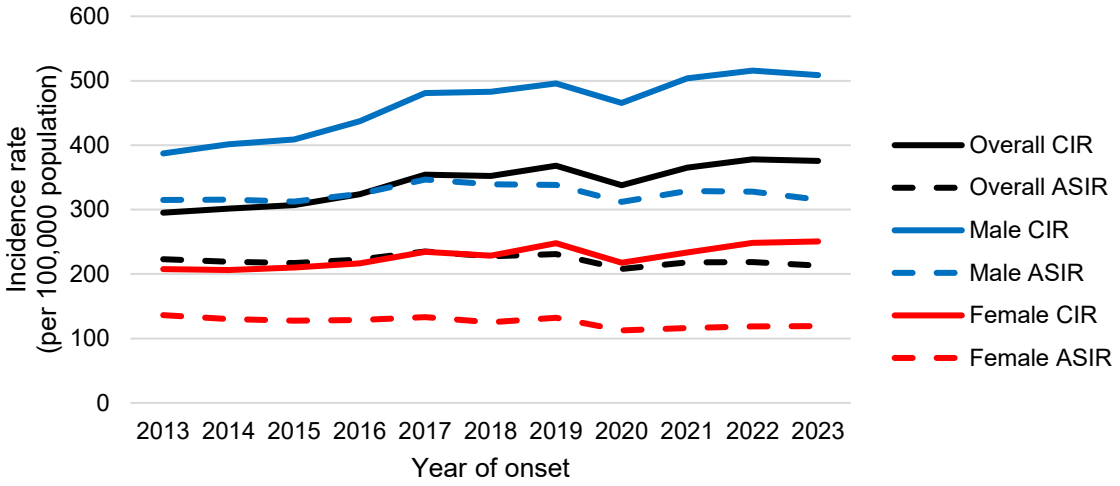
Males are known to have a higher risk of AMI than females. The underlying causes are multifactorial and related to pathophysiological sex differences in AMI[11]. Furthermore, the prevalence of hypertension, hyperlipidaemia, diabetes, high body mass index (BMI) and smoking, which are common risk factors for AMI, was higher among males than females in the general population, based on the National Population Health Survey (NPHS) 2023[12].

Table 5.1.4: Incidence number and rate of AMI (per 100,000 population) by sex

Male						
Year of onset	**Number**	**%**	**CIR**	**95% CI**	**ASIR**	**95% CI**
2013	6106	64.1	387.2	377.5-396.9	314.9	307.0-322.8
2014	6391	65.0	401.4	391.5-411.2	315.4	307.7-323.2
2015	6581	65.0	408.9	399.0-418.8	312.7	305.1-320.3
2016	7105	65.7	437.0	426.8-447.2	324.3	316.7-331.9
2017	7890	66.0	480.9	470.3-491.5	346.6	338.9-354.3
2018	7991	66.7	483.1	472.5-493.6	339.3	331.8-346.8
2019	8271	65.4	495.9	485.2-506.5	338.3	330.9-345.7
2020	7812	66.9	465.7	455.4-476.0	312.0	305.0-319.1
2021	8355	67.1	503.9	493.1-514.7	328.7	321.5-336.0
2022	8730	66.2	515.7	504.8-526.5	327.9	320.8-334.9
2023	8773	65.5	508.7	498.0-519.3	315.5	308.7-322.3
P for trend	-	-	<0.001**	-	0.610	-
Female						
Year of onset	**Number**	**%**	**CIR**	**95% CI**	**ASIR**	**95% CI**
2013	3426	35.9	207.4	200.4-214.3	136.2	131.5-140.9
2014	3444	35.0	206.2	199.3-213.1	130.1	125.6-134.6
2015	3551	35.0	210.0	203.1-216.9	127.7	123.3-132.1
2016	3710	34.3	216.8	209.8-223.7	128.7	124.3-133.0
2017	4059	34.0	234.5	227.3-241.7	133.3	129.0-137.5
2018	3992	33.3	228.3	221.2-235.3	125.4	121.4-129.5
2019	4380	34.6	247.9	240.5-255.2	132.2	128.0-136.3
2020	3868	33.1	217.5	210.6-224.3	112.5	108.8-116.3
2021	4093	32.9	233.7	226.5-240.8	116.1	112.3-119.9
2022	4467	33.8	248.4	241.1-255.7	118.8	115.1-122.5
2023	4619	34.5	250.6	243.4-257.9	119.1	115.4-122.8
P for trend	-	-	0.001**	-	0.005**	-

[11] Mehta LS et al. Acute myocardial infarction in women. Circulation 2016; 133.
[12] National Population Health Survey 2023 Report. Ministry of Health, Singapore. Accessed 2 October 2025.

Figure 5.1.4: Incidence rate of AMI (per 100,000 population) by sex

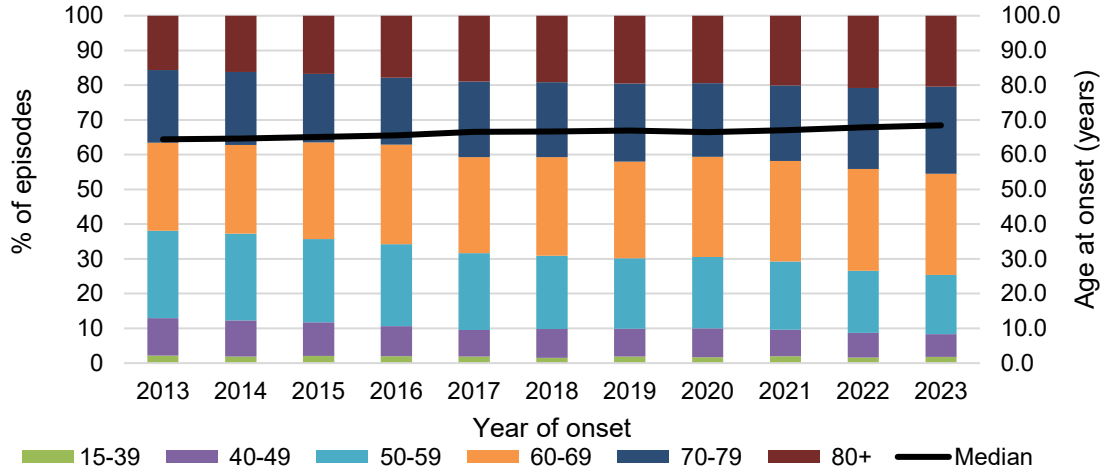


The median age at onset of AMI among males increased from 64.4 years in 2013 to 68.4 years in 2023 (p<0.001) (Table 5.1.5a). The highest proportion of male AMI patients in 2023 was among those aged 60-69 years (29.1%); and this pattern was consistent throughout the years from 2013 onwards (Figure 5.1.5a).

Table 5.1.5a: Age distribution at onset of AMI among males

Year of onset	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2013	64.4	10	0.2	121	2.0	661	10.8
2014	64.7	10	0.2	111	1.7	664	10.4
2015	65.1	8	0.1	126	1.9	637	9.7
2016	65.6	11	0.2	133	1.9	613	8.6
2017	66.6	14	0.2	134	1.7	607	7.7
2018	66.7	12	0.2	112	1.4	660	8.3
2019	66.9	16	0.2	144	1.7	660	8.0
2020	66.5	14	0.2	118	1.5	646	8.3
2021	67.1	11	0.1	154	1.8	637	7.6
2022	67.9	4	0.0	137	1.6	623	7.1
2023	68.4	10	0.1	149	1.7	573	6.5
Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2013	1534	25.1	1547	25.3	1277	20.9	956	15.7
2014	1599	25.0	1632	25.5	1342	21.0	1033	16.2
2015	1576	23.9	1834	27.9	1298	19.7	1102	16.7
2016	1675	23.6	2036	28.7	1366	19.2	1271	17.9
2017	1740	22.1	2181	27.6	1716	21.7	1498	19.0
2018	1684	21.1	2270	28.4	1725	21.6	1528	19.1
2019	1679	20.3	2301	27.8	1856	22.4	1615	19.5
2020	1610	20.6	2254	28.9	1656	21.2	1514	19.4
2021	1644	19.7	2413	28.9	1823	21.8	1673	20.0
2022	1553	17.8	2562	29.3	2036	23.3	1815	20.8
2023	1493	17.0	2557	29.1	2196	25.0	1795	20.5

Figure 5.1.5a: Age distribution at onset of AMI among males



The median age at onset of AMI among females remained at 77-78 years over the past 10 years (p=0.124) (Table 5.1.5b), about 10 years older than the median age at onset among males (Table 5.1.5a). In contrast to males, whereby those aged 60-69 years formed the largest age group with AMI (29.1%); for females, those aged 80 years and above consistently constituted the largest proportion of female AMI patients each year, accounting for 43.6% in 2023 (Figure 5.1.5b).

Globally, the pattern of females experiencing AMI onset 9-10 years later than males persists across regions, primarily because younger males have a higher prevalence of risk factors than females of the same age, especially lipid abnormalities and smoking[13,14]. The same risk profile has been observed in Singapore, based on the NPHS 2023[15], whereby the prevalence of hyperlipidaemia and smoking was substantially higher among males aged 30-59 years compared with females of the same age.

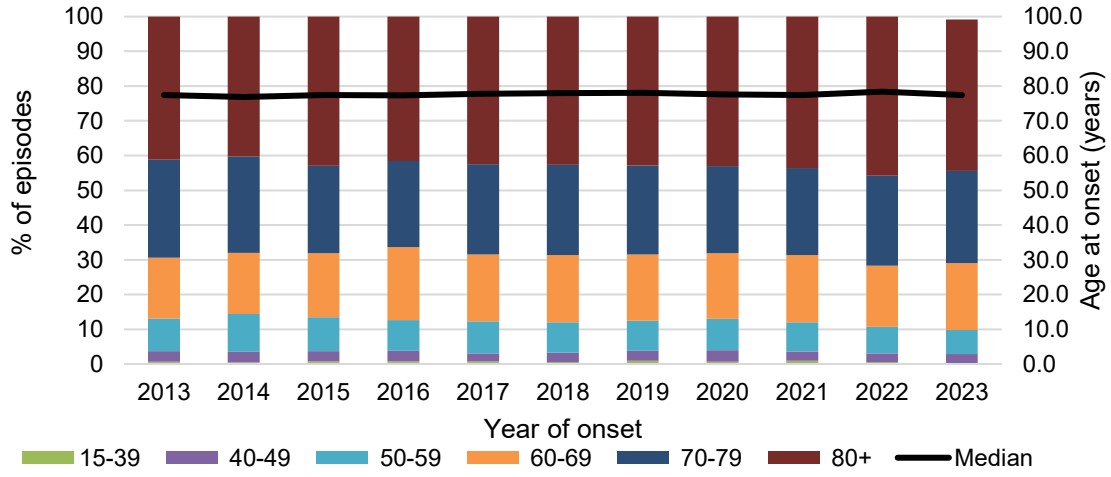
Table 5.1.5b: Age distribution at onset of AMI among females

Year of onset	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2013	77.4	3	0.1	18	0.5	104	3.0
2014	76.9	1	0.0	16	0.5	104	3.0
2015	77.4	5	0.1	22	0.6	105	3.0
2016	77.3	5	0.1	22	0.6	114	3.1
2017	77.8	2	0.0	28	0.7	93	2.3
2018	78.0	3	0.1	20	0.5	105	2.6
2019	78.0	6	0.1	35	0.8	125	2.9
2020	77.6	1	0.0	25	0.6	128	3.3
2021	77.4	1	0.0	36	0.9	110	2.7
2022	78.4	6	0.1	21	0.5	111	2.5
2023	77.4	7	0.2	32	0.7	131	2.8

[13] Yusof, S et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. Lancet. 2004;364:937-952.
[14] Campbell, D. J. Why do men and women differ in their risk of myocardial infarction? European Heart Journal. 2008;29:835-835.
[15] National Population Health Survey 2023 Report. Ministry of Health, Singapore. Accessed 2 October 2025.

Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2013	325	9.5	599	17.5	964	28.1	1413	41.2
2014	373	10.8	609	17.7	955	27.7	1386	40.2
2015	347	9.8	655	18.4	891	25.1	1526	43.0
2016	329	8.9	778	21.0	919	24.8	1543	41.6
2017	376	9.3	782	19.3	1052	25.9	1726	42.5
2018	352	8.8	770	19.3	1037	26.0	1705	42.7
2019	378	8.6	835	19.1	1122	25.6	1879	42.9
2020	350	9.0	730	18.9	968	25.0	1666	43.1
2021	344	8.4	790	19.3	1026	25.1	1786	43.6
2022	341	7.6	786	17.6	1157	25.9	2045	45.8
2023	322	7.0	888	19.2	1224	26.5	2015	43.6

Figure 5.1.5b: Age distribution at onset of AMI among females



When comparing the ethnic distribution of the AMI population with that of the general population, the proportion of Chinese was lower among the AMI population (Table 5.1.6). The Chinese also consistently had the lowest ASIR across the years – less than half that of the Malays and Indians (Figure 5.1.6). In 2023, the ASIRs of AMI among the Chinese, Malays and Indians were 168.5, 410.6 and 399.2 per 100,000 population, respectively. The changes in ASIR over the years were not statistically significant for any of the three ethnic groups.

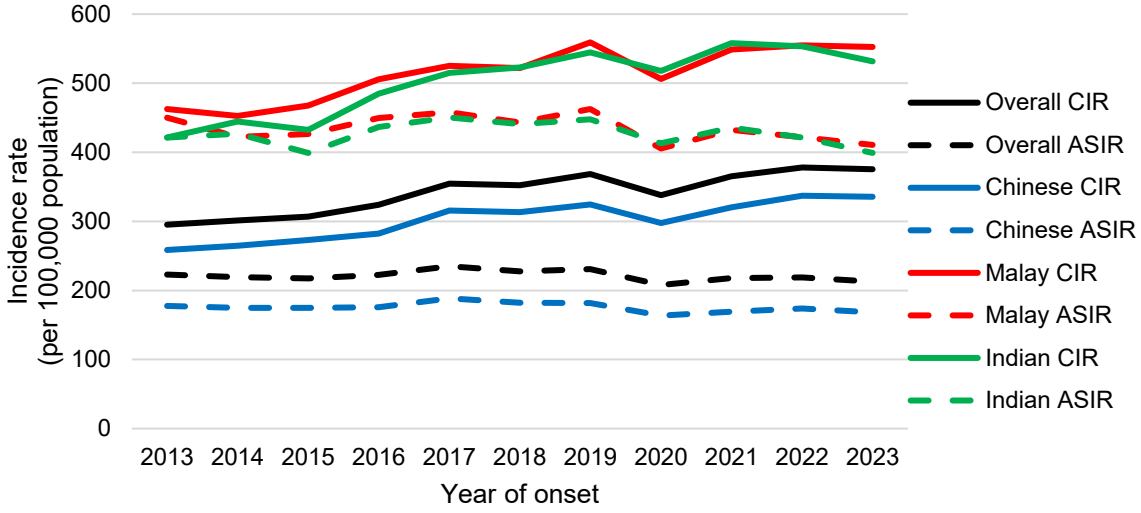
A possible reason for the comparatively higher incidence of AMI among Malays and Indians could be that diabetes and high BMI, which are common risk factors for AMI, were more prevalent among Malays and Indians than among Chinese in the general population, based on the NPHS 2023[16]. Smoking, another significant risk factor for AMI, was also found to be more prevalent among Malays than among the other ethnic groups[16]. Furthermore, Indians have an ethnic-specific predisposition to coronary artery disease[17].

[16] National Population Health Survey 2023 Report. Ministry of Health, Singapore. Accessed 2 October 2025.
[17] Zheng H et al. Ethnic differences and trends in ST-segment elevation myocardial infarction incidence and mortality in a multi-ethnic population. Annuals Academy of Medicine Singapore. 2019; 48: 75-85.

Table 5.1.6: Incidence number and rate (per 100,000 population) of AMI by ethnicity

Chinese						
Year of onset	**Number**	**%**	**CIR**	**95% CI**	**ASIR**	**95% CI**
2013	6309	66.2	258.6	252.2-265.0	177.5	173.1-182.0
2014	6521	66.3	264.7	258.2-271.1	175.0	170.7-179.4
2015	6801	67.1	272.8	266.3-279.3	175.0	170.8-179.3
2016	7119	65.8	282.4	275.9-289.0	175.7	171.5-179.9
2017	8035	67.2	315.6	308.7-322.5	188.5	184.3-192.8
2018	8046	67.1	313.2	306.3-320.0	182.0	177.9-186.1
2019	8410	66.5	324.3	317.4-331.3	181.9	177.9-186.0
2020	7756	66.4	297.4	290.7-304.0	163.6	159.8-167.4
2021	8230	66.1	320.1	313.2-327.0	169.1	165.2-173.0
2022	8858	67.1	337.1	330.1-344.2	173.8	169.9-177.6
2023	9001	67.2	335.7	328.7-342.6	168.5	164.8-172.2
P for trend	-	-	<0.001**	-	0.187	-
Malay						
Year of onset	**Number**	**%**	**CIR**	**95% CI**	**ASIR**	**95% CI**
2013	1892	19.8	462.8	442.0-483.7	450.0	429.3-470.7
2014	1876	19.1	452.6	432.1-473.0	422.3	402.8-441.8
2015	1965	19.4	467.7	447.1-488.4	426.6	407.3-445.9
2016	2154	19.9	505.8	484.5-527.2	449.6	430.2-469.0
2017	2263	18.9	525.2	503.6-546.9	458.1	438.9-477.2
2018	2271	19.0	521.7	500.3-543.2	442.9	424.5-461.4
2019	2455	19.4	559.1	537.0-581.2	462.6	444.1-481.1
2020	2238	19.2	506.0	485.0-527.0	405.5	388.5-422.6
2021	2417	19.4	548.8	526.9-570.6	432.5	414.9-450.0
2022	2483	18.8	554.7	532.9-576.5	421.8	405.0-438.6
2023	2505	18.7	552.7	531.0-574.3	410.6	394.2-427.0
P for trend	-	-	<0.001**	-	0.196	-
Indian						
Year of onset	**Number**	**%**	**CIR**	**95% CI**	**ASIR**	**95% CI**
2013	1185	12.4	421.4	397.4-445.4	421.2	396.7-445.7
2014	1261	12.8	444.3	419.8-468.9	426.7	402.8-450.7
2015	1237	12.2	432.4	408.3-456.5	399.0	376.4-421.6
2016	1399	12.9	485.0	459.6-510.4	436.4	413.2-459.6
2017	1500	12.6	514.9	488.9-541.0	450.4	427.4-473.3
2018	1538	12.8	523.0	496.8-549.1	440.6	418.5-462.7
2019	1620	12.8	544.6	518.1-571.1	447.8	426.0-469.6
2020	1548	13.3	517.8	492.0-543.6	413.1	392.6-433.7
2021	1638	13.2	558.0	531.0-585.0	435.9	414.8-457.0
2022	1692	12.8	553.6	527.2-580.0	421.4	401.3-441.4
2023	1675	12.5	531.4	505.9-556.8	399.2	380.2-418.3
P for trend	-	-	<0.001**	-	0.723	-

Figure 5.1.6: Incidence rate of AMI (per 100,000 population) by ethnicity



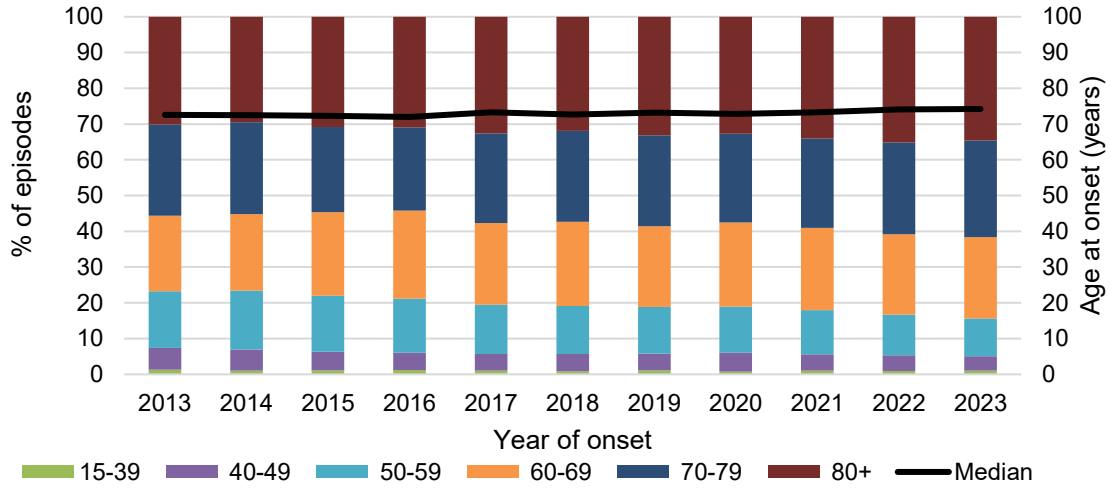
The Chinese had the oldest median age at onset of AMI, which increased from 72.6 years in 2013 to 74.2 years in 2023 (p=0.002). Since 2013, those aged 80 years and above accounted for the largest proportion of AMI cases among the Chinese, ranging from 29.5% to 35.1% (Table 5.1.7a and Figure 5.1.7a).

Table 5.1.7a: Age distribution at onset of AMI among Chinese

Year of onset	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2013	72.6	8	0.1	75	1.2	381	6.0
2014	72.5	6	0.1	60	0.9	389	6.0
2015	72.3	9	0.1	66	1.0	353	5.2
2016	72.0	4	0.1	81	1.1	344	4.8
2017	73.3	6	0.1	80	1.0	372	4.6
2018	72.7	6	0.1	61	0.8	394	4.9
2019	73.2	10	0.1	87	1.0	392	4.7
2020	72.8	7	0.1	56	0.7	404	5.2
2021	73.3	7	0.1	82	1.0	369	4.5
2022	74.1	5	0.1	78	0.9	392	4.4
2023	74.2	9	0.1	86	1.0	357	4.0

Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2013	1002	15.9	1335	21.2	1610	25.5	1898	30.1
2014	1072	16.4	1398	21.4	1674	25.7	1922	29.5
2015	1067	15.7	1590	23.4	1619	23.8	2097	30.8
2016	1079	15.2	1750	24.6	1662	23.3	2199	30.9
2017	1110	13.8	1835	22.8	2010	25.0	2622	32.6
2018	1079	13.4	1895	23.6	2045	25.4	2566	31.9
2019	1096	13.0	1898	22.6	2137	25.4	2790	33.2
2020	999	12.9	1829	23.6	1925	24.8	2536	32.7
2021	1018	12.4	1899	23.1	2050	24.9	2805	34.1
2022	1002	11.3	1994	22.5	2278	25.7	3109	35.1
2023	954	10.6	2049	22.8	2436	27.1	3110	34.6

Figure 5.1.7a: Age distribution at onset of AMI among Chinese



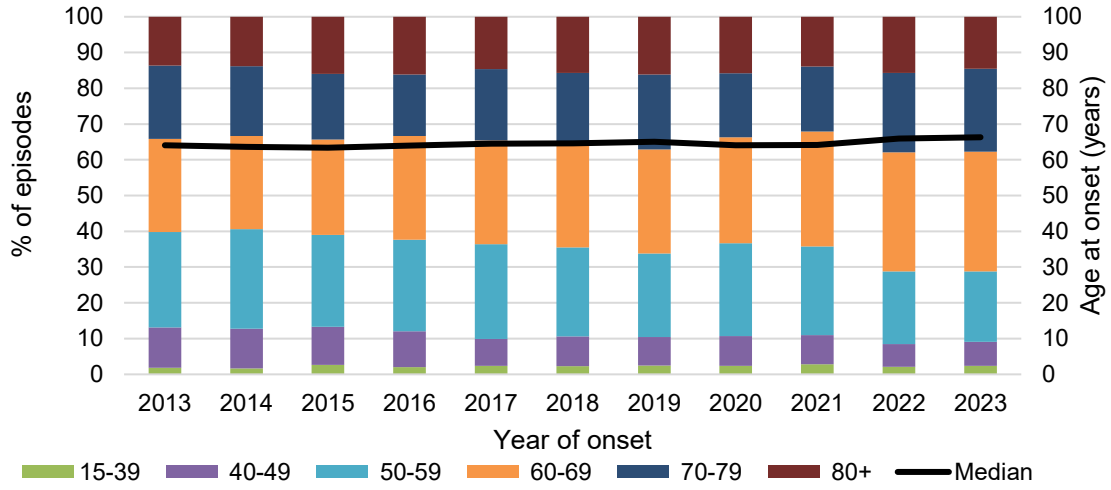
The median age at onset of AMI among the Malays was younger than that among the Chinese, increasing from 64.0 years in 2013 to 66.3 years in 2023 (p=0.005). From 2015 onwards, those aged 60-69 years constituted the largest proportion of Malay AMI patients (33.5% in 2023) (Table 5.1.7b and Figure 5.1.7b).

Table 5.1.7b: Age distribution at onset of AMI among Malays

Year of onset	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2013	64.0	3	0.2	32	1.7	214	11.3
2014	63.7	3	0.2	28	1.5	208	11.1
2015	63.4	4	0.2	48	2.4	209	10.6
2016	64.0	7	0.3	37	1.7	215	10.0
2017	64.5	7	0.3	46	2.0	172	7.6
2018	64.6	6	0.3	45	2.0	191	8.4
2019	65.0	7	0.3	54	2.2	195	7.9
2020	64.1	5	0.2	48	2.1	187	8.4
2021	64.1	3	0.1	66	2.7	196	8.1
2022	66.0	3	0.1	49	2.0	159	6.4
2023	66.3	4	0.2	55	2.2	168	6.7

Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2013	504	26.6	493	26.1	388	20.5	258	13.6
2014	523	27.9	489	26.1	366	19.5	259	13.8
2015	505	25.7	524	26.7	361	18.4	314	16.0
2016	552	25.6	624	29.0	371	17.2	348	16.2
2017	598	26.4	657	29.0	452	20.0	331	14.6
2018	564	24.8	660	29.1	449	19.8	356	15.7
2019	574	23.4	714	29.1	515	21.0	396	16.1
2020	581	26.0	663	29.6	400	17.9	354	15.8
2021	600	24.8	777	32.1	439	18.2	336	13.9
2022	503	20.3	827	33.3	552	22.2	390	15.7
2023	495	19.8	839	33.5	580	23.2	364	14.5

Figure 5.1.7b: Age distribution at onset of AMI among Malays



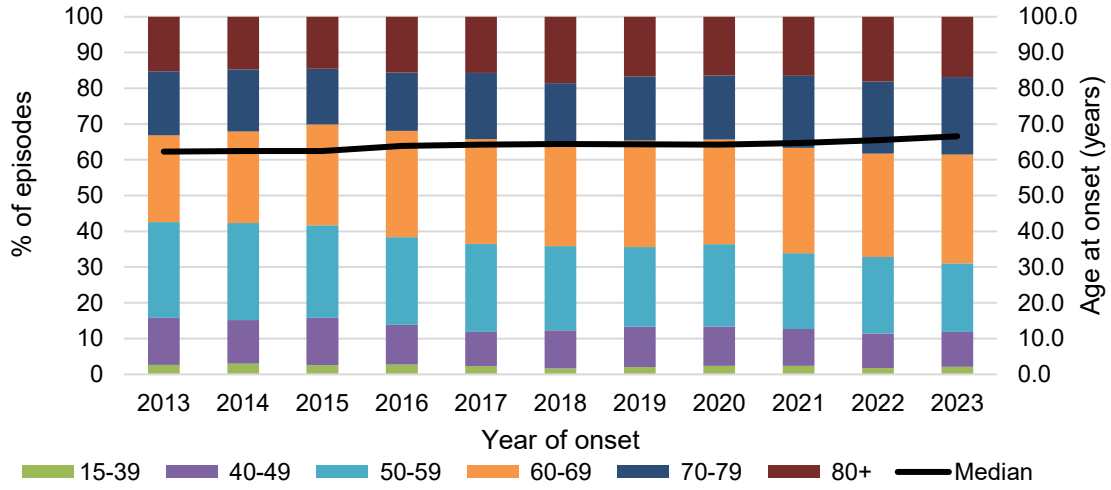
The median age at onset of AMI among the Indians increased from 62.3 years in 2013 to 66.6 years in 2023 (p<0.001). Similar to the Malays, from 2015 onwards, those aged 60-69 years constituted the largest proportion of Indian AMI patients (30.4% in 2023) (Table 5.1.7c and Figure 5.1.7c).

Table 5.1.7c: Age distribution at onset of AMI among Indians

Year of onset	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2013	62.3	2	0.2	29	2.4	156	13.2
2014	62.4	2	0.2	36	2.9	154	12.2
2015	62.5	0	0.0	32	2.6	164	13.3
2016	63.9	5	0.4	33	2.4	155	11.1
2017	64.3	2	0.1	32	2.1	144	9.6
2018	64.5	3	0.2	22	1.4	164	10.7
2019	64.3	2	0.1	31	1.9	182	11.2
2020	64.2	2	0.1	35	2.3	171	11.0
2021	64.7	2	0.1	37	2.3	168	10.3
2022	65.5	2	0.1	28	1.7	163	9.6
2023	66.6	4	0.2	31	1.9	164	9.8

Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2013	318	26.8	287	24.2	212	17.9	181	15.3
2014	342	27.1	322	25.5	219	17.4	186	14.8
2015	320	25.9	349	28.2	192	15.5	180	14.6
2016	344	24.6	416	29.7	227	16.2	219	15.7
2017	369	24.6	439	29.3	278	18.5	236	15.7
2018	363	23.6	448	29.1	253	16.4	285	18.5
2019	361	22.3	484	29.9	290	17.9	270	16.7
2020	355	22.9	454	29.3	277	17.9	254	16.4
2021	348	21.2	482	29.4	331	20.2	270	16.5
2022	362	21.4	490	29.0	340	20.1	307	18.1
2023	320	19.1	510	30.4	363	21.7	283	16.9

Figure 5.1.7c: Age distribution at onset of AMI among Indians



NSTEMI occurred more frequently than STEMI (Table 5.1.8), and the ASIRs for NSTEMI were consistently higher than those for STEMI across the years (Figure 5.1.8). NSTEMI was more prevalent because it could occur on its own or as a complication in critically ill patients. Such patients had an increased risk of NSTEMI due to greater myocardial demand[18]. Additionally, type 2 MI (T2MI) is classified under NSTEMI; the lowering of the diagnostic threshold for troponin, together with the advent of more sensitive assays, has led to an increase in the number of patients identified with T2MI[19].

Overall, AMI incidence declined in 2020, possibly attributable to the COVID-19 pandemic, though STEMI incidence increased while NSTEMI incidence decreased in 2020. STEMI is more severe and carries a higher likelihood of fatality if intervention is not provided promptly. Thus, the number of STEMIs continued to increase in 2020 and the ASIR remained relatively stable, as these patients were less likely to avoid hospital visits during the pandemic. However, the number of NSTEMIs fell in 2020, as these patients, especially the elderly, may have avoided seeking hospital care due to COVID-19 concerns. The ASIR for STEMI generally remained stable, ranging between 52.8 and 57.2 per 100,000 over the past decade (p=0.976), as did that for NSTEMI (range: 143.4-172.4 per 100,000 population; p=0.361).

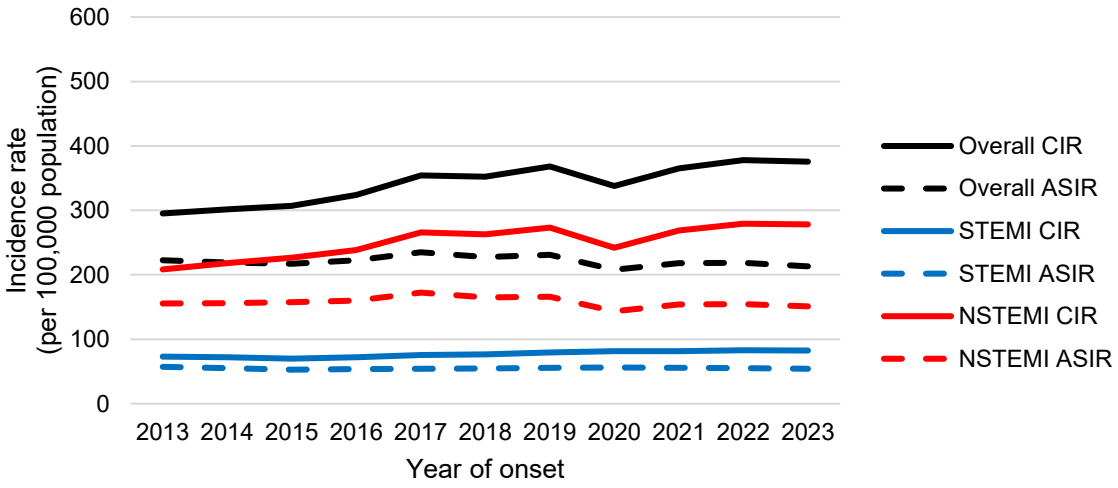
As the percentages in Table 5.1.8 are calculated among all AMI patients, and patients without documentation of STEMI or NSTEMI are not shown, the sum of the percentages for STEMI and NSTEMI is therefore less than 100% for each year. Figures for overall CIR and ASIR include cases of unknown etiology.

[18]Jeremy B. Richards, Renee D. Stapleton. Non-pulmonary complications of critical care. A clinical guide. Respiratory Medicine. 2014th Edition.
[19] White K.,Kinarivala M., Scott I. Diagnostic features, management and prognosis of type 2 myocardial infarction compared to type 1 myocardial infarction: A systematic review and meta-analysis. *BMJ Open 2022, 12*(2), e055755.

Table 5.1.8: Incidence number and rate of AMI (per 100,000 population) by subtype

STEMI						
Year of onset	**Number**	**%**	**CIR**	**95% CI**	**ASIR**	**95% CI**
2013	2362	24.8	73.1	70.2-76.1	57.2	54.9-59.6
2014	2345	23.8	71.9	69.0-74.8	55.1	52.9-57.4
2015	2308	22.8	69.9	67.1-72.8	52.8	50.6-55.0
2016	2406	22.2	72.1	69.2-75.0	53.9	51.7-56.1
2017	2540	21.3	75.3	72.4-78.3	54.4	52.3-56.6
2018	2609	21.8	76.7	73.7-79.6	54.8	52.7-57.0
2019	2736	21.6	79.6	76.7-82.6	55.9	53.7-58.0
2020	2815	24.1	81.5	78.4-84.5	56.0	53.9-58.1
2021	2773	22.3	81.3	78.3-84.4	55.6	53.5-57.8
2022	2895	21.9	82.9	79.9-85.9	55.4	53.3-57.5
2023	2940	22.0	82.4	79.4-85.4	54.0	51.9-56.0
P for trend	-	-	<0.001**	-	0.976	-
NSTEMI						
Year of onset	**Number**	**%**	**CIR**	**95% CI**	**ASIR**	**95% CI**
2013	6731	70.6	208.4	203.5-213.4	155.6	151.8-159.4
2014	7109	72.3	217.9	212.8-222.9	156.0	152.3-159.7
2015	7481	73.8	226.7	221.5-231.8	157.3	153.6-160.9
2016	7953	73.5	238.3	233.1-243.5	159.8	156.2-163.4
2017	8959	75.0	265.7	260.2-271.2	172.4	168.7-176.0
2018	8941	74.6	262.7	257.3-268.2	164.8	161.3-168.3
2019	9396	74.3	273.5	268.0-279.1	166.0	162.6-169.5
2020	8364	71.6	242.0	236.8-247.2	143.4	140.3-146.6
2021	9158	73.6	268.6	263.1-274.1	153.8	150.5-157.1
2022	9753	73.9	279.3	273.8-284.9	154.7	151.5-157.9
2023	9933	74.2	278.4	273.0-283.9	151.0	147.9-154.1
P for trend	-	-	<0.001**	-	0.361	-

Figure 5.1.8: Incidence rate of AMI (per 100,000 population) by subtype



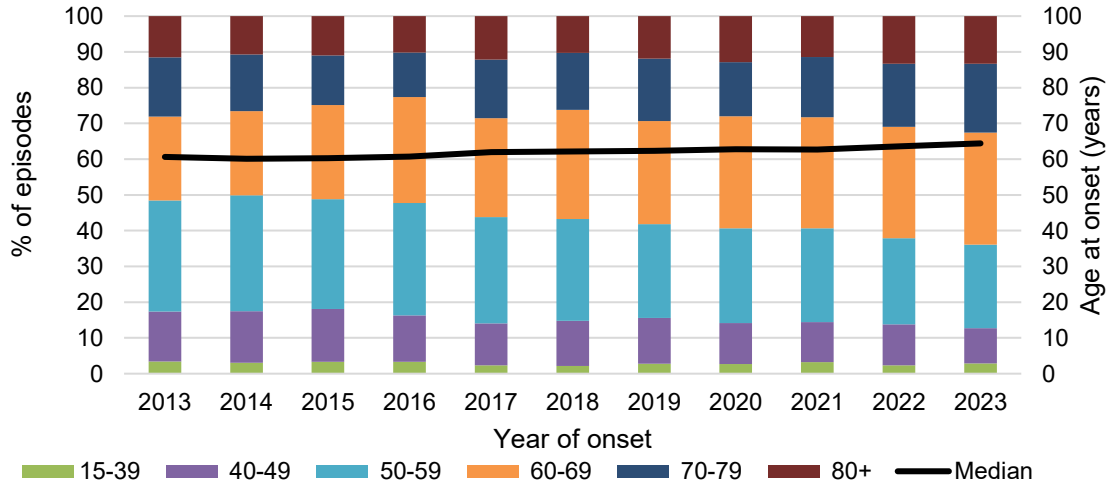
The median age at onset of STEMI increased from 60.6 years in 2013 to 64.4 years in 2023 (p<0.001). Each year, more than half of STEMI patients were aged 50-69 years at onset (54.7% in 2023); and the proportion of STEMI patients aged 60 years and above also increased from about 52% in 2013 to 64% in 2023 (Table 5.1.9a and Figure 5.1.9a).

Table 5.1.9a: Age distribution at onset of STEMI

Year of onset	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2013	60.6	5	0.2	76	3.2	329	13.9
2014	60.1	8	0.3	63	2.7	338	14.4
2015	60.2	3	0.1	74	3.2	340	14.7
2016	60.7	9	0.4	71	3.0	312	13.0
2017	62.0	7	0.3	52	2.0	299	11.8
2018	62.1	5	0.2	52	2.0	329	12.6
2019	62.4	9	0.3	67	2.4	351	12.8
2020	62.7	9	0.3	67	2.4	323	11.5
2021	62.7	5	0.2	84	3.0	312	11.3
2022	63.5	3	0.1	64	2.2	333	11.5
2023	64.4	8	0.3	76	2.6	291	9.9

Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2013	735	31.1	554	23.5	391	16.6	272	11.5
2014	760	32.4	553	23.6	372	15.9	251	10.7
2015	710	30.8	606	26.3	321	13.9	254	11.0
2016	756	31.4	714	29.7	299	12.4	245	10.2
2017	754	29.7	702	27.6	417	16.4	309	12.2
2018	743	28.5	797	30.5	415	15.9	268	10.3
2019	718	26.2	789	28.8	477	17.4	325	11.9
2020	745	26.5	882	31.3	427	15.2	362	12.9
2021	727	26.2	862	31.1	465	16.8	318	11.5
2022	697	24.1	901	31.1	512	17.7	385	13.3
2023	686	23.3	922	31.4	565	19.2	392	13.3

Figure 5.1.9a: Age distribution at onset of STEMI



The median age at onset of NSTEMI increased from 72.3 years in 2013 to 73.6 years in 2023 (p=0.003) (Table 5.1.9b), about 10 years older than the median age at onset for STEMI (Table 5.1.9a). Unlike STEMI, the highest proportion of NSTEMI patients in 2023 was among those aged 80 years and above (32.5% in 2023) (Figure 5.1.9b).

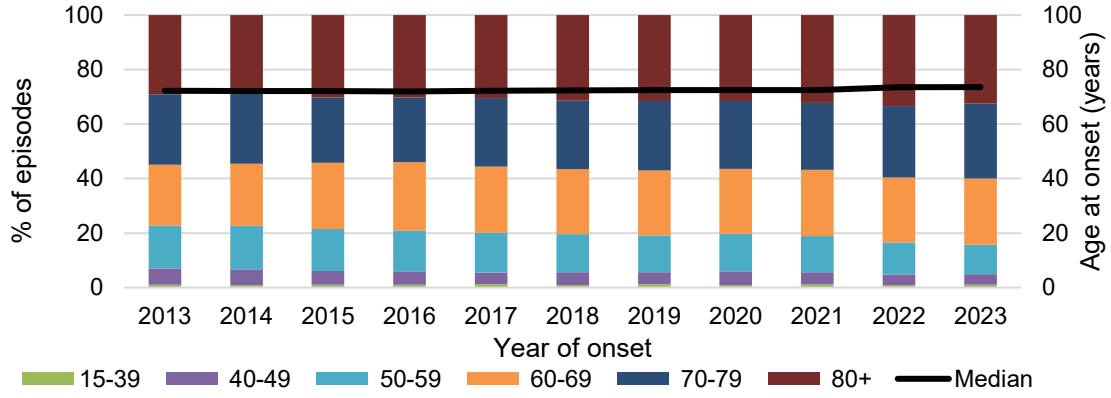
Data from the Global Registry of Acute Coronary Events (GRACE) and the UK Myocardial Ischaemia National Audit Project have similarly demonstrated that older adults are more likely to present with NSTEMI than STEMI[20]. This trend of NSTEMI patients being older is generally consistent internationally[21].

Table 5.1.9b: Age distribution at onset of NSTEMI

Year of onset	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2013	72.3	8	0.1	60	0.9	407	6.0
2014	72.1	3	0.0	59	0.8	411	5.8
2015	72.1	10	0.1	67	0.9	381	5.1
2016	72.0	7	0.1	79	1.0	393	4.9
2017	72.2	9	0.1	104	1.2	382	4.3
2018	72.4	10	0.1	73	0.8	417	4.7
2019	72.5	11	0.1	106	1.1	409	4.4
2020	72.4	6	0.1	70	0.8	424	5.1
2021	72.5	6	0.1	102	1.1	412	4.5
2022	73.5	6	0.1	84	0.9	376	3.9
2023	73.6	9	0.1	97	1.0	387	3.9

Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2013	1061	15.8	1503	22.3	1738	25.8	1954	29.0
2014	1141	16.1	1621	22.8	1834	25.8	2040	28.7
2015	1148	15.3	1820	24.3	1790	23.9	2265	30.3
2016	1186	14.9	1996	25.1	1891	23.8	2401	30.2
2017	1312	14.6	2175	24.3	2252	25.1	2725	30.4
2018	1249	14.0	2140	23.9	2247	25.1	2805	31.4
2019	1273	13.5	2245	23.9	2388	25.4	2964	31.5
2020	1146	13.7	1995	23.9	2088	25.0	2635	31.5
2021	1207	13.2	2231	24.4	2248	24.5	2952	32.2
2022	1151	11.8	2328	23.9	2550	26.1	3258	33.4
2023	1066	10.7	2424	24.4	2722	27.4	3228	32.5

Figure 5.1.9b: Age distribution at onset of NSTEMI



[20] Dai X et al. Acute coronary syndrome in older adults. Journal of Geriatric Cardiology; 2016:13. 101-108.
[21] McManus D. V. et al. Recent Trends in the Incidence, Treatment, and Outcomes of Patients with ST and Non-ST-Segment Acute Myocardial Infarction. Am J Med 2011; 124(1): 40-47.

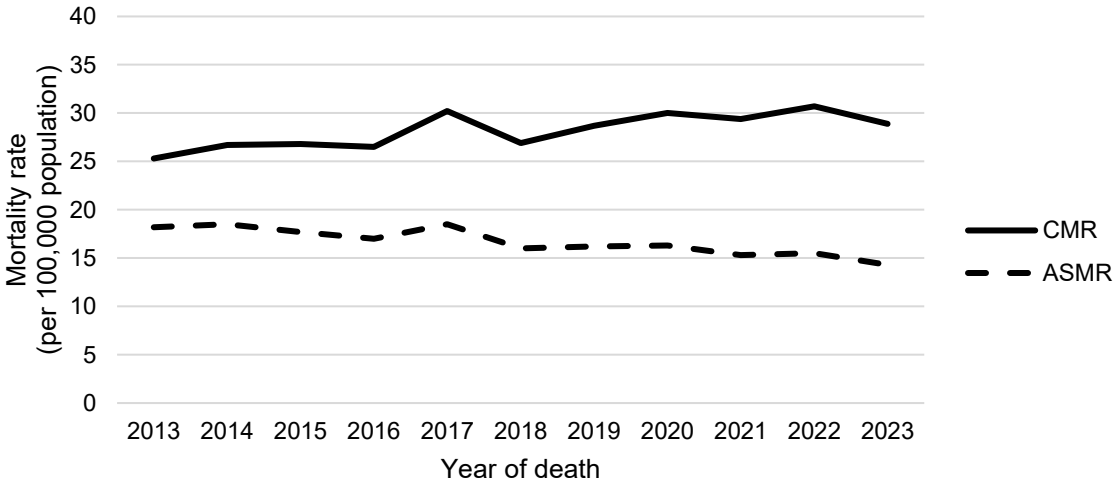
5.2 Mortality

The number of AMI deaths increased by about 26%, from 817 in 2013 to 1,032 in 2023 (Table 5.2.1), a comparatively less pronounced rise than the 40% increase in the number of AMI episodes from 9,532 to 13,392 over the same period (Table 5.1.1). Overall, the crude mortality rate (CMR) rose from 25.3 to 28.9 per 100,000 population over the past decade (Figure 5.2.1). However, the increase in CMR is partly attributable to population ageing, as there was a significant decline in the ASMR from 18.2 per 100,000 in 2013 to 14.3 per 100,000 in 2023 (p<0.001). This decreasing trend in ASMR was likely due to improvements in revascularisation and pharmacotherapy over the years[22,23,24,25].

Table 5.2.1: Mortality number and rate of AMI (per 100,000 population)

Year of death	Number	CMR	95% CI	ASMR	95% CI
2013	817	25.3	23.6-27.0	18.2	16.9-19.5
2014	870	26.7	24.9-28.4	18.5	17.2-19.7
2015	885	26.8	25.0-28.6	17.7	16.5-18.9
2016	886	26.5	24.8-28.3	17.0	15.9-18.2
2017	1018	30.2	28.3-32.1	18.5	17.3-19.7
2018	915	26.9	25.1-28.6	16.0	14.9-17.0
2019	986	28.7	26.9-30.5	16.2	15.2-17.3
2020	1036	30.0	28.2-31.8	16.3	15.3-17.3
2021	1003	29.4	27.6-31.2	15.3	14.3-16.3
2022	1073	30.7	28.9-32.6	15.5	14.5-16.4
2023	1032	28.9	27.2-30.7	14.3	13.3-15.2
P for trend	-	0.004**	-	<0.001**	-

Figure 5.2.1: Mortality rate of AMI (per 100,000 population)



[22] Aronow, H.D and Bavashi, C. Mechanical Complications in Acute Myocardial Infarction. JACC Cardiovascular Interventions; 2019:12(18).
[23] Takeji Y. et al. Differences in mortality and causes of death between STEMI and NSTEMI in the early and late phases after acute myocardial infarction. PLoS ONE 2021; 16(11).
[24] McManus D. V. et al. Recent Trends in the Incidence, Treatment, and Outcomes of Patients with ST and Non-ST-Segment Acute Myocardial Infarction. Am J Med 2011; 124(1): 40-47.
[25] Laforgia PL et al. The Reduction of Mortality in Acute Myocardial Infarction: From Bed Rest to Future Directions. International Journal of Preventive Medicine 2022.

The median age at death increased from 77.5 years in 2013 to 79.5 years in 2023 (p<0.001) (Table 5.2.2). The proportion of those in the oldest age group among AMI deaths has increased over the years – almost half of the patients who died from AMI in 2023 were aged 80 years and above (48.5%), compared with 39.7% in 2013 (Figure 5.2.2).

As older persons are less likely to survive an AMI than those who are younger[26], individuals aged 80 years and above comprised a substantially larger proportion of AMI deaths vis-à-vis AMI incidence (about 24%-29%) (Table 5.1.2). Other possible reasons for poorer outcomes among older AMI patients include delayed treatment-seeking due to atypical presenting symptoms and exclusion from coronary reperfusion therapy owing to the higher prevalence of comorbidities and frailty associated with advanced age[27,28]. Studies have shown that frailty is associated with a markedly increased risk of mortality, with a 6.51-fold increase in all-cause mortality among elderly STEMI patients[29].

Table 5.2.2: Age distribution at death of AMI

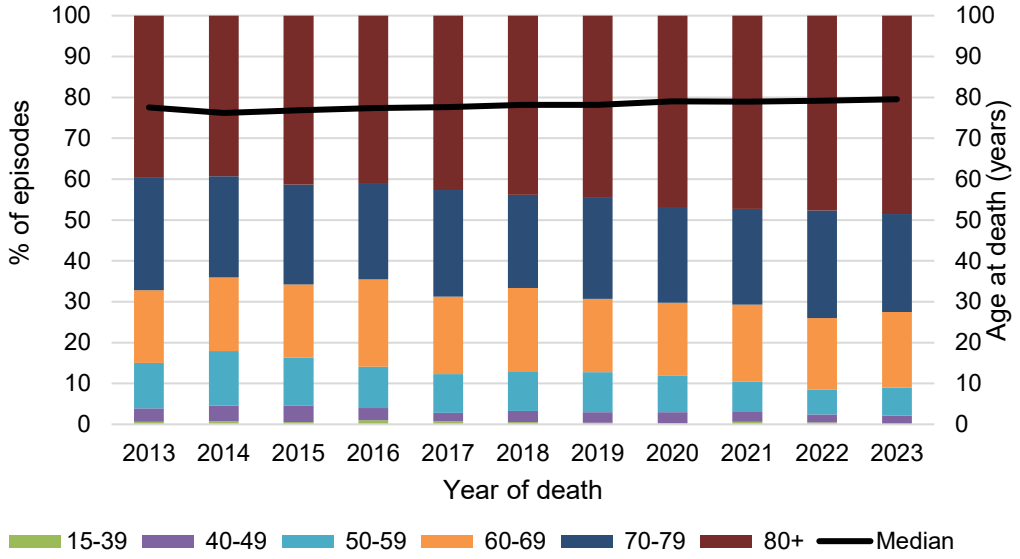
Year of death	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2013	77.5	0	0.0	5	0.6	27	3.3
2014	76.2	1	0.1	6	0.7	33	3.8
2015	76.8	0	0.0	5	0.6	35	4.0
2016	77.4	2	0.2	7	0.8	26	2.9
2017	77.6	1	0.1	7	0.7	21	2.1
2018	78.1	0	0.0	5	0.5	25	2.7
2019	78.2	0	0.0	4	0.4	25	2.5
2020	79.0	0	0.0	3	0.3	28	2.7
2021	79.0	0	0.0	6	0.6	26	2.6
2022	79.2	1	0.1	4	0.4	21	2.0
2023	79.5	0	0.0	1	0.1	21	2.0

Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2013	91	11.1	145	17.7	225	27.5	324	39.7
2014	116	13.3	157	18.0	215	24.7	342	39.3
2015	104	11.8	159	18.0	216	24.4	366	41.4
2016	90	10.2	189	21.3	207	23.4	365	41.2
2017	96	9.4	193	19.0	266	26.1	434	42.6
2018	89	9.7	186	20.3	209	22.8	401	43.8
2019	97	9.8	177	18.0	245	24.8	438	44.4
2020	93	9.0	184	17.8	243	23.5	485	46.8
2021	73	7.3	189	18.8	235	23.4	474	47.3
2022	65	6.1	188	17.5	282	26.3	512	47.7
2023	71	6.9	191	18.5	247	23.9	501	48.5

[26] Mangion K et al. Survival in the elderly after acute myocardial infarction: room for more improvement. Age and Ageing 2014; 43: 739–740.
[27] Ibid.
[28] Carro A, Kaski JC. Myocardial Infarction in the Elderly. Aging and Disease. 2011;2(1): 116-137.
[29] Dou Q, et al. Prognostic value of frailty in elderly patients with acute coronary syndrome: a systematic review and meta-analysis. BMC Geriatr. 2019; 19(1):222. doi: 10.1186/s12877-019-1242-8. PMID: 31416442; PMCID: PMC6694517.

Figure 5.2.2: Age distribution at death of AMI

(Age groups 15-29 and 30-39 are combined for ease of visualisation.)



The age-specific mortality rate (ASPMR) of AMI increased with age, with the oldest age group consistently having the highest mortality rate each year. Significant declines in mortality rates were observed across almost all age groups aged 30 years and above (Table 5.2.3, Figures 5.2.3a and 5.2.3b).

Table 5.2.3: Age-specific mortality rate of AMI (per 100,000 population)

Year of death	Overall		Age 15-29		Age 30-39		Age 40-49	
	CMR	95% CI	CMR	95% CI	CMR	95% CI	CMR	95% CI
2013	25.3	23.6-27.0	0.0	0.0-0.0	0.8	0.1-1.6	4.3	2.7-5.9
2014	26.7	24.9-28.4	0.1	0.0-0.4	1.0	0.2-1.8	5.3	3.5-7.1
2015	26.8	25.0-28.6	0.0	0.0-0.0	0.8	0.1-1.6	5.6	3.8-7.5
2016	26.5	24.8-28.3	0.3	0.0-0.6	1.2	0.3-2.1	4.2	2.6-5.9
2017	30.2	28.3-32.1	0.1	0.0-0.4	1.2	0.3-2.1	3.4	2.0-4.9
2018	26.9	25.1-28.6	0.0	0.0-0.0	0.9	0.1-1.6	4.1	2.5-5.7
2019	28.7	26.9-30.5	0.0	0.0-0.0	0.7	0.0-1.3	4.1	2.5-5.7
2020	30.0	28.2-31.8	0.0	0.0-0.0	0.5	0.0-1.1	4.6	2.9-6.3
2021	29.4	27.6-31.2	0.0	0.0-0.0	1.0	0.2-1.8	4.4	2.7-6.1
2022	30.7	28.9-32.6	0.1	0.0-0.4	0.7	0.0-1.3	3.5	2.0-5.0
2023	28.9	27.2-30.7	0.0	0.0-0.0	0.2	0.0-0.5	3.4	2.0-4.9
P for trend	0.004**	-	0.755	-	0.054*	-	0.060	-
Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	CMR	95% CI	CMR	95% CI	CMR	95% CI	CMR	95% CI
2013	15.3	12.2-18.5	39.4	33.0-45.8	127.8	111.1-144.5	394.6	351.7-437.6
2014	19.2	15.7-22.7	40.0	33.7-46.2	117.4	101.7-133.1	391.8	350.3-433.3
2015	17.0	13.8-20.3	37.6	31.8-43.4	117.5	101.8-133.2	391.7	351.5-431.8
2016	14.6	11.6-17.7	42.0	36.0-48.0	108.0	93.2-122.7	373.2	334.9-411.5
2017	15.6	12.5-18.7	41.4	35.5-47.2	125.8	110.7-140.9	428.5	388.2-468.8
2018	14.5	11.5-17.5	38.4	32.9-44.0	91.3	78.9-103.7	375.2	338.5-411.9
2019	15.9	12.8-19.1	35.4	30.2-40.6	100.1	87.6-112.6	378.7	343.2-414.2
2020	15.5	12.3-18.6	35.8	30.6-41.0	93.1	81.4-104.8	391.2	356.4-426.0
2021	12.5	9.6-15.4	36.5	31.3-41.7	86.3	75.3-97.3	361.0	328.5-393.5
2022	11.0	8.3-13.6	35.1	30.1-40.1	95.8	84.6-107.0	376.9	344.3-409.6
2023	11.8	9.0-14.5	34.5	29.6-39.4	77.5	67.8-87.1	358.1	326.7-389.4
P for trend	0.003**	-	0.005**	-	<0.001**	-	0.075	-

Figure 5.2.3a: Age-specific mortality rate of AMI (per 100,000 population), 2013 vs 2023

(For ease of visualisation, the graph shows only the ASPIR trend for 2013 and 2023 only. For detailed ASPIR information across years, please refer to Table 5.2.3.)

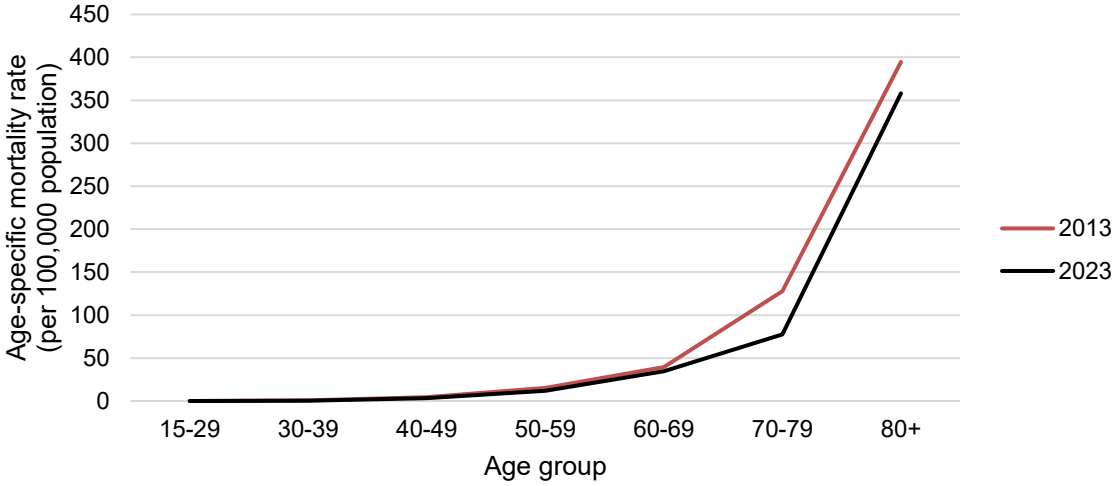
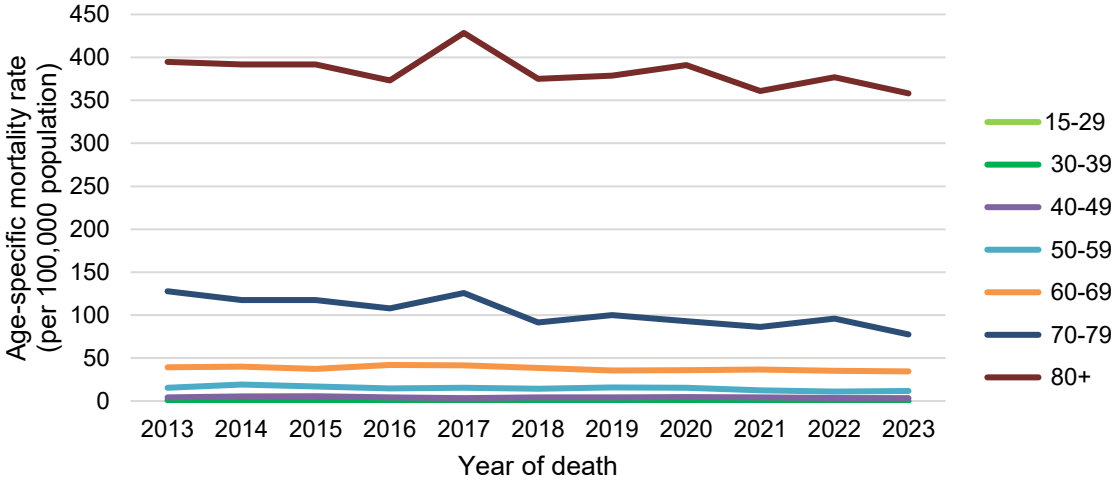


Figure 5.2.3b: Age-specific mortality rate of AMI (per 100,000 population) across age groups

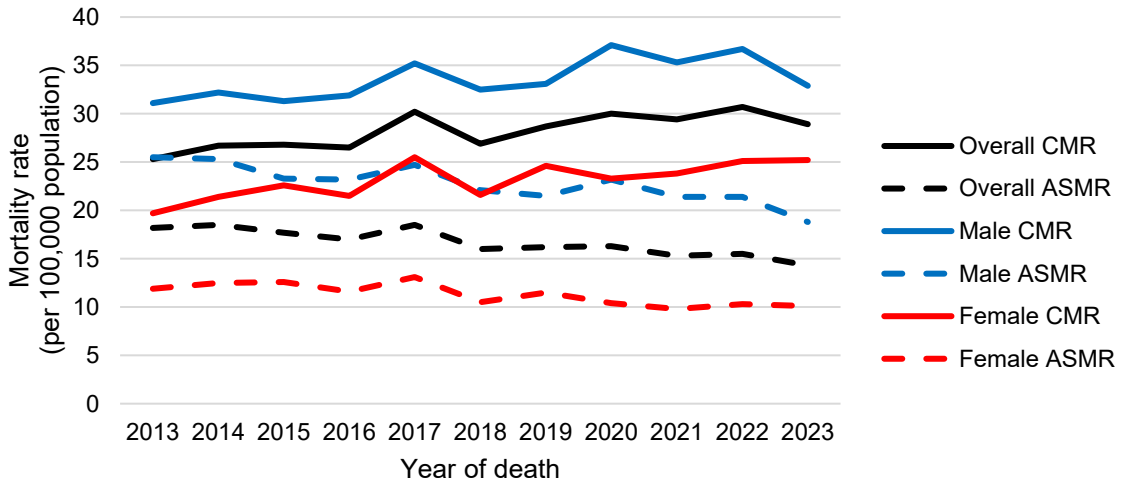


As with the incidence trends (Table 5.1.4), males also accounted for a greater proportion of AMI deaths than females, ranging from 55% to 60% each year. The ASMRs for AMI were consistently higher among males over the past decade. In 2023, the ASMR for males was 18.8 per 100,000, while that for females was 10.1 per 100,000. The ASMR declined significantly over the years for both males and females ($p<0.001$ and $p=0.003$ respectively) (Table 5.2.4 and Figure 5.2.4).

Table 5.2.4: Mortality number and rate of AMI (per 100,000 population) by sex

Male						
Year of death	**Number**	**%**	**CMR**	**95% CI**	**ASMR**	**95% CI**
2013	491	60.1	31.1	28.4-33.9	25.5	23.2-27.7
2014	513	59.0	32.2	29.4-35.0	25.3	23.1-27.5
2015	503	56.8	31.3	28.5-34.0	23.3	21.2-25.4
2016	518	58.5	31.9	29.1-34.6	23.2	21.1-25.2
2017	577	56.7	35.2	32.3-38.0	24.7	22.6-26.7
2018	538	58.8	32.5	29.8-35.3	22.1	20.2-24.0
2019	552	56.0	33.1	30.3-35.9	21.5	19.7-23.3
2020	622	60.0	37.1	34.2-40.0	23.2	21.3-25.0
2021	586	58.4	35.3	32.5-38.2	21.4	19.6-23.1
2022	622	58.0	36.7	33.9-39.6	21.4	19.7-23.2
2023	568	55.0	32.9	30.2-35.6	18.8	17.2-20.4
P for trend	-	-	0.023*	-	<0.001**	-
Female						
Year of death	**Number**	**%**	**CMR**	**95% CI**	**ASMR**	**95% CI**
2013	326	39.9	19.7	17.6-21.9	11.9	10.6-13.3
2014	357	41.0	21.4	19.2-23.6	12.5	11.1-13.8
2015	382	43.2	22.6	20.3-24.9	12.6	11.3-13.9
2016	368	41.5	21.5	19.3-23.7	11.6	10.3-12.8
2017	441	43.3	25.5	23.1-27.9	13.1	11.8-14.3
2018	377	41.2	21.6	19.4-23.7	10.5	9.4-11.6
2019	434	44.0	24.6	22.2-26.9	11.5	10.4-12.6
2020	414	40.0	23.3	21-25.5	10.4	9.3-11.4
2021	417	41.6	23.8	21.5-26.1	9.8	8.8-10.8
2022	451	42.0	25.1	22.8-27.4	10.3	9.3-11.3
2023	464	45.0	25.2	22.9-27.5	10.1	9.1-11.1
P for trend	-	-	0.005**	-	0.003**	-

Figure 5.2.4: Mortality rate of AMI (per 100,000 population) by sex



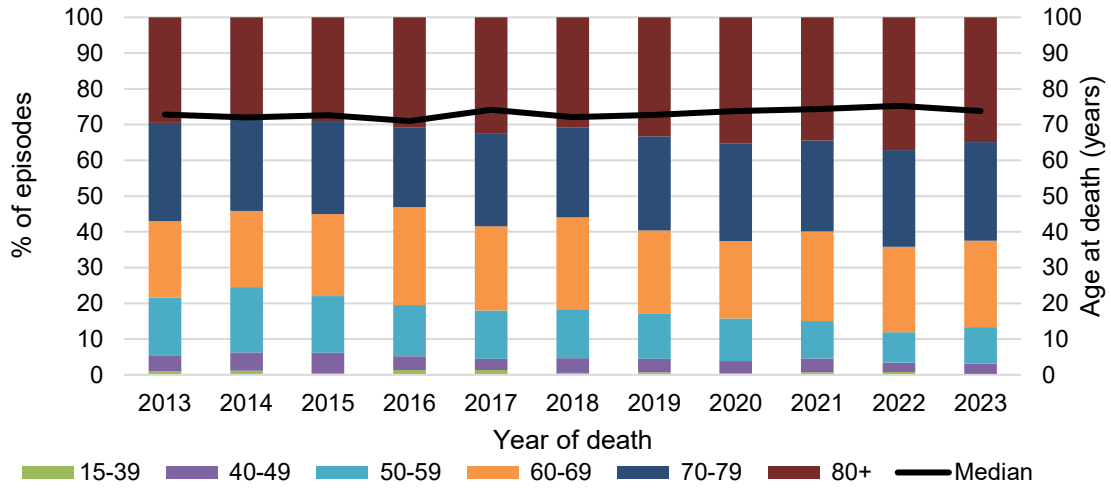
There was an overall increase in the median age at AMI death among males, from 72.8 years in 2013 to 73.8 years in 2023 (p=0.026). In 2023, those aged 80 years and above accounted for the highest proportion of male AMI deaths (34.9%), compared with 29.5% in 2013 (Table 5.2.5a and Figure 5.2.5a).

Table 5.2.5a: Age distribution at death of AMI among males

Year of death	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2013	72.8	0	0.0	5	1.0	22	4.5
2014	72.0	1	0.2	5	1.0	26	5.1
2015	72.6	0	0.0	2	0.4	29	5.8
2016	71.0	1	0.2	6	1.2	20	3.9
2017	74.1	1	0.2	7	1.2	18	3.1
2018	72.1	0	0.0	3	0.6	22	4.1
2019	72.7	0	0.0	4	0.7	21	3.8
2020	73.7	0	0.0	3	0.5	21	3.4
2021	74.3	0	0.0	4	0.7	23	3.9
2022	75.2	1	0.2	4	0.6	16	2.6
2023	73.8	0	0.0	1	0.2	17	3.0

Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2013	79	16.1	105	21.4	135	27.5	145	29.5
2014	94	18.3	109	21.2	133	25.9	145	28.3
2015	80	15.9	115	22.9	130	25.8	147	29.2
2016	74	14.3	142	27.4	115	22.2	160	30.9
2017	78	13.5	136	23.6	150	26.0	187	32.4
2018	74	13.8	138	25.7	135	25.1	166	30.9
2019	70	12.7	128	23.2	145	26.3	184	33.3
2020	74	11.9	135	21.7	169	27.2	220	35.4
2021	61	10.4	147	25.1	149	25.4	202	34.5
2022	53	8.5	149	24.0	168	27.0	231	37.1
2023	58	10.2	137	24.1	157	27.6	198	34.9

Figure 5.2.5a: Age distribution at death of AMI among males



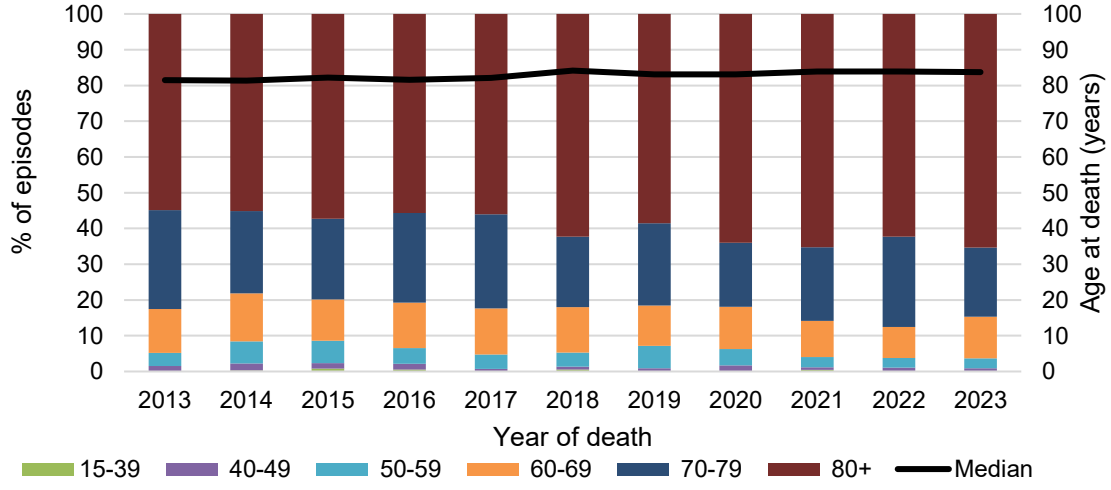
Females had an older median age at death than males, increasing from 81.5 years in 2013 to 83.7 years in 2023 (p=0.001). As with males, those aged 80 years and above comprised the largest proportion of female AMI deaths (65.3% in 2023), and this proportion each year was nearly twice that among males in the oldest age group (Table 5.2.5b and Figure 5.2.5b).

Table 5.2.5b: Age distribution at death of AMI among females

Year of death	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2013	81.5	0	0.0	0	0.0	5	1.5
2014	81.3	0	0.0	1	0.3	7	2.0
2015	82.2	0	0.0	3	0.8	6	1.6
2016	81.6	1	0.3	1	0.3	6	1.6
2017	82.1	0	0.0	0	0.0	3	0.7
2018	84.2	0	0.0	2	0.5	3	0.8
2019	83.1	0	0.0	0	0.0	4	0.9
2020	83.1	0	0.0	0	0.0	7	1.7
2021	83.9	0	0.0	2	0.5	3	0.7
2022	83.9	0	0.0	0	0.0	5	1.1
2023	83.7	0	0.0	0	0.0	4	0.9

Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2013	12	3.7	40	12.3	90	27.6	179	54.9
2014	22	6.2	48	13.4	82	23.0	197	55.2
2015	24	6.3	44	11.5	86	22.5	219	57.3
2016	16	4.3	47	12.8	92	25.0	205	55.7
2017	18	4.1	57	12.9	116	26.3	247	56.0
2018	15	4.0	48	12.7	74	19.6	235	62.3
2019	27	6.2	49	11.3	100	23.0	254	58.5
2020	19	4.6	49	11.8	74	17.9	265	64.0
2021	12	2.9	42	10.1	86	20.6	272	65.2
2022	12	2.7	39	8.6	114	25.3	281	62.3
2023	13	2.8	54	11.6	90	19.4	303	65.3

Figure 5.2.5b: Age distribution at death of AMI among females



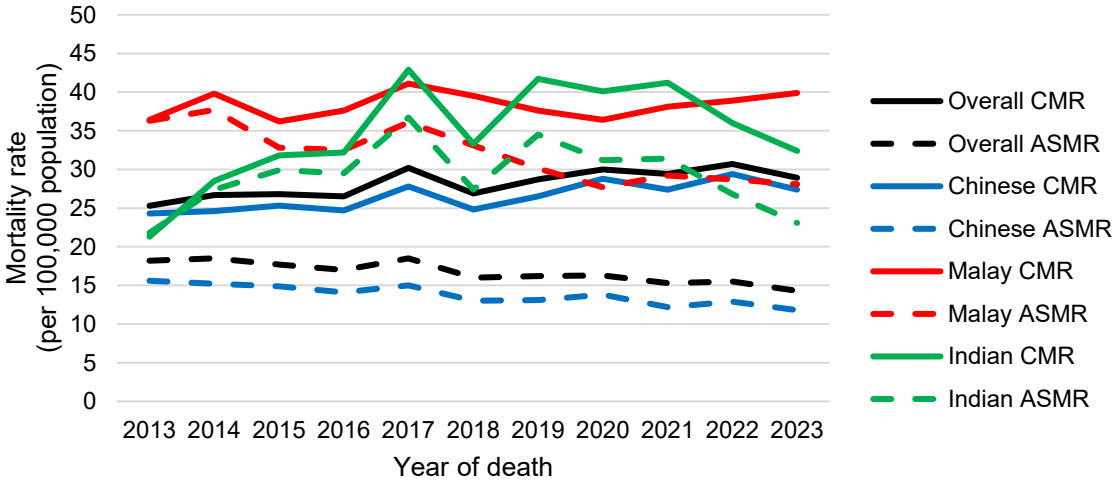
The Chinese consistently had the lowest ASIR of AMI among the different ethnic groups across the years (Table 5.1.6); likewise, they consistently had the lowest ASMR (Table 5.2.6). In 2023, the ASMR among the Chinese (11.8 per 100,000) was lower than that among the Malays (28.1 per 100,000) and Indians (23.1 per 100,000). The ASMR showed a significant downward trend over the years for the Chinese ($p<0.001$) and the Malays ($p<0.001$). Among Indians, the ASMR also showed a downward trend in the most recent five years, although the overall trend from 2013 to 2023 was not statistically significant ($p=0.822$) (Figure 5.2.6).

Table 5.2.6: Mortality number and rate of AMI (per 100,000 population) by ethnicity

Chinese						
Year of death	**Number**	**%**	**CMR**	**95% CI**	**ASMR**	**95% CI**
2013	592	72.5	24.3	22.3-26.2	15.6	14.3-16.9
2014	606	69.7	24.6	22.6-26.6	15.2	14.0-16.4
2015	630	71.2	25.3	23.3-27.2	14.9	13.7-16.1
2016	623	70.3	24.7	22.8-26.7	14.1	13.0-15.3
2017	707	69.4	27.8	25.7-29.8	15.0	13.9-16.2
2018	637	69.6	24.8	22.9-26.7	13.0	11.9-14.0
2019	687	69.7	26.5	24.5-28.5	13.1	12.0-14.1
2020	752	72.6	28.8	26.8-30.9	13.8	12.7-14.8
2021	705	70.3	27.4	25.4-29.4	12.2	11.3-13.2
2022	773	72.0	29.4	27.3-31.5	12.9	12.0-13.9
2023	735	71.2	27.4	25.4-29.4	11.8	10.9-12.7
P for trend	-	-	0.003**	-	<0.001**	-
Malay						
Year of death	**Number**	**%**	**CMR**	**95% CI**	**ASMR**	**95% CI**
2013	149	18.2	36.4	30.6-42.3	36.3	30.3-42.3
2014	165	19.0	39.8	33.7-45.9	37.7	31.8-43.6
2015	152	17.2	36.2	30.4-41.9	32.8	27.4-38.2
2016	160	18.1	37.6	31.8-43.4	32.5	27.3-37.7
2017	177	17.4	41.1	35.0-47.1	36.1	30.7-41.5
2018	172	18.8	39.5	33.6-45.4	33.1	28.1-38.1
2019	165	16.7	37.6	31.8-43.3	30.1	25.4-34.8
2020	161	15.5	36.4	30.8-42.0	27.7	23.3-32.0
2021	168	16.7	38.1	32.4-43.9	29.2	24.7-33.7
2022	174	16.2	38.9	33.1-44.6	28.7	24.4-33.0
2023	181	17.5	39.9	34.1-45.8	28.1	24.0-32.3
P for trend	-	-	0.443	-	<0.001**	-

Indian						
Year of death	**Number**	**%**	**CMR**	**95% CI**	**ASMR**	**95% CI**
2013	60	7.3	21.3	15.9-26.7	21.8	16.1-27.5
2014	81	9.3	28.5	22.3-34.8	27.4	21.3-33.6
2015	91	10.3	31.8	25.3-38.3	29.9	23.6-36.2
2016	93	10.5	32.2	25.7-38.8	29.5	23.4-35.6
2017	125	12.3	42.9	35.4-50.4	36.7	30.2-43.2
2018	98	10.7	33.3	26.7-39.9	27.4	21.9-32.9
2019	124	12.6	41.7	34.3-49	34.5	28.3-40.6
2020	120	11.6	40.1	33-47.3	31.2	25.5-36.8
2021	121	12.1	41.2	33.9-48.6	31.4	25.7-37
2022	110	10.3	36.0	29.3-42.7	26.8	21.8-31.8
2023	102	9.9	32.4	26.1-38.6	23.1	18.6-27.6
P for trend	-	-	0.043*	-	0.822	-

Figure 5.2.6: Mortality rate of AMI (per 100,000 population) by ethnicity



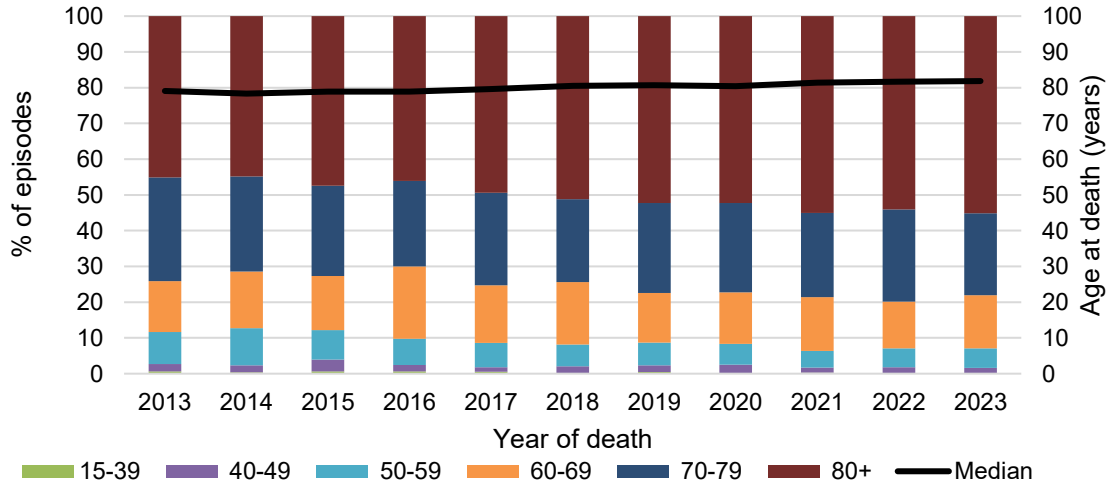
Similar to the median age at onset of AMI (Tables 5.1.7a to 5.1.7c), the Chinese had the oldest median age at death, which increased from 79.0 years in 2013 to 81.8 years in 2023 ($p<0.001$) (Table 5.2.7a). Those aged 80 years and above accounted for the highest proportion of AMI deaths among the Chinese, increasing from 45.1% in 2013 to 55.1% in 2023 (Figure 5.2.7a).

Table 5.2.7a: Age distribution at death of AMI among Chinese

Year of death	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2013	79.0	0	0.0	4	0.7	12	2.0
2014	78.3	1	0.2	1	0.2	12	2.0
2015	78.9	0	0.0	4	0.6	21	3.3
2016	78.9	0	0.0	4	0.6	11	1.8
2017	79.6	1	0.1	3	0.4	9	1.3
2018	80.5	0	0.0	1	0.2	12	1.9
2019	80.7	0	0.0	3	0.4	13	1.9
2020	80.4	0	0.0	1	0.1	18	2.4
2021	81.4	0	0.0	2	0.3	10	1.4
2022	81.7	1	0.1	0	0.0	13	1.7
2023	81.8	0	0.0	0	0.0	12	1.6

Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2013	53	9.0	84	14.2	172	29.1	267	45.1
2014	63	10.4	96	15.8	161	26.6	272	44.9
2015	52	8.3	95	15.1	159	25.2	299	47.5
2016	46	7.4	126	20.2	149	23.9	287	46.1
2017	48	6.8	114	16.1	183	25.9	349	49.4
2018	39	6.1	111	17.4	148	23.2	326	51.2
2019	44	6.4	95	13.8	173	25.2	359	52.3
2020	44	5.9	108	14.4	188	25.0	393	52.3
2021	33	4.7	106	15.0	166	23.5	388	55.0
2022	41	5.3	101	13.1	199	25.7	418	54.1
2023	40	5.4	109	14.8	169	23.0	405	55.1

Figure 5.2.7a: Age distribution at death of AMI among Chinese



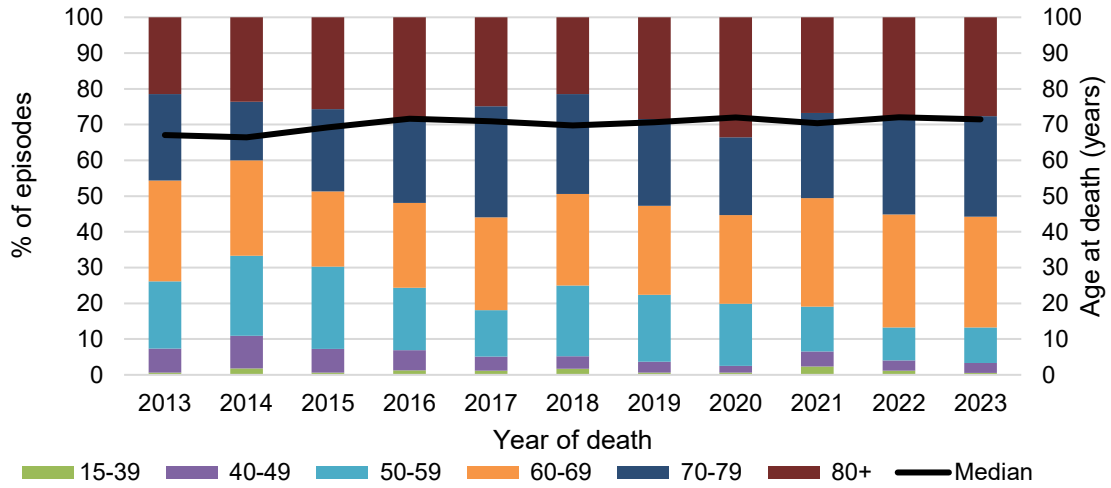
The median age at death among Malay AMI patients was about 10 years younger than that of the Chinese, increasing from 67.0 years in 2013 to 71.5 years in 2023 (p=0.006) (Table 5.2.7b). In 2023, the highest proportion of Malays who died from AMI was among those aged 60-69 years (30.9%) (Figure 5.2.7b).

Table 5.2.7b: Age distribution at death of AMI among Malays

Year of death	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2013	67.0	0	0.0	1	0.7	10	6.7
2014	66.4	0	0.0	3	1.8	15	9.1
2015	69.2	0	0.0	1	0.7	10	6.6
2016	71.7	1	0.6	1	0.6	9	5.6
2017	70.9	0	0.0	2	1.1	7	4.0
2018	69.8	0	0.0	3	1.7	6	3.5
2019	70.6	0	0.0	1	0.6	5	3.0
2020	72.0	0	0.0	1	0.6	3	1.9
2021	70.3	0	0.0	4	2.4	7	4.2
2022	72.0	0	0.0	2	1.1	5	2.9
2023	71.5	0	0.0	1	0.6	5	2.8

Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2013	28	18.8	42	28.2	36	24.2	32	21.5
2014	37	22.4	44	26.7	27	16.4	39	23.6
2015	35	23.0	32	21.1	35	23.0	39	25.7
2016	28	17.5	38	23.8	37	23.1	46	28.8
2017	23	13.0	46	26.0	55	31.1	44	24.9
2018	34	19.8	44	25.6	48	27.9	37	21.5
2019	31	18.8	41	24.8	40	24.2	47	28.5
2020	28	17.4	40	24.8	35	21.7	54	33.5
2021	21	12.5	51	30.4	40	23.8	45	26.8
2022	16	9.2	55	31.6	47	27.0	49	28.2
2023	18	9.9	56	30.9	51	28.2	50	27.6

Figure 5.2.7b: Age distribution at death of AMI among Malays



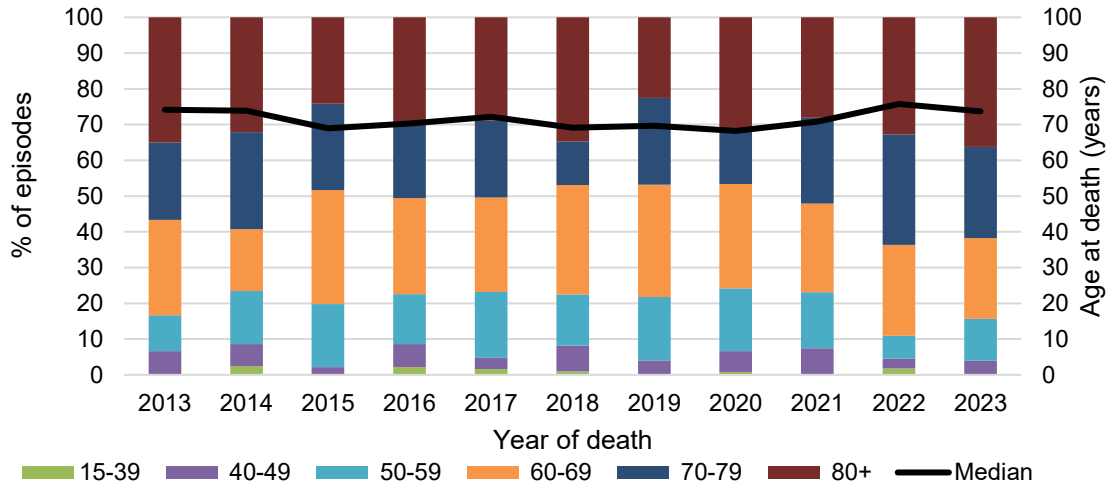
The median age at death among Indian AMI patients ranged between 68.2 and 75.8 years over the past decade (p=0.881) (Table 5.2.7c). In 2023, those aged 80 years and above comprised the largest proportion of AMI deaths among Indians (36.3%) (Figure 5.2.7c).

Table 5.2.7c: Age distribution at death of AMI among Indians

Year of death	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2013	74.2	0	0.0	0	0.0	4	6.7
2014	73.8	0	0.0	2	2.5	5	6.2
2015	68.9	0	0.0	0	0.0	2	2.2
2016	70.3	1	1.1	1	1.1	6	6.5
2017	72.1	0	0.0	2	1.6	4	3.2
2018	69.1	0	0.0	1	1.0	7	7.1
2019	69.7	0	0.0	0	0.0	5	4.0
2020	68.2	0	0.0	1	0.8	7	5.8
2021	70.8	0	0.0	0	0.0	9	7.4
2022	75.8	0	0.0	2	1.8	3	2.7
2023	73.7	0	0.0	0	0.0	4	3.9

Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2013	6	10.0	16	26.7	13	21.7	21	35.0
2014	12	14.8	14	17.3	22	27.2	26	32.1
2015	16	17.6	29	31.9	22	24.2	22	24.2
2016	13	14.0	25	26.9	19	20.4	28	30.1
2017	23	18.4	33	26.4	27	21.6	36	28.8
2018	14	14.3	30	30.6	12	12.2	34	34.7
2019	22	17.7	39	31.5	30	24.2	28	22.6
2020	21	17.5	35	29.2	18	15.0	38	31.7
2021	19	15.7	30	24.8	29	24.0	34	28.1
2022	7	6.4	28	25.5	34	30.9	36	32.7
2023	12	11.8	23	22.5	26	25.5	37	36.3

Figure 5.2.7c: Age distribution at death of AMI among Indians



The incidence numbers and ASIRs of NSTEMI were consistently higher than those of STEMI across the years (Table 5.1.8); likewise, the mortality numbers and ASMRs of NSTEMI were consistently higher (Table 5.2.8). From 2013 to 2023, the ASMR for STEMI decreased from 4.9 to 4.1 per 100,000 (p=0.061), while that for NSTEMI decreased from 6.5 to 5.0 per 100,000 (p=0.002). The older age of NSTEMI patients was likely a contributing factor, as advanced age has been shown to be a strong predictor of poorer health outcomes (including mortality) following AMI, compounded by a greater prevalence of comorbidities[30].

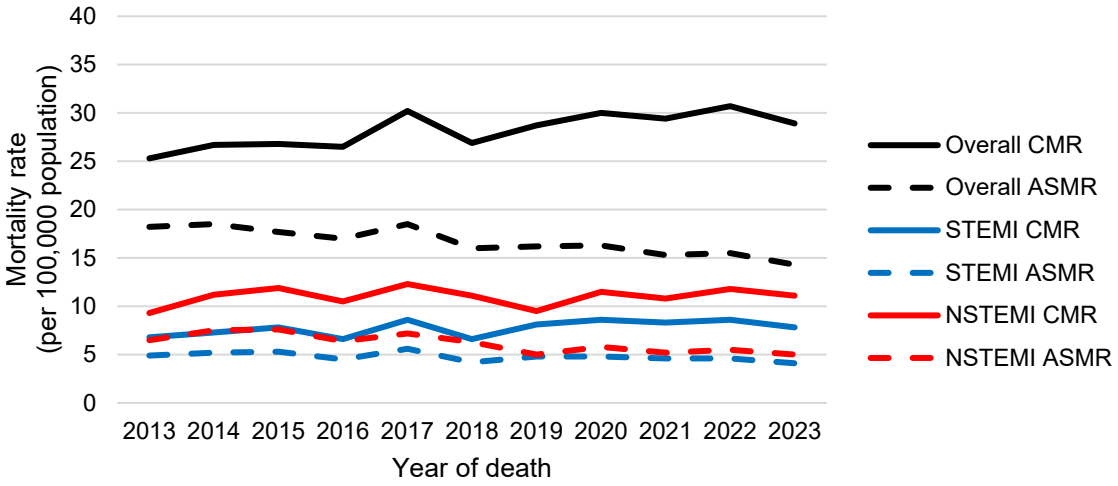
As the percentages in Table 5.2.8 are calculated among all AMI patients, and patients without documentation of STEMI or NSTEMI are not shown, the sum of the percentages for STEMI and NSTEMI is therefore less than 100% for each year. Figures for overall CMR and ASMR include cases of unknown etiology.

Table 5.2.8: Mortality number and rate of AMI (per 100,000 population) by subtype

STEMI						
Year of death	**Number**	**%**	**CMR**	**95% CI**	**ASMR**	**95% CI**
2013	218	26.7	6.8	5.9-7.6	4.9	4.3-5.6
2014	237	27.2	7.3	6.3-8.2	5.2	4.5-5.9
2015	257	29.0	7.8	6.8-8.7	5.3	4.6-5.9
2016	221	24.9	6.6	5.7-7.5	4.5	3.9-5.1
2017	291	28.6	8.6	7.6-9.6	5.6	5.0-6.3
2018	226	24.7	6.6	5.8-7.5	4.2	3.6-4.7
2019	277	28.1	8.1	7.1-9.0	4.8	4.2-5.4
2020	296	28.6	8.6	7.6-9.5	4.8	4.3-5.4
2021	282	28.1	8.3	7.3-9.2	4.6	4.1-5.2
2022	301	28.1	8.6	7.6-9.6	4.6	4.1-5.2
2023	277	26.8	7.8	6.9-8.7	4.1	3.6-4.6
P for trend	-	-	0.066	-	0.061	-
NSTEMI						
Year of death	**Number**	**%**	**CMR**	**95% CI**	**ASMR**	**95% CI**
2013	301	36.8	9.3	8.3-10.4	6.5	5.7-7.2
2014	367	42.2	11.2	10.1-12.4	7.5	6.8-8.3
2015	393	44.4	11.9	10.7-13.1	7.6	6.8-8.3
2016	350	39.5	10.5	9.4-11.6	6.4	5.7-7.1
2017	414	40.7	12.3	11.1-13.5	7.2	6.5-7.9
2018	378	41.3	11.1	10.0-12.2	6.3	5.6-6.9
2019	326	33.1	9.5	8.5-10.5	5.0	4.4-5.5
2020	398	38.4	11.5	10.4-12.6	5.8	5.2-6.4
2021	369	36.8	10.8	9.7-11.9	5.2	4.6-5.7
2022	411	38.3	11.8	10.6-12.9	5.5	5.0-6.1
2023	397	38.5	11.1	10.0-12.2	5.0	4.5-5.5
P for trend	-	-	0.463	-	0.002**	-

[30] Dai X et al. Acute coronary syndrome in older adults. Journal of Geriatric Cardiology; 2016:13. 101-108.

Figure 5.2.8: Mortality rate of AMI (per 100,000 population) by subtype



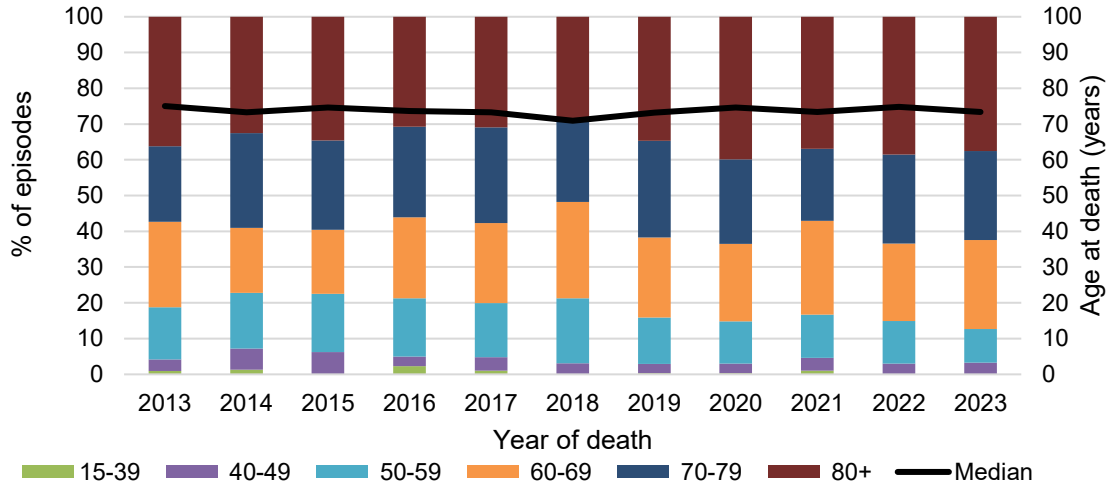
The median age at death among STEMI patients ranged between 70.9 and 75.0 years over the past decade (p=0.779) (Table 5.2.9a). In 2023, the highest proportion of STEMI patients who died from AMI was among those aged 80 years and above (37.5%) – a pattern that has remained consistent since 2013 (Figure 5.2.9a).

Table 5.2.9a: Age distribution at death of STEMI

Year of death	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2013	75.0	0	0.0	2	0.9	7	3.2
2014	73.3	1	0.4	2	0.8	14	5.9
2015	74.6	0	0.0	0	0.0	16	6.2
2016	73.6	2	0.9	3	1.4	6	2.7
2017	73.3	1	0.3	2	0.7	11	3.8
2018	70.9	0	0.0	0	0.0	7	3.1
2019	73.2	0	0.0	1	0.4	7	2.5
2020	74.6	0	0.0	1	0.3	8	2.7
2021	73.4	0	0.0	3	1.1	10	3.5
2022	74.8	0	0.0	0	0.0	9	3.0
2023	73.4	0	0.0	0	0.0	9	3.2

Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2013	32	14.7	52	23.9	46	21.1	79	36.2
2014	37	15.6	43	18.1	63	26.6	77	32.5
2015	42	16.3	46	17.9	64	24.9	89	34.6
2016	36	16.3	50	22.6	56	25.3	68	30.8
2017	44	15.1	65	22.3	78	26.8	90	30.9
2018	41	18.1	61	27.0	52	23.0	65	28.8
2019	36	13.0	62	22.4	75	27.1	96	34.7
2020	35	11.8	64	21.6	70	23.6	118	39.9
2021	34	12.1	74	26.2	57	20.2	104	36.9
2022	36	12.0	65	21.6	75	24.9	116	38.5
2023	26	9.4	69	24.9	69	24.9	104	37.5

Figure 5.2.9a: Age distribution at death of STEMI



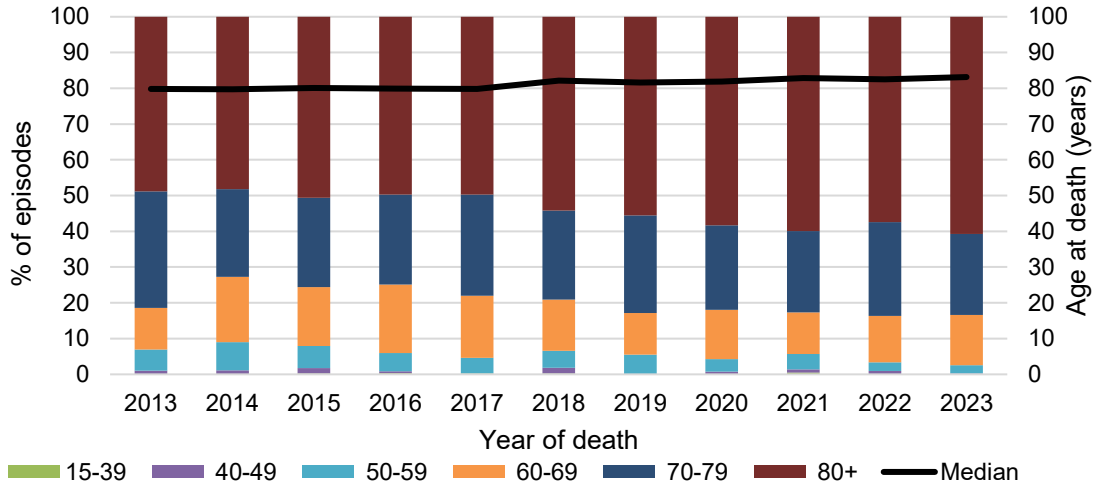
Like the median age at onset (Tables 5.1.9a and 5.1.9b), NSTEMI patients had an older median age at death than STEMI patients, increasing from 79.8 years in 2013 to 83.1 years in 2023 (Table 5.2.9b). Those aged 80 years and above accounted for the largest proportion of NSTEMI deaths in 2023 (60.7%) (Figure 5.2.9b).

Table 5.2.9b: Age distribution at death of NSTEMI

Year of death	Overall	Age 15-29		Age 30-39		Age 40-49	
	Median age	Number	%	Number	%	Number	%
2013	79.8	0	0.0	0	0.0	3	1.0
2014	79.7	0	0.0	0	0.0	4	1.1
2015	80.1	0	0.0	1	0.3	6	1.5
2016	79.9	0	0.0	1	0.3	2	0.6
2017	79.8	0	0.0	1	0.2	0	0.0
2018	82.1	0	0.0	1	0.3	6	1.6
2019	81.6	0	0.0	0	0.0	0	0.0
2020	81.9	0	0.0	0	0.0	3	0.8
2021	82.9	0	0.0	2	0.5	3	0.8
2022	82.5	0	0.0	0	0.0	4	1.0
2023	83.1	0	0.0	0	0.0	1	0.3

Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2013	18	6.0	35	11.6	98	32.6	147	48.8
2014	29	7.9	67	18.3	90	24.5	177	48.2
2015	24	6.1	65	16.5	98	24.9	199	50.6
2016	18	5.1	67	19.1	88	25.1	174	49.7
2017	18	4.3	72	17.4	117	28.3	206	49.8
2018	18	4.8	54	14.3	94	24.9	205	54.2
2019	18	5.5	38	11.7	89	27.3	181	55.5
2020	14	3.5	55	13.8	94	23.6	232	58.3
2021	16	4.3	43	11.7	84	22.8	221	59.9
2022	10	2.4	53	12.9	108	26.3	236	57.4
2023	9	2.3	56	14.1	90	22.7	241	60.7

Figure 5.2.9b: Age distribution at death of NSTEMI



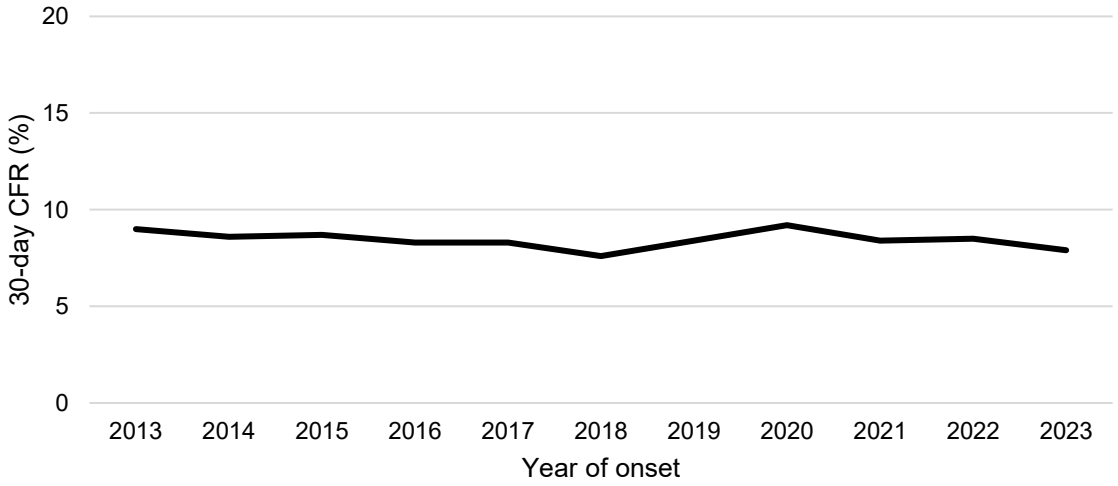
5.3 30-day Case Fatality

The number of AMI deaths within 30 days (Table 5.3.1) did not increase as much as the number of AMI episodes over the years (Table 5.1.1). The case fatality rate (CFR) remained relatively stable over the years, at 9.0% in 2013 and 7.9% in 2023 (p=0.323) (Figure 5.3.1).

Table 5.3.1: 30-day case fatality number and rate of AMI (%)

Year of onset	Number	CFR	95% CI
2013	789	9.0	8.3-9.6
2014	785	8.6	8.0-9.2
2015	825	8.7	8.1-9.3
2016	837	8.3	7.7-8.8
2017	923	8.3	7.7-8.8
2018	849	7.6	7.1-8.1
2019	971	8.4	7.8-8.9
2020	998	9.2	8.6-9.8
2021	964	8.4	7.8-8.9
2022	1033	8.5	8.0-9.0
2023	982	7.9	7.4-8.4
P for trend	-	0.323	-

Figure 5.3.1: 30-day case fatality rate of AMI (%)



Although the ASMRs of AMI for males were consistently higher than those for females across the years (Table 5.2.4), the 30-day CFRs for males were consistently lower than those for females (Table 5.3.2). In 2023, the CFR was 6.6% for males and about 1.5 times higher, at 10.4%, for females. As females tended to experience AMI at an older age than males (Tables 5.1.5a and 5.1.5b), they were more likely to have comorbidities at AMI onset, making them more susceptible to contraindications for revascularisation or more likely to decline revascularisation. A lower rate of revascularisation of the blocked arteries could have contributed to the higher CFR among females[31]. Other possible reasons include delayed treatment-seeking

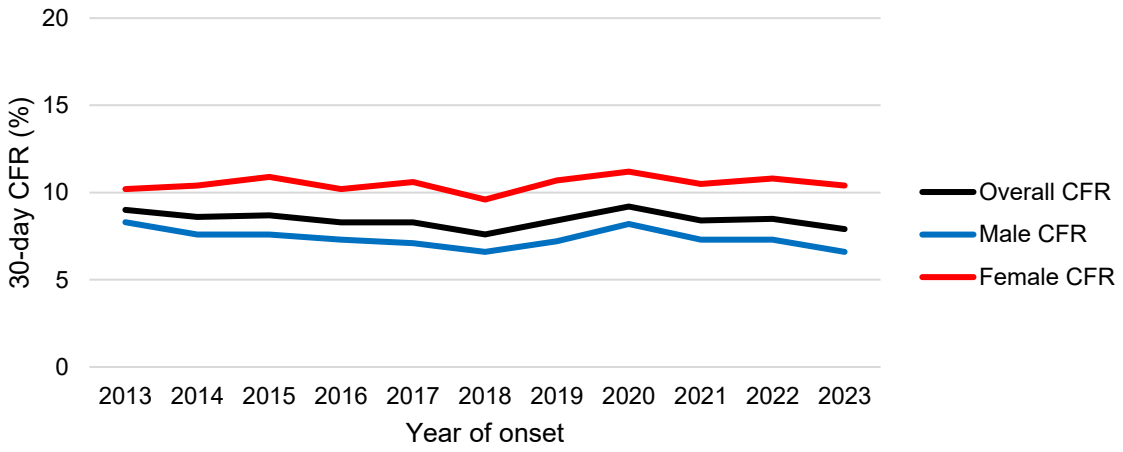
[31] Berger JS et al. Sex differences in mortality following acute coronary syndromes. JAMA 2009; 302(8): 874-882.

behaviour among females, due to a more atypical presentation of symptoms[32]. The decline in CFR was not statistically significant for either males or females over the years (p=0.130 and p=0.467 respectively) (Table 5.3.2 and Figure 5.3.2).

Table 5.3.2: 30-day case fatality number and rate of AMI (%) by sex

Male				
Year of onset	**Number**	**%**	**CFR**	**95% CI**
2013	475	60.2	8.3	7.6-9.0
2014	455	58.0	7.6	6.9-8.3
2015	468	56.7	7.6	6.9-8.2
2016	488	58.3	7.3	6.7-8.0
2017	521	56.4	7.1	6.4-7.7
2018	495	58.3	6.6	6.0-7.2
2019	548	56.4	7.2	6.6-7.8
2020	599	60.0	8.2	7.6-8.9
2021	568	58.9	7.3	6.7-7.9
2022	595	57.6	7.3	6.7-7.9
2023	545	55.5	6.6	6.1-7.2
P for trend	-	-	0.130	-
Female				
Year of onset	**Number**	**%**	**CFR**	**95% CI**
2013	314	39.8	10.2	9.0-11.3
2014	330	42.0	10.4	9.3-11.6
2015	357	43.3	10.9	9.7-12.0
2016	349	41.7	10.2	9.1-11.2
2017	402	43.6	10.6	9.6-11.7
2018	354	41.7	9.6	8.6-10.6
2019	423	43.6	10.7	9.7-11.7
2020	399	40.0	11.2	10.1-12.3
2021	396	41.1	10.5	9.5-11.5
2022	438	42.4	10.8	9.8-11.8
2023	437	44.5	10.4	9.4-11.4
P for trend	-	-	0.467	-

Figure 5.3.2: 30-day case fatality rate of AMI (%) by sex



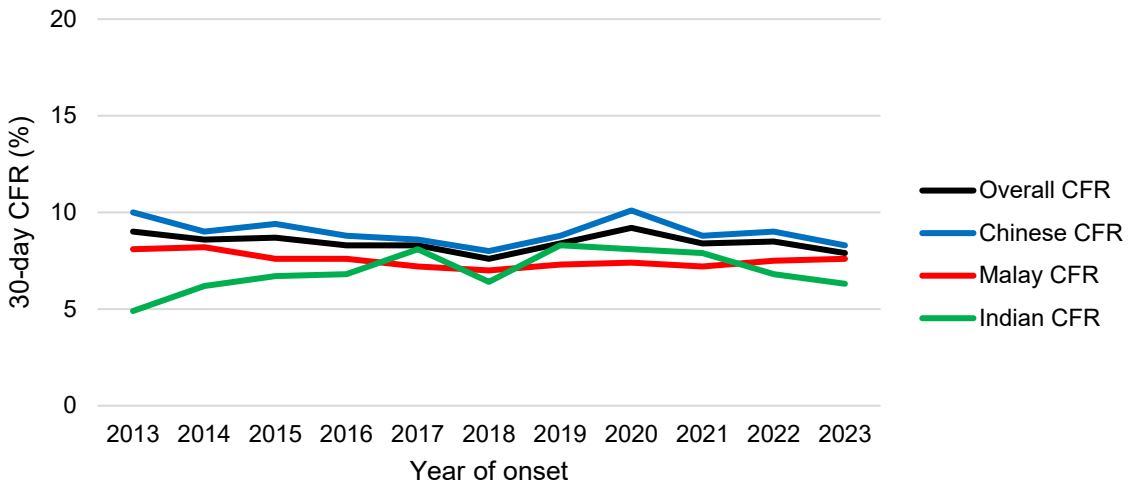
[32] Stehli et al. Sex differences in Time to Presentation, Revascularization, and Mortality in Myocardial Infarction Treated with Percutaneous Coronary Intervention. JAHA. 2019;8.

Although Chinese generally had the lowest ASMR (Table 5.2.6), they had the highest 30-day CFR across the years (Table 5.3.3). In 2023, the CFRs were 8.3%, 7.6%, and 6.3% for the Chinese, Malays, and Indians respectively. This was likely because the Chinese were the oldest at AMI onset (Tables 5.1.7a to 5.1.7c). For the Chinese and Malays, the CFRs had generally declined over the years (Chinese: from 10% in 2013 to 8.3% in 2023, Malays: from 8.1% to 7.6% over the same period) (Table 5.3.3 and Figure 5.3.3). For the Indians, the CFR ranged from 4.9% to 8.3% in the past 10 years. The Indians had the lowest CFR compared to the Chinese and Malays for most of the years in the past decade.

Table 5.3.3: 30-day case fatality number and rate of AMI (%) by ethnicity

Chinese				
Year of onset	**Number**	**%**	**CFR**	**95% CI**
2013	581	73.6	10.0	9.1-10.8
2014	550	70.1	9.0	8.3-9.8
2015	597	72.4	9.4	8.6-10.1
2016	589	70.4	8.8	8.1-9.6
2017	651	70.5	8.6	8.0-9.3
2018	602	70.9	8.0	7.4-8.6
2019	678	69.8	8.8	8.1-9.4
2020	725	72.6	10.1	9.3-10.8
2021	675	70.0	8.8	8.1-9.5
2022	743	71.9	9.0	8.4-9.7
2023	697	71.0	8.3	7.7-8.9
P for trend	-	-	0.286	-
Malay				
Year of onset	**Number**	**%**	**CFR**	**95% CI**
2013	140	17.7	8.1	6.8-9.4
2014	144	18.3	8.2	6.8-9.5
2015	141	17.1	7.6	6.4-8.9
2016	152	18.2	7.6	6.4-8.8
2017	150	16.3	7.2	6.0-8.3
2018	149	17.6	7.0	5.9-8.2
2019	161	16.6	7.3	6.2-8.4
2020	155	15.5	7.4	6.3-8.6
2021	162	16.8	7.2	6.1-8.4
2022	170	16.5	7.5	6.3-8.6
2023	173	17.6	7.6	6.4-8.7
P for trend	-	-	0.082	-
Indian				
Year of onset	**Number**	**%**	**CFR**	**95% CI**
2013	54	6.8	4.9	3.6-6.1
2014	73	9.3	6.2	4.8-7.6
2015	77	9.3	6.7	5.2-8.2
2016	88	10.5	6.8	5.4-8.2
2017	113	12.2	8.1	6.6-9.6
2018	90	10.6	6.4	5.0-7.7
2019	123	12.7	8.3	6.9-9.8
2020	116	11.6	8.1	6.6-9.5
2021	118	12.2	7.9	6.5-9.3
2022	105	10.2	6.8	5.5-8.2
2023	97	9.9	6.3	5.1-7.6
P for trend	-	-	0.137	-

Figure 5.3.3: 30-day case fatality rate of AMI (%) by ethnicity



Although STEMI patients had lower ASMRs than NSTEMI patients across the years (Table 5.2.8), the 30-day CFRs among STEMI patients were consistently higher than those among NSTEMI patients (Table 5.3.4). In 2023, the CFRs were 9.5% and 3.9% for STEMI and NSTEMI patients respectively. A plausible reason is that STEMI is more severe, with a higher likelihood of fatality if intervention is not provided promptly. Complications associated with high short-term fatality rates also tend to be more frequently observed among STEMI cases than among NSTEMI cases[33]. While the CFR for STEMI patients fluctuated over the years (p=0.688), it declined for NSTEMI patients (p=0.079) (Table 5.3.4 and Figure 5.3.4).

As the percentages in Table 5.3.4 are calculated among all AMI patients, and patients without documentation of STEMI or NSTEMI are not shown, the sum of the percentages for STEMI and NSTEMI is therefore less than 100% for each year. Figures for overall CFR include cases of unknown etiology.

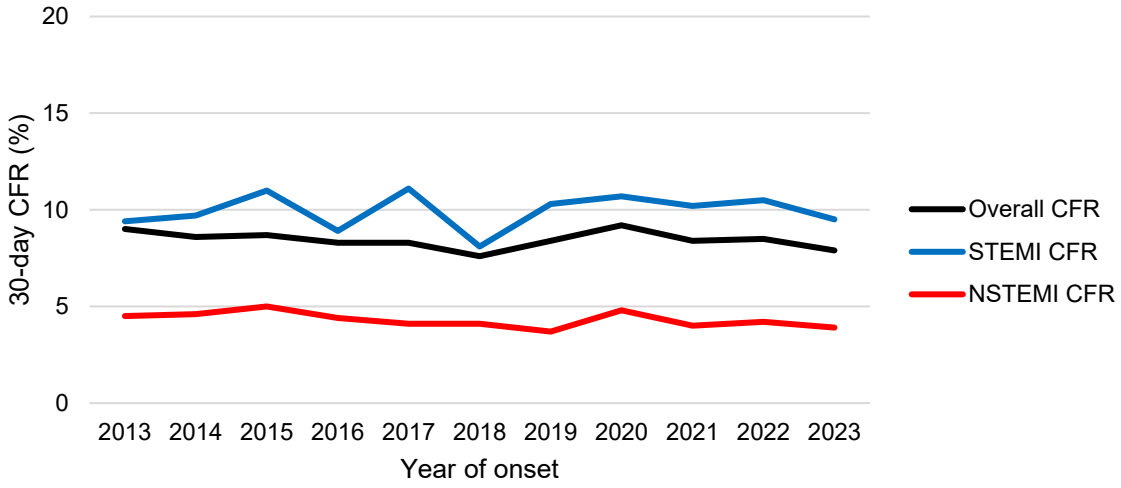
Table 5.3.4: 30-day case fatality number and rate of AMI (%) by subtype

STEMI				
Year of onset	**Number**	**%**	**CFR**	**95% CI**
2013	214	27.1	9.4	8.1-10.6
2014	220	28.0	9.7	8.4-11.0
2015	249	30.2	11.0	9.7-12.4
2016	208	24.9	8.9	7.7-10.1
2017	274	29.7	11.1	9.8-12.4
2018	207	24.4	8.1	7.0-9.2
2019	272	28.0	10.3	9.0-11.5
2020	294	29.5	10.7	9.5-12.0
2021	276	28.6	10.2	9.0-11.4
2022	296	28.7	10.5	9.3-11.7
2023	270	27.5	9.5	8.4-10.6
P for trend	-	-	0.688	-

[33] Bouisset F. et al. Comparison of Short- and Long-Term Prognosis between ST-Elevation and Non-ST Elevation Myocardial Infarction. J. Clin. Med. 2023; 10(180).

NSTEMI				
Year of onset	**Number**	**%**	**CFR**	**95% CI**
2013	276	35.0	4.5	4.0-5.1
2014	303	38.6	4.6	4.1-5.2
2015	341	41.3	5.0	4.4-5.5
2016	319	38.1	4.4	3.9-4.8
2017	335	36.3	4.1	3.6-4.5
2018	335	39.5	4.1	3.6-4.5
2019	315	32.4	3.7	3.3-4.1
2020	363	36.4	4.8	4.3-5.3
2021	336	34.9	4.0	3.6-4.5
2022	373	36.1	4.2	3.8-4.7
2023	356	36.3	3.9	3.5-4.3
P for trend	-	-	0.079	-

Figure 5.3.4: 30-day case fatality rate of AMI (%) by subtype



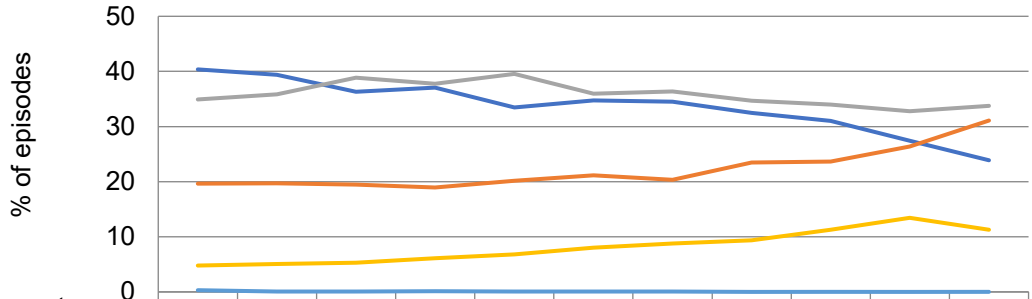
5.4 Symptoms

Clinical presentation influences patient recognition of symptoms, triage categorisation, prescription of diagnostic tests, and disease management[34]. Symptoms of AMI were defined as typical when there was continuous chest pain lasting at least 20 minutes. Symptoms were deemed atypical if the chest pain was of short duration and/or intermittent, with each episode lasting less than 20 minutes, or if pain was experienced at unusual sites such as the upper abdomen, arm, jaw, or neck. For well-described symptoms that did not satisfy the criteria for typical or atypical, they were classified as others. These included symptoms due to a definite non-cardiac cause, a definite non-atherosclerotic cardiac cause, or cases of collapse or unresponsiveness. Data were deemed insufficient when symptoms were not stated in the medical records or lacked details on their description and duration.

The proportion of AMI patients experiencing typical symptoms was higher in earlier years, declining from 40.4% in 2013 to 23.9% in 2023 (Figure 5.4.1). Conversely, the proportion of patients presenting with atypical symptoms increased by about 58% over the same period, rising from 19.6% to 31.1%. This trend is consistent with the demographic profile of NSTEMI patients, who are generally older than those with STEMI[35]. Studies have also shown that older adults are more likely to present with atypical symptoms compared with younger patients[36]. Similarly, the proportion of those with no symptoms increased from 4.8% to 11.3% over the same period. The proportion of patients with symptoms that were neither typical nor atypical remained largely unchanged over the past decade, ranging from 32.8% to 39.5%.

[34] Kim Soo-Joong. Global Awareness of Myocardial Infarction Symptoms in General Population. Korean Circulation Journal 2021;51(12): 997-1000.
[35] Chang S., et al. Prognosis Between ST-Elevation and Non-ST-elevation Myocardial Infarction in Older Adult Patients. Frontiers in cardiovascular medicine, 2022, 8, 749072.
[36] Wolfermann S., et al. Frequencies and Trends of Myocardial Infarction Symptoms From the Years 1985-2019: A Register-based, Real-world Analysis, CJC Open, Volume 7, Issue 11, 2025, Pages 1474-1481, ISSN 2589-790X.

Figure 5.4.1: Type of symptoms (%)



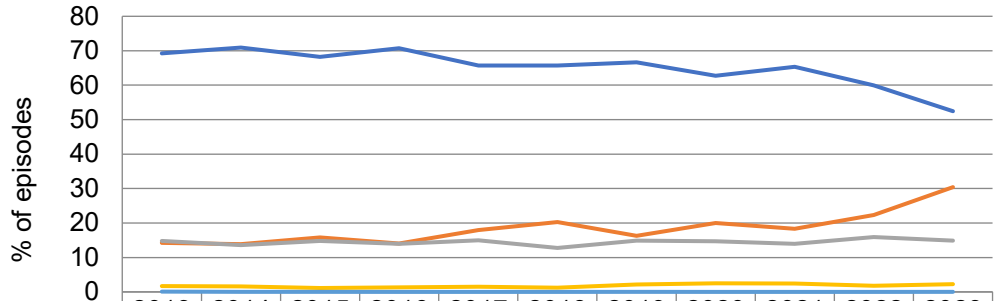
Year of onset	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Typical	40.4	39.4	36.3	37.1	33.5	34.8	34.5	32.5	31.0	27.4	23.9
Atypical	19.6	19.7	19.5	18.9	20.1	21.2	20.4	23.5	23.7	26.4	31.1
Others	34.9	35.8	38.9	37.8	39.5	36.0	36.3	34.7	34.0	32.8	33.7
None	4.8	5.1	5.3	6.1	6.8	8.0	8.8	9.4	11.3	13.4	11.3
Insufficient data	0.3	0.0	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0

Among STEMI patients, 52.5% experienced typical symptoms in 2023 (Figure 5.4.2a), which remained the most common presentation in this group. In contrast, only 15.7% of NSTEMI patients experienced typical symptoms in 2023 (Figure 5.4.2b). This observation could be attributed to the smaller infarct size in NSTEMI, where the infarction does not involve the full thickness of the myocardium and epicardium[37]. Additionally, as NSTEMI patients tended to be older, diminished chest pain sensation and cognitive impairment may have affected symptom perception, leading to a greater likelihood of presenting with atypical symptoms[38].

The proportion of both STEMI and NSTEMI patients presenting with typical symptoms declined over the years, while the proportion with atypical symptoms increased. Among NSTEMI patients, “other symptoms” were the most common category, followed by atypical symptoms, together accounting for about 70% of NSTEMI cases in 2023.

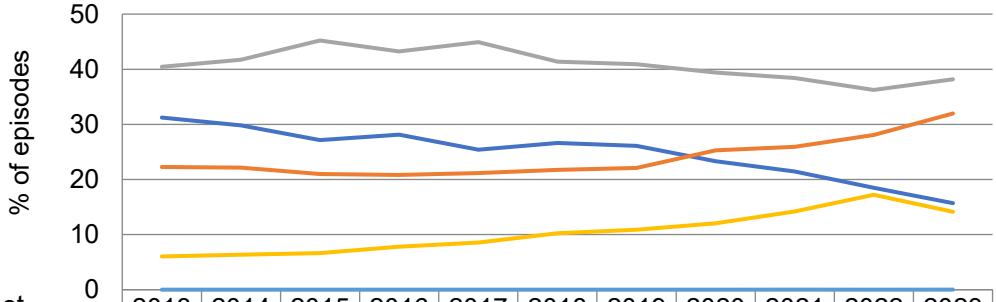
[37] Brieger D et al. Acute coronary syndromes without chest pain, an underdiagnosed and undertreated high-risk group: insights from the global registry of acute coronary events. Chest 2004; 126: 461-469.
[38] Carro A, Kaski JC. Myocardial Infarction in the Elderly. Aging and Disease. 2011;2(1): 116-137.

Figure 5.4.2a: Type of symptoms (%) among STEMI



Year of onset	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Typical	69.3	70.9	68.2	70.7	65.7	65.7	66.7	62.8	65.3	59.9	52.5
Atypical	14.2	13.9	15.8	14.1	17.9	20.3	16.3	20.0	18.3	22.4	30.4
Others	14.8	13.6	14.8	13.9	15.0	12.8	14.9	14.7	14.0	15.9	14.9
None	1.6	1.6	1.1	1.3	1.5	1.2	2.1	2.5	2.4	1.8	2.2
Insufficient data	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 5.4.2b: Type of symptoms (%) among NSTEMI

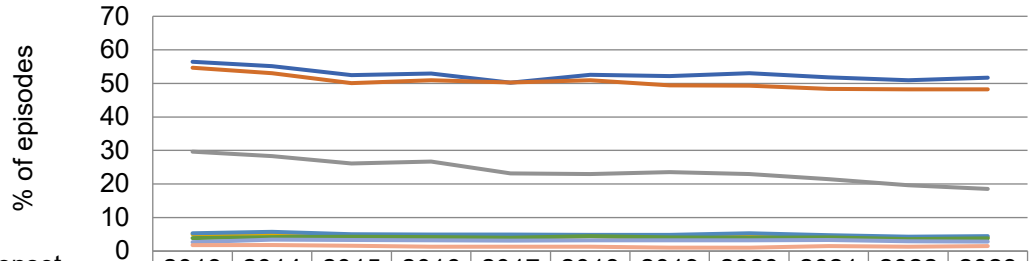


Year of onset	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Typical	31.2	29.8	27.1	28.1	25.4	26.6	26.1	23.3	21.5	18.5	15.7
Atypical	22.3	22.2	21.0	20.8	21.1	21.8	22.1	25.3	25.9	28.1	32.0
Others	40.5	41.7	45.2	43.2	44.9	41.4	40.9	39.4	38.4	36.2	38.2
None	6.0	6.3	6.7	7.8	8.5	10.2	10.9	12.0	14.2	17.2	14.1
Insufficient data	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Consistently across the years, the two most common presenting symptoms of AMI were chest pain and breathlessness, with about half of the patients experiencing these symptoms in 2023 (chest pain: 51.7%, breathlessness: 48.2%) (Figure 5.4.3). About one-fifth (18.5%) of patients had diaphoresis (abnormal sweating) in 2023, while other symptoms such as epigastric pain, back pain, shoulder pain, jaw pain, and syncope (loss of consciousness) were less common, with fewer than 5% of patients experiencing them. Downward trends were observed for chest pain, breathlessness, and diaphoresis over the past decade.

As a patient could present with multiple symptoms, the percentages in Figures 5.4.3, 5.4.4a, and 5.4.4b do not add up to 100% for each year.

Figure 5.4.3: Presenting symptoms (%)

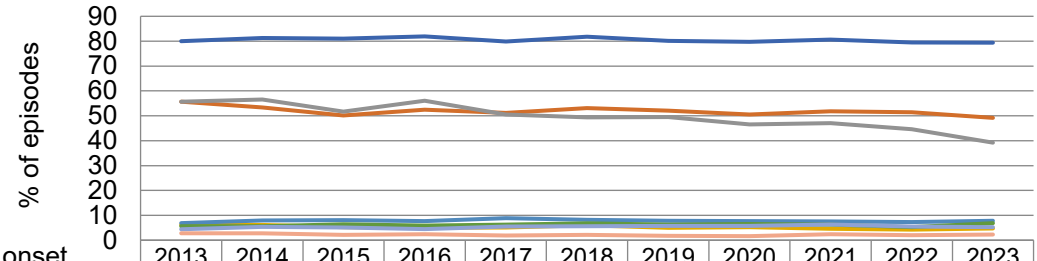


Year of onset	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Chest pain	56.4	55.2	52.5	53.0	50.2	52.6	52.2	53.0	51.8	51.0	51.7
Breathlessness	54.7	53.0	50.1	51.0	50.3	50.9	49.4	49.3	48.4	48.2	48.2
Diaphoresis	29.6	28.3	26.2	26.7	23.1	22.9	23.6	23.0	21.4	19.6	18.5
Epigastric pain	5.1	5.2	4.5	4.3	3.9	4.4	3.8	4.4	3.9	3.8	4.1
Back pain	5.3	5.7	5.1	4.9	5.0	4.9	4.8	5.3	4.7	4.3	4.4
Shoulder pain	3.9	4.2	4.3	4.2	3.9	4.4	4.1	4.0	4.1	3.6	3.8
Jaw pain	2.7	3.4	3.3	3.2	3.2	3.2	3.2	3.2	3.3	2.9	2.8
Syncope	1.8	1.8	1.6	1.3	1.3	1.3	1.0	1.1	1.5	1.3	1.5

Chest pain was the most common presenting symptom of STEMI, with about four in five STEMI patients experiencing this symptom each year (Figure 5.4.4a). In contrast, breathlessness was the most common presenting symptom of NSTEMI, with about half (48.7%) of patients experiencing this symptom in 2023 (Figure 5.4.4b). While the proportion of STEMI patients with chest pain remained stable over the years, the proportion of NSTEMI patients with chest pain declined from 49.9% in 2013 to 44.5% in 2023. The proportion experiencing breathlessness also declined for both STEMI and NSTEMI patients over the years. This may indicate a rise in silent AMI among NSTEMI patients, whereby mild and brief symptoms are experienced, leading to delays in seeking medical attention[39].

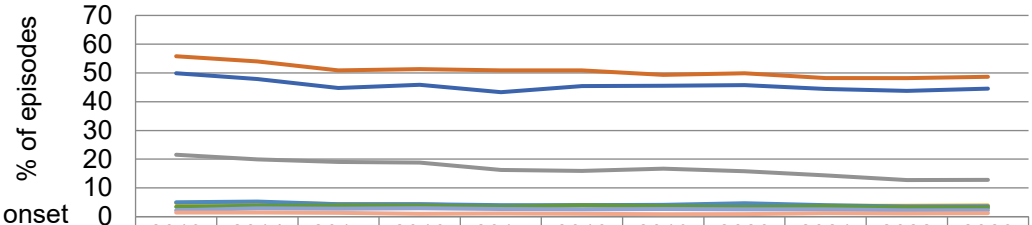
[39] The danger of "silent" heart attacks. Harvard Health Publishing, Harvard Medical School. https://www.health.harvard.edu/heart-health/the-danger-of-silent-heart-attacks Accessed 5 May 2023.

Figure 5.4.4a: Presenting symptoms (%) among STEMI



Year of onset	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Chest pain	79.9	81.2	81.0	81.9	79.9	81.8	80.1	79.7	80.7	79.5	79.4
Breathlessness	55.7	53.3	50.2	52.5	51.1	53.1	52.0	50.5	51.8	51.4	49.2
Diaphoresis	55.7	56.5	51.7	56.0	50.5	49.3	49.5	46.5	47.0	44.6	39.2
Epigastric pain	6.2	6.1	5.3	5.0	5.1	6.0	4.9	5.3	4.7	4.3	4.7
Back pain	6.9	7.9	8.0	7.7	8.9	8.2	7.8	7.6	7.6	7.3	7.8
Shoulder pain	5.6	5.7	6.4	5.9	6.2	6.8	6.2	6.5	6.2	5.3	6.8
Jaw pain	4.4	5.4	5.2	4.4	5.4	5.6	5.7	5.7	6.3	5.5	5.2
Syncope	2.8	2.8	2.2	2.4	1.9	2.2	1.8	1.6	2.5	2.0	2.2

Figure 5.4.4b: Presenting symptoms (%) among NSTEMI



Year of onset	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Chest pain	49.9	47.9	44.7	45.9	43.3	45.4	45.5	45.8	44.4	43.7	44.5
Breathlessness	55.8	54.0	50.9	51.3	50.9	50.9	49.3	49.9	48.2	48.2	48.7
Diaphoresis	21.5	19.9	19.1	18.9	16.3	15.9	16.7	15.9	14.4	12.7	12.8
Epigastric pain	4.7	4.9	4.4	4.3	3.5	4.0	3.6	4.3	3.8	3.8	3.9
Back pain	5.0	5.3	4.3	4.3	4.0	4.0	4.1	4.7	4.1	3.5	3.5
Shoulder pain	3.5	3.8	3.8	3.8	3.4	3.9	3.6	3.3	3.6	3.2	3.0
Jaw pain	2.2	2.9	2.8	2.9	2.7	2.6	2.7	2.5	2.5	2.2	2.2
Syncope	1.4	1.5	1.4	1.0	1.1	1.0	0.8	0.9	1.2	1.0	1.3

5.5 Risk Factors

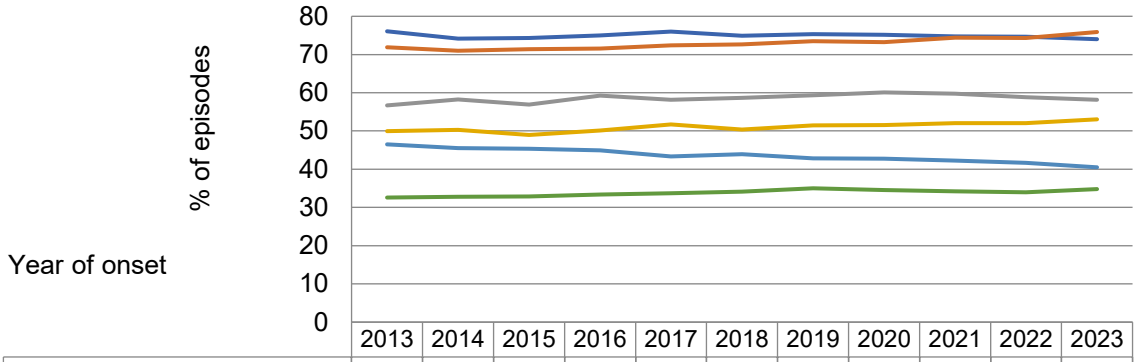
Hypertension, hyperlipidaemia, type 2 diabetes, obesity, and smoking have been identified as the five main modifiable risk factors for cardiovascular diseases (CVD), including AMI[40]. The increasing prevalence of hypertension, high blood cholesterol, and high BMI could partly explain the rise in the crude incidence of AMI[41]. In 2019, CVD accounted for about 80% of the total societal costs (in the form of healthcare costs and productivity losses) attributed to the trio of metabolic risk factors – high blood pressure, high blood glucose, and high cholesterol[42]. It has also been found that the risk factors for CVD tend to cluster – for example, high blood pressure often co-exists with high cholesterol, resulting in a synergistic effect and presenting a greater likelihood of developing CVD compared with an individual risk factor alone[43].

In this report, hypertension, hyperlipidaemia, and diabetes were considered to be present if there was a history of the condition or if it was newly diagnosed during the index admission. Moderate-to-high BMI refers to a BMI of 23 kg/m^2 and above, whereby the risk for cardiovascular disease and diabetes is increased among Asian populations[44]. Smoking includes former and current smokers. As a patient could have multiple risk factors, the percentages in all figures in this section do not add up to 100% for each year.

Hypertension, hyperlipidaemia and moderate-to-high BMI were consistently the three most common risk factors among AMI patients across the years (Figure 5.5.1). In 2023, 74.0% of AMI patients had hypertension, 75.9% had hyperlipidaemia, and 58.2% had moderate-to-high BMI. Diabetes was also prevalent among AMI patients, with more than half of them having this risk factor in 2023. The proportion of AMI patients with a history of AMI/revascularisation was 34.2% in 2023. Slight upward trends were observed for hyperlipidaemia and diabetes, whereas the proportion of AMI patients who were current or former smokers declined gradually over time.

[40] Leonard A. et al. The importance of healthy lifestyle behaviors in the prevention of cardiovascular disease, Progress in Cardiovascular Diseases, Volume 70, 2022, Pages 8-15, ISSN 0033-0620.
[41] Tan J. et al. Strategies to prevent cardiovascular disease in Singapore: A call to action from Singapore Heart Foundation, Singapore Cardiac Society, and Chapter of Cardiologists of the Academy of Medicine, Singapore. Ann Acad Med Singap 2024;53: 23-33.
[42] Tan V., Lim J., Katika A., Chow WL., Ma S., Chen C. The societal cost of modifiable risk factors in Singapore. BMC Public Health 2023; 23:1285.
[43] Ibid.
[44] WHO expert consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet 2004; 363: 157-163.

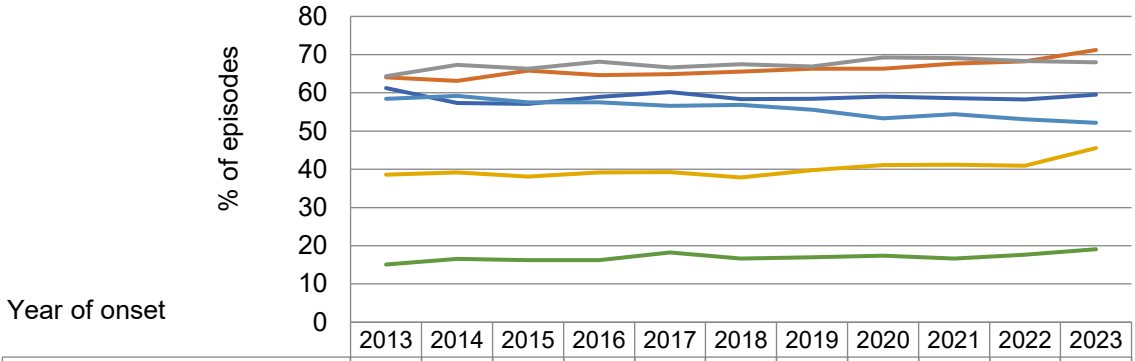
Figure 5.5.1: Risk factors (%)



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Hypertension	76.1	74.2	74.3	75.0	76.0	74.9	75.3	75.2	74.8	74.7	74.0
Hyperlipidaemia	71.9	71.0	71.4	71.6	72.4	72.7	73.5	73.2	74.4	74.3	75.9
Moderate-to-high risk BMI	56.7	58.3	56.9	59.3	58.1	58.7	59.4	60.1	59.8	58.9	58.2
Diabetes	50.0	50.3	49.0	50.2	51.7	50.4	51.5	51.5	52.1	52.0	53.0
Smoking	46.5	45.5	45.4	45.0	43.3	43.9	42.9	42.8	42.3	41.7	40.5
History of AMI / revascularisation	32.6	32.8	32.9	33.3	33.7	34.1	35.0	34.5	34.2	34.0	34.8

More than half of the STEMI patients had hypertension, hyperlipidaemia, moderate-to-high BMI, or a smoking history (Figure 5.5.2a). Compared with STEMI patients, the proportions of NSTEMI patients with hypertension, hyperlipidaemia, diabetes, and a history of AMI/revascularisation were higher (Figure 5.5.2b) as they tended to be older (Tables 5.1.9a and 5.1.9b), which is associated with an increased burden of cardiovascular risk factors[45]. However, NSTEMI patients were observed to be less likely to have moderate-to-high BMI or smoke.

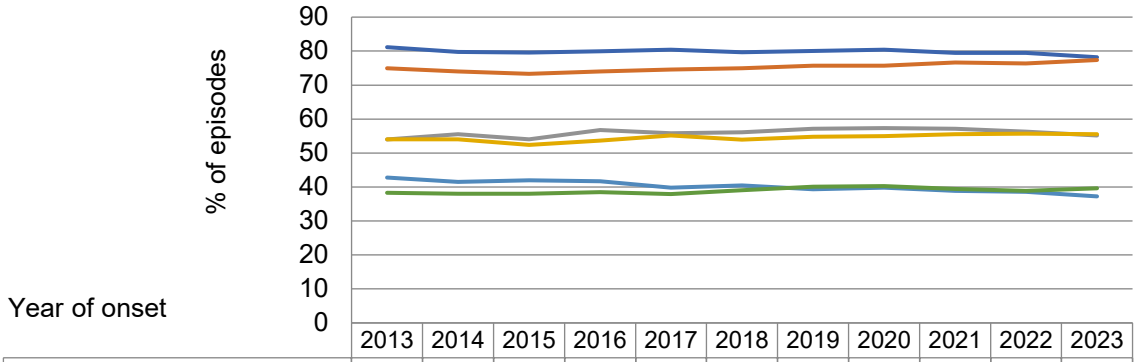
Figure 5.5.2a: Risk factors (%) among STEMI



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Hypertension	61.3	57.4	57.1	59.0	60.2	58.3	58.4	59.1	58.6	58.3	59.6
Hyperlipidaemia	64.1	63.1	65.8	64.7	64.9	65.6	66.3	66.3	67.7	68.2	71.2
Moderate-to-high risk BMI	64.4	67.3	66.3	68.2	66.6	67.5	66.9	69.3	69.1	68.3	68.0
Diabetes	38.6	39.2	38.1	39.2	39.2	37.9	39.8	41.1	41.2	40.9	45.6
Smoking	58.4	59.2	57.5	57.5	56.6	56.8	55.6	53.3	54.4	53.1	52.2
History of AMI / revascularisation	15.1	16.6	16.2	16.2	18.2	16.6	17.0	17.4	16.6	17.7	19.1

[45] Zuhdi A et al. Acute coronary syndrome in the elderly: the Malaysian National Cardiovascular Disease Database-Acute Coronary Syndrome registry. Singapore Med J 2016; 57(4): 191-197.

Figure 5.5.2b: Risk factors (%) among NSTEMI



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Hypertension	81.2	79.8	79.6	79.9	80.4	79.7	80.0	80.4	79.5	79.5	78.2
Hyperlipidaemia	74.9	74.0	73.3	74.0	74.6	74.9	75.7	75.7	76.7	76.4	77.4
Moderate-to-high risk BMI	54.0	55.6	54.0	56.8	55.9	56.1	57.2	57.3	57.1	56.3	55.2
Diabetes	54.0	54.1	52.4	53.7	55.2	54.0	54.8	55.0	55.6	55.7	55.6
Smoking	42.8	41.5	42.0	41.7	39.8	40.5	39.4	39.8	38.8	38.5	37.2
History of AMI / revascularisation	38.3	38.1	38.0	38.5	37.9	39.1	40.0	40.3	39.4	38.9	39.6

Additionally, for the latest year (2023), the proportions of patients with various risk factors, were further stratified by age group. Overall, the prevalence of hypertension, hyperlipidaemia, diabetes and history of AMI/revascularisation increased with advancing age (Figure 5.5.3). This pattern is consistent with the findings from NPHS 2023[46], which similarly reported increasing prevalence of hypertension, hyperlipidaemia, and diabetes with age. In contrast, for younger AMI patients, moderate-to-high risk BMI and smoking were the more common risk factors. The age distribution of risk factors was further stratified by STEMI and NSTEMI patients, and similar patterns to the overall AMI population were observed (Figure 5.5.4a, Figure 5.5.4b).

Figure 5.5.3: Age Distribution of Risk factors (%) for 2023 Onset Patients

(Darker colours indicate higher proportions for each risk factor)

2023	15-29	30-39	40-49	50-59	60-69	70-79	80+	Overall
Hypertension	31.3	28.2	48.8	55.8	68.8	81.1	86.8	74.0
Hyperlipidaemia	50.0	49.1	65.9	69.7	76.0	80.2	77.7	75.9
Moderate-to-high risk BMI	66.7	81.5	82.5	77.6	65.8	54.3	38.1	58.2
Diabetes	31.3	30.7	37.7	46.4	55.9	61.7	49.5	53.0
Smoking	53.9	62.0	60.8	58.4	48.3	36.3	23.6	40.5
History of AMI/revascularisation	18.8	8.6	21.5	25.3	35.1	39.3	38.1	34.8

[46] National Population Health Survey 2023 Report. Ministry of Health, Singapore. Accessed 2 October 2025.

Figure 5.5.4a: Age Distribution of Risk factors (%) for 2023 Onset Among STEMI Patients

2023	15-29	30-39	40-49	50-59	60-69	70-79	80+	STEMI
Hypertension	37.5	25.7	40.2	46.6	57.2	74.0	85.3	59.6
Hyperlipidaemia	62.5	52.9	64.9	68.4	70.3	77.6	76.5	71.2
Moderate-to-high risk BMI	75.0	86.6	84.4	77.4	69.4	57.8	45.0	68.0
Diabetes	37.5	28.6	35.4	41.3	46.3	54.4	48.1	45.6
Smoking	50.0	79.4	66.4	66.4	55.8	38.8	21.7	52.2
History of AMI/revascularisation	25.0	8.6	13.3	14.4	21.4	21.5	23.5	19.1

Figure 5.5.4b: Age Distribution of Risk factors (%) for 2023 Onset Among NSTEMI Patients

2023	15-29	30-39	40-49	50-59	60-69	70-79	80+	NSTEMI
Hypertension	25.0	32.2	54.4	61.4	73.5	82.5	86.9	78.2
Hyperlipidaemia	37.5	47.1	65.6	70.8	78.5	80.8	77.9	77.4
Moderate-to-high risk BMI	57.1	78.5	81.8	77.7	64.4	53.4	37.4	55.2
Diabetes	25.0	33.3	40.0	50.3	60.0	63.6	49.8	55.6
Smoking	60.0	51.2	57.5	53.6	45.8	35.9	23.7	37.2
History of AMI/revascularisation	12.5	9.2	27.2	32.0	40.5	43.4	40.2	39.6

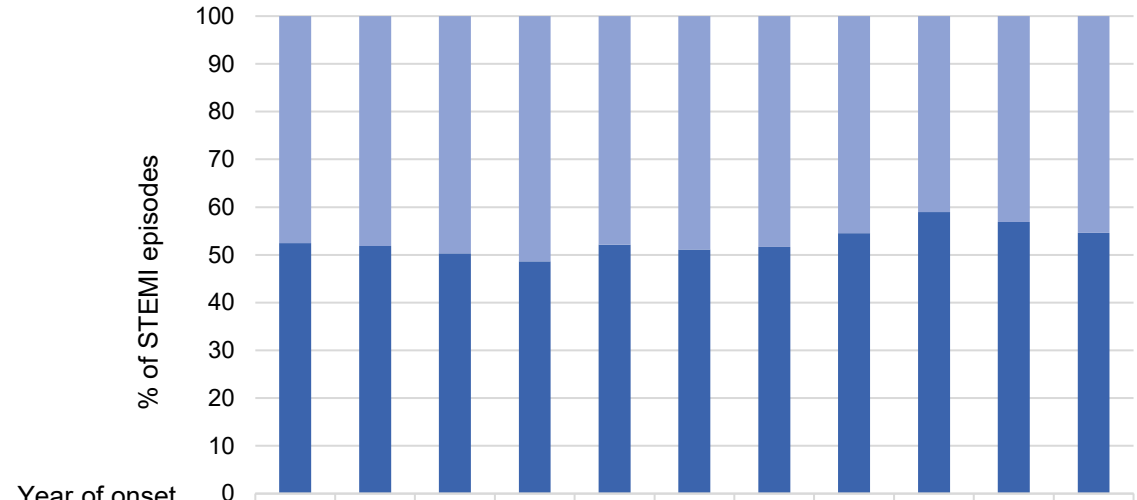
5.6 Time Factors

Door-to-balloon (DTB) time: DTB time refers to the time from first medical contact to the start of primary PCI (first device time). The timeliness of hospitals in treating STEMI through primary PCI is indicated by the DTB time. Imprecise recording of the time of first medical contact and the start of primary PCI by hospitals will affect the accuracy of the DTB time. The targeted DTB time recommended by the American Heart Association is within 90 minutes[47].

Studies have shown that direct ambulance admission to the catheterisation laboratory significantly reduces DTB time[48]. The Singapore Civil Defence Force (SCDF) is the main provider of emergency ambulance services in Singapore. Non-SCDF transport includes private ambulances (non-SCDF), public transport, private vehicles, and walk-in cases.

The utilisation of SCDF ambulances among STEMI patients ranged from about 50% to 60% between 2013 and 2023 (Figure 5.6.1). In 2023, 54.6% of STEMI patients arrived by SCDF ambulance.

Figure 5.6.1: Mode of arrival (%) among STEMI patients



Year of onset	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Non-SCDF transport	47.6	48.1	49.7	51.4	47.9	48.8	48.4	45.5	41.0	43.1	45.4
SCDF ambulance	52.4	51.9	50.3	48.6	52.1	51.2	51.6	54.5	59.0	56.9	54.6

[47] Antman EM et al. ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to revise the 1999 guidelines for the management of patients with acute myocardial infarction). Journal of American College of Cardiology 2004; 94: 722-774.

[48] Dorsch MF et al. Direct ambulance admission to the cardiac catheterization laboratory significantly reduces door-to-balloon times in primary percutaneous coronary intervention. American Heart Journal 2008; 155(6): 1054-1058.

Patients who were admitted for a non-AMI condition but developed AMI during hospitalisation, those who were transferred from another hospital, and patients who experienced non-system delays[49] were excluded from the calculation of DTB time. These exclusion criteria were applied as the DTB time would be abnormally short or long under such scenarios.

The median DTB time remained relatively unchanged at 56 minutes (interquartile range [IQR]: 45-71) in 2013 and 57 minutes (IQR: 44-72) in 2023 among STEMI patients (Figure 5.6.2). The proportion of STEMI patients with a DTB time of 90 minutes or less also remained stable, at 94.4% in 2023. This demonstrates the efficiency of the healthcare delivery system, which comprises early response teams and hospitals.

The median DTB time was consistently shorter for STEMI patients who arrived by SCDF ambulance (49 minutes in 2023) compared with those who relied on other modes of transport (67 minutes in 2023) across the years. SCDF paramedics are trained to recognise STEMI changes on the ECG. Individuals assessed by SCDF paramedics to be in need of immediate intervention can bypass triage upon arrival at the receiving hospital's emergency department (ED), resulting in shorter times to the initiation of primary PCI.[50] A comparable difference was found in a single-centre retrospective cohort study in Singapore, where arrival via emergency ambulance was similarly associated with DTB times approximately 15 minutes shorter than arrival via other modes of transport[51]. This difference was largely attributable to reduced door-to-ECG and door-to-catheterisation laboratory times.

Similarly, the proportion of STEMI patients with a DTB time within 90 minutes was consistently higher among those who arrived at the hospital via SCDF ambulance than among those who arrived via other modes of transport (98.0% versus 89.2%, respectively, in 2023) across the years.

When a STEMI diagnosis is determined in the pre-hospital setting through the SCDF Emergency Medical Services and the patient is triaged for a primary PCI, he/she will be conveyed to a PCI centre. The receiving hospital's ED is notified by the SCDF in advance to be put on standby, and the patient's ECG is transmitted to the ED before the ambulance's arrival[52]. This allows the hospital to confirm the diagnosis, prepare the resuscitation bay and controlled drugs if necessary, pre-order procedures, and activate the catheterisation laboratory, thereby shortening DTB time and ultimately

[49] The SMIR only started collecting this variable from 2012 onwards. Non-system delay refers to delay in primary PCI due to patient's condition. It includes: unfit for primary PCI at the point of hospital arrival (indicated by cardiopulmonary resuscitation, direct current shock, cardiogenic shock, deterioration before or during primary PCI), requirement for other procedure or test prior to primary PCI, equivocal ECG, evolved AMI, delayed consent. System delay refers to delay in primary PCI due to hospital's system. It includes: delayed process leading to the start of primary PCI, catheterisation laboratory being occupied, procedure difficulty, uptriaged, missed diagnosis, unknown reason.

[50] CNA Insider. On Call With Singapore's Emergency Medical Services: When Minutes Can Mean Life Or Death. https://www.youtube.com/watch?v=9PjWLStxWCc Accessed 8 May 2024.

[51] Liu et al. Improved door-to-balloon time for primary percutaneous coronary intervention for patients conveyed via emergency ambulance service. Ann Acad Med Singapore 2021;50:671-678.

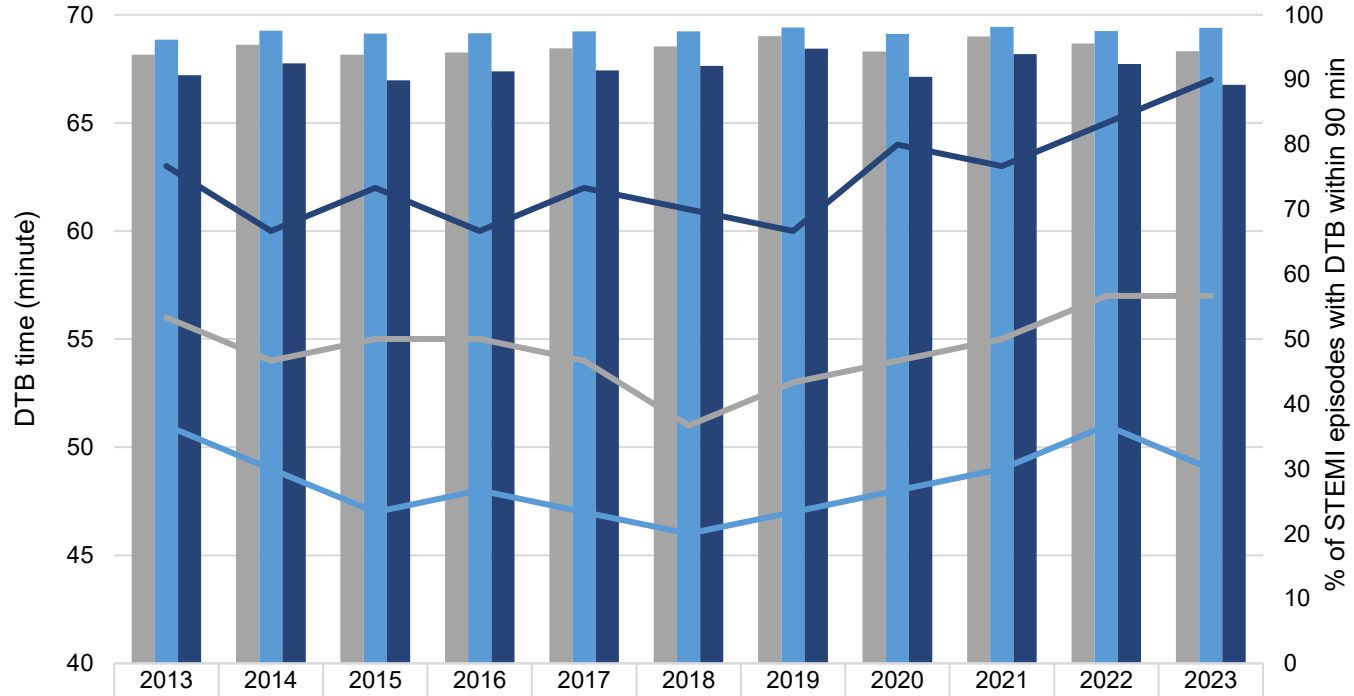
[52] Chia YW and Chia M. Reducing the total ischaemic time in ST-segment elevation myocardial infarction: Every step matters. Ann Acad Med Singapore 2021;50:662-665.

reducing mortality[53,54]. Worldwide, interventions such as pre-hospital ECG transmission and early activation of catheterisation laboratories have been shown to reduce DTB times. These interventions are typically available only to patients conveyed via emergency ambulance services[55].

In August 2021, a platform jointly developed by the SCDF and the Ministry of Health (MOH), called the Operational Medical Networks Informatics Integrator (OMNII), was launched. This platform allows stakeholders in pre-hospital emergency care (such as the SCDF) and hospitals to view, document, and share patient data (including vital signs) with one another, resulting in faster patient management and improved chances of survival[56],[57]. With OMNII, SCDF paramedics can also pre-register patients prior to their arrival at the ED, potentially further improving the DTB time for STEMI patients who arrive by SCDF ambulance.

[53] Nallamothu BK et al. Relation between door-to-balloon times and mortality after primary percutaneous coronary intervention over time: a retrospective study. Lancet 2015; 385(9973): 1114-1122.
[54] CNA Insider. On Call With Singapore's Emergency Medical Services: When Minutes Can Mean Life Or Death. https://www.youtube.com/watch?v=9PjWLStxWCc Accessed 8 May 2024.
[55] Liu et al. Improved door-to-balloon time for primary percutaneous coronary intervention for patients conveyed via emergency ambulance service. Ann Acad Med Singapore 2021;50:671-678.
[56] New digital platform for paramedics and hospitals to share patient data in real time. Yeoh G. https://www.channelnewsasia.com/singapore/digital-platform-scdf-moh-hospitals-patients-omnii-2132121 Accessed 10 May 2023.
[57] Home Team Science and Technology Agency (HTX). Embracing innovation and technology to save lives with OMNII. https://www.htx.gov.sg/news/featured-news-embracing-innovation-and-technology-to-save-lives-with-omnii Accessed 8 May 2024.

Figure 5.6.2: DTB time by mode of arrival among STEMI patients



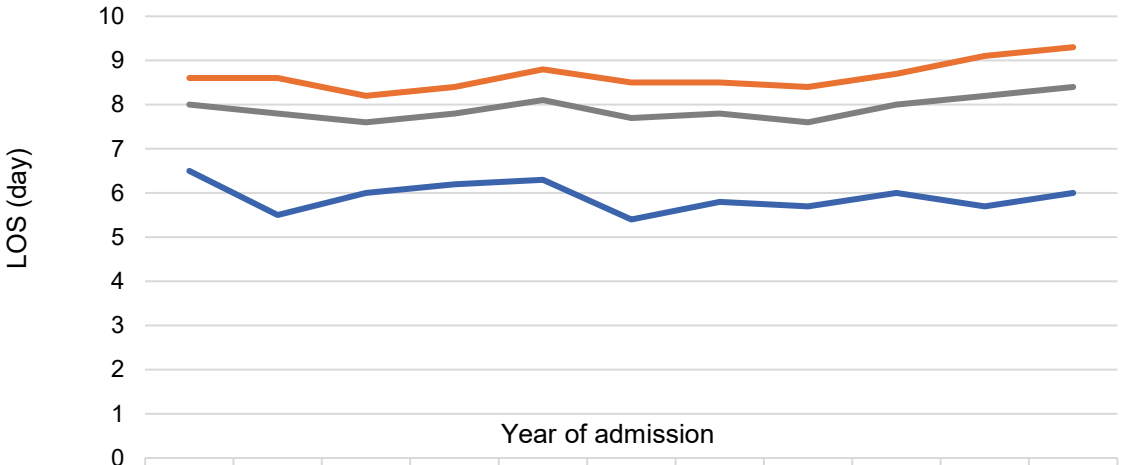
Year of onset	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Overall DTB time within 90 min (%)	93.8	95.4	93.9	94.2	94.8	95.1	96.7	94.4	96.7	95.6	94.4
SCDF DTB time within 90 min (%)	96.2	97.6	97.1	97.2	97.4	97.4	98.1	97.1	98.1	97.5	98.0
Non-SCDF DTB time within 90 min (%)	90.7	92.5	89.9	91.3	91.4	92.1	94.8	90.4	94.0	92.4	89.2
Overall median DTB time (min)	56	54	55	55	54	51	53	54	55	57	57
SCDF median DTB time (min)	51	49	47	48	47	46	47	48	49	51	49
Non-SCDF median DTB time (min)	63	60	62	60	62	61	60	64	63	65	67

5.7 Length of Hospitalisation

Patients who died during hospitalisation, those who were discharged against medical advice, transferred from another hospital, or were admitted for a non-AMI condition but developed AMI during hospitalisation, were excluded from the calculation of length of hospital stay (LOS). These exclusion criteria were applied as the LOS would be abnormally short or long under such scenarios.

The average LOS ranged between 7.6 and 8.4 days from 2013 to 2023 (Figure 5.7.1). The average LOS was consistently longer among NSTEMI patients than STEMI patients by about 2 to 3 days. This could be due to their older age at onset and, therefore, higher prevalence of comorbidities, coupled with a greater tendency for complications, necessitating more extensive monitoring[58,59].

Figure 5.7.1: Length of hospitalisation (days)



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Overall	8.0	7.8	7.6	7.8	8.1	7.7	7.8	7.6	8.0	8.2	8.4
STEMI	6.5	5.5	6.0	6.2	6.3	5.4	5.8	5.7	6.0	5.7	6.0
NSTEMI	8.6	8.6	8.2	8.4	8.8	8.5	8.5	8.4	8.7	9.1	9.3

[58] Bhat A. G. et al. Hospitalisation Duration of Acute Myocardial Infarction: A Temporal Analysis of 18-Year United States Data. Medicina 2022; 58.
[59] Dai X et al. Acute coronary syndrome in older adults. Journal of Geriatric Cardiology; 2016:13. 101-108.

6. CONCLUSION

Driven partly by population ageing, the crude incidence of AMI has risen over the past decade. In 2023, cardiovascular diseases were the top contributor to the combined burden of early death and disability in Singapore, accounting for 15.4% of all disability-adjusted life years (DALYs)[60]. It is important for individuals at high risk of AMI to take preventive action. Hypertension, hyperlipidaemia, smoking, diabetes, obesity, unhealthy diet, and lack of regular physical activity are all significantly associated with an increased risk of AMI onset, regardless of sex and age, and this has been observed across all regions of the world. Collectively, these account for the vast majority of the attributable risk of AMI and are all modifiable through lifestyle interventions such as a healthier diet and regular exercise[61,62].

Individuals can reduce their chances of developing AMI by adopting a healthy lifestyle – eating all foods in moderation and choosing healthier options, exercising and maintaining a healthy weight, avoiding smoking, attending regular health screenings and follow-ups, and keeping blood pressure, cholesterol, and glucose levels under control[63]. Awareness of both typical and atypical symptoms of AMI can shorten the time from onset to treatment, thereby improving outcomes, reducing overall mortality, and lowering the risk of reinfarction[64]. For individuals experiencing symptoms suggestive of AMI, seeking medical help promptly plays a crucial role in prognosis. Among those who survive an AMI, adherence to medication and a healthy lifestyle can reduce the risk of subsequent cardiovascular events and death.

[60] Institute for Health Metrics and Evaluation (IHME). GBD Results. Seattle, WA: IHME, University of Washington, 2025. Available from https://vizhub.healthdata.org/gbd-results/. Accessed 24 October 2025.
[61] Yusof, S et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. Lancet. 2004;364:937-952.
[62] Tan J. et al. Strategies to prevent cardiovascular disease in Singapore: A call to action from Singapore Heart Foundation, Singapore Cardiac Society, and Chapter of Cardiologists of the Academy of Medicine, Singapore. Ann Acad Med Singap 2024;53: 23-33.
[63] Ibid.
[64] Kim Soo-Joong. Global Awareness of Myocardial Infarction Symptoms in General Population. Korean Circulation Journal 2021;51(12): 997-1000.