



Singapore Myocardial Infarction Registry Annual Report 2017

**National Registry of Diseases Office
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Acknowledgement

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1. GLOSSARY

AMI	Acute myocardial infarction
ASIR	Age-standardized incidence rate
ASMR	Age-standardized 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
HPB	Health Promotion Board
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
PCI	Percutaneous coronary intervention
SMIR	Singapore Myocardial Infarction Registry
STEMI	ST-segment elevation myocardial infarction

2. EXECUTIVE SUMMARY

The number of acute myocardial infarction (AMI) episodes increased from 7,246 episodes in 2008 to 11,877 episodes in 2017. The age-standardized incidence rate (ASIR) also increased significantly from 212.2 per 100,000 population in 2008 to 233.7 per 100,000 population in 2017.

The number of AMI deaths was 1,004 in 2017, a drop compared to 1,242 in 2008. The age-standardized mortality rate (ASMR) declined significantly from 35.9 per 100,000 population in 2008 to 18.3 per 100,000 population in 2017. The number of AMI deaths within 30 days from onset fell from 1,182 in 2008 to 907 in 2017. The 30-day case fatality rate (CFR) decreased significantly from 17.3% in 2008 to 8.2% in 2017.

The three most common presenting symptoms of AMI were chest pain, breathlessness and diaphoresis. Half of the patients in 2017 had chest pain (50.4%) and breathlessness (50.3%) accompanying the onset of AMI, about a quarter of them (23.3%) had diaphoresis.

Hypertension and hyperlipidemia were consistently the two most common risk factors among AMI patients across the years. 76.0% of the patients in 2017 had hypertension and 72.4% had hyperlipidemia. The proportions of patients with hypertension and hyperlipidemia rose slightly over the years. Obesity, diabetes and smoking were also prevalent among AMI patients in 2017, with 58.2%, 51.8% and 43.2% of them being obese, diabetic and smokers respectively.

The median door-to-balloon (DTB) time improved from 84 minutes in 2008 to 54 minutes in 2017. The proportion of ST-segment elevation myocardial infarction (STEMI) with DTB time of 90 minutes or less improved from 58.3% in 2008 to 94.8% in 2017.

3. INTRODUCTION

Ischaemic heart disease was the fourth most common cause of hospitalization in 2016, accounting for 3.1% of all discharges in Singapore¹. It was also the third most common cause of death in 2017, accounting for 18.5% of all deaths in Singapore². AMI, commonly known as heart attack, is a type of ischaemic heart disease.

The most common cause of AMI is atherosclerosis - narrowing of arteries due to the build-up of cholesterol deposits. AMI occurs when blood flow to the heart is restricted, resulting in a poor supply of oxygen to the heart. Restoring blood flow to the heart through revascularization of the blocked arteries, coupled with medications, are the recommended treatment for AMI. There are two main types of AMI - STEMI and NSTEMI. STEMI is more severe and require prompt intervention. NSTEMI can occur on its own or as a complication in very sick patients. The most common and classic cause of NSTEMI is the development of non-occlusive blood clot (arterial thrombus) within a coronary artery which leads to a mismatch in oxygen supply (due to reduced blood flow) and demand of the heart muscles. Critically ill patients are at increased risk for NSTEMI as myocardial demand is higher in these patients³.

Singapore's population is rapidly ageing. The old-age support ratio has dropped from 8.4 people aged 15 to 64 years per person aged 65 years or above in 2008 to 5.5 in 2017⁴. Common risk factors of AMI are: hypertension, hyperlipidemia, diabetes, obesity, smoking and old age. With a rapidly aging population, we can expect the incidence of AMI to rise. In order to mitigate the impact of AMI, preventive measures that reduce cardiovascular risks, as well as post-AMI interventions such as pre-hospitalization care, revascularization programmes and cardiac rehabilitation, are essential.

¹ Top 10 Conditions of Hospitalisation. Ministry of Health, Singapore.

² Principal Causes of Death. Ministry of Health, Singapore.

³ Jeremy B. Richards, Renee D. Stapleton. Non-pulmonary complications of critical care. A clinical guide. Respiratory Medicine.

⁴ SingStat Population Trends. Department of Statistics, Singapore.

4. METHODOLOGY

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

The Acute Myocardial Infarction Registry was established in 1988 and managed by the Ministry of Health (MOH). It was subsequently transferred to the Singapore Cardiac Databank in 2002. In April 2007, the NRDO, under the purview of Health Promotion Board (HPB), took over the management of the Registry, which was re-named to Singapore Myocardial Infarction Registry (SMIR). The SMIR collects epidemiological data on AMI cases diagnosed in all public hospitals, private hospitals and a small number of AMI deaths that occurred at home, which are certified by the general practitioners in Singapore. Legislation mandated notification from all healthcare institutions since September 2012.

Data sources

The SMIR receives AMI case notifications from:

1. All healthcare institutions via the Hospital In-patient Discharge Summary and the cardiac biomarkers list,
2. MOH via the Mediclaims list and Casemix & Subvention list, and
3. Death Registry of the Ministry of Home Affairs (MHA) via the death list.

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

The registry coordinators confirm the diagnosis of AMI by viewing the patients' case notes and electronic medical records, before extracting relevant detailed clinical information from the case notes and electronic medical records at the healthcare institutions. All cases collected by the SMIR must be diagnosed as an AMI by a certified doctor, accompanied by symptoms of AMI, raised cardiac enzymes or abnormal electrocardiogram (ECG).

The MONICA (Monitoring Trends and Determinants in Cardiovascular Disease) criterion is used for episode management, whereby a recurring AMI after 28 days of a preceding episode will be counted as another episode⁵. AMI are broadly classified into STEMI, NSTEMI and others (neither STEMI nor NSTEMI) in the SMIR. From 2011 onwards, besides STEMI and NSTEMI, type 1, 2, 3, 4A, 4B and 5 are also used to classify the cases based on the clinical classification recommended by the American Heart Association⁶. In particular, type 2 AMI episodes were eventually combined with NSTEMI episodes in this report as their clinical characteristics are similar⁷.

The death status of all patients registered in the SMIR were updated till 31 August 2018 by matching the patients' NRIC with the death information imported from the MHA.

Population estimates

The Singapore population estimates used to calculate the incidence rate and mortality rate 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) annually⁸. The Segi World population estimates used for age standardization are available on the World Health Organization website⁹.

Incidence rate

The incidence rate in each year was computed by taking the number of AMI episodes that occurred in a year, divided by the number of Singapore residents in the same year. The count was based on the onset date of each AMI episode. Patients were categorized into 5-year age groups and age standardization was done using the direct method with the Segi World population as the standardization weights.

Mortality rate

The mortality rate in each year was computed by taking the number of deaths with AMI as the primary cause of death occurring in a year, divided by the number of Singapore residents in the same year. The count was based on the death date of each AMI patient. Patients were categorized into 5-year age groups and age standardization was done using the direct method with the Segi World population as the standardization weights.

⁵ Tunstall-Pedoe H et al. Myocardial infarction and coronary deaths in the World Health Organisation MONICA project. *Circulation* 1994; 90: 583-612.

⁶ American College of Cardiology Foundation. Universal definition of myocardial infarction. *Journal of the American College of Cardiology* 2007; 50(22): 2173-2195.

⁷ Stein YG et al. Type-II myocardial infarction – patient characteristics, management and outcomes. *PLoS One* 2014; 9(1): e84285.

⁸ SingStat Table Builder, Population and Population Structure, Annual Population, Singapore Residents by age group, ethnic group and sex. Department of Statistics, Singapore.

⁹ 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.

Case fatality rate

The case fatality rate in each year was computed by taking the number of deaths with AMI as the primary cause of death that occurred within 30 days from AMI onset, regardless of whether the death occurred within or outside the hospital in a year, divided by the number of AMI patients in the same year. The count was based on the onset date of each AMI patient. This indicator reflects the severity of AMI, the timeliness of healthcare delivery and the effectiveness of AMI treatment.

This annual report focuses on Singapore residents, aged 15 years and above, diagnosed with AMI in the past decade, from 2008 to 2017 as they stood on 5 November 2018. All findings in this report except mortality and case fatality, were based on episodes.

5. FINDINGS

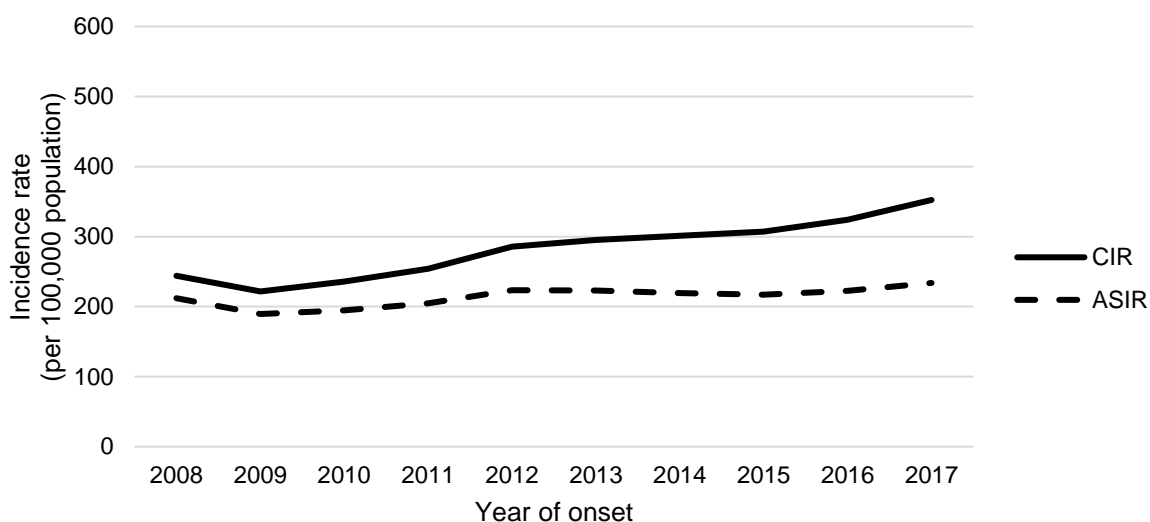
5.1 Incidence of AMI

The number of AMI episodes increased from 7,246 episodes in 2008 to 11,877 episodes in 2017 (Table 5.1.1). Similarly, the crude incidence rate (CIR) increased significantly from 243.9 per 100,000 population in 2008 to 352.3 per 100,000 population in 2017 ($p < 0.001$) (Figure 5.1.1). Taking into account Singapore's ageing population, the ASIR also increased significantly from 212.2 per 100,000 population in 2008 to 233.7 per 100,000 population in 2017 ($p = 0.023$).

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

Year of onset	Number	CIR	95% CI	ASIR	95% CI
2008	7246	243.9	238.3-249.5	212.2	207.2-217.2
2009	6796	221.6	216.4-226.9	189.4	184.9-194.0
2010	7344	235.6	230.2-241.0	194.5	190.0-199.1
2011	8014	254.2	248.7-259.8	204.7	200.1-209.3
2012	9122	285.8	280.0-291.7	223.2	218.6-227.9
2013	9531	295.2	289.2-301.1	222.8	218.2-227.3
2014	9833	301.4	295.4-307.3	219.3	214.9-223.7
2015	10131	307.0	301.0-313.0	217.2	212.8-221.5
2016	10813	324.0	317.9-330.1	222.5	218.2-226.8
2017	11877	352.3	346.0-358.6	233.7	229.5-238.0
P for trend	-	<0.001	-	0.023	-

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



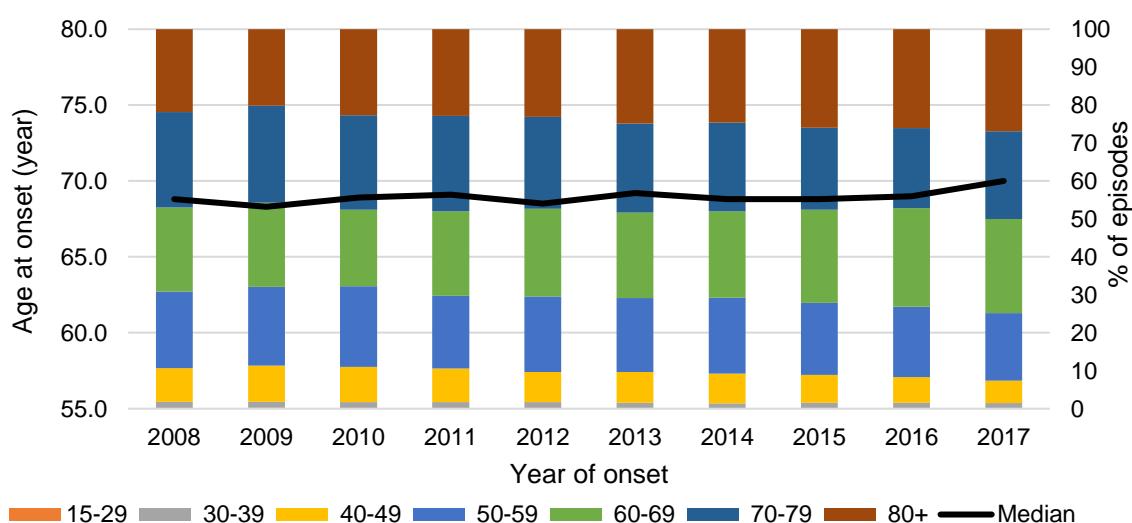
The median age at onset of AMI ranged from 68 to 70 years (Table 5.1.2 and Figure 5.1.2). Notably, the proportion of AMI patients in the oldest age group increased from 21.8% in 2008 to 26.9% in 2017.

Table 5.1.2: Median age (year) and age distribution (%) at onset

Year of onset	Median age	Age 15-29		Age 30-39		Age 40-49	
		Number	%	Number	%	Number	%
2008	68.8	10	0.1	121	1.7	642	8.9
2009	68.3	13	0.2	112	1.6	649	9.5
2010	68.9	12	0.2	118	1.6	676	9.2
2011	69.1	13	0.2	126	1.6	709	8.8
2012	68.5	15	0.2	139	1.5	725	7.9
2013	69.2	13	0.1	139	1.5	765	8.0
2014	68.8	11	0.1	126	1.3	768	7.8
2015	68.8	13	0.1	148	1.5	742	7.3
2016	69.0	16	0.1	154	1.4	727	6.7
2017	70.0	17	0.1	162	1.4	698	5.9

Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2008	1460	20.1	1608	22.2	1824	25.2	1581	21.8
2009	1410	20.7	1508	22.2	1735	25.5	1369	20.1
2010	1563	21.3	1484	20.2	1826	24.9	1665	22.7
2011	1536	19.2	1784	22.3	2016	25.2	1830	22.8
2012	1817	19.9	2107	23.1	2213	24.3	2106	23.1
2013	1859	19.5	2145	22.5	2241	23.5	2369	24.9
2014	1972	20.1	2240	22.8	2297	23.4	2419	24.6
2015	1922	19.0	2489	24.6	2189	21.6	2628	25.9
2016	2004	18.5	2814	26.0	2284	21.1	2814	26.0
2017	2110	17.8	2946	24.8	2748	23.1	3196	26.9

Figure 5.1.2: Median age (year) and age distribution (%) at onset



The age-specific incidence rate increased with age (Table 5.1.3), with the oldest age group having the highest incidence rate (Figure 5.1.3a). Over the past decade, significant rise in incidence rates were observed for all the age groups below 60 years old, as well as the oldest age group (Figure 5.1.3b). The rise in incidence rate was fastest among the oldest age group.

Table 5.1.3: Age-specific incidence rate (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
2008	243.9	238.3-249.5	1.3	0.5-2.2	20.3	16.7-23.9	101.1	93.2-108.9
2009	221.6	216.4-226.9	1.7	0.8-2.6	18.2	14.8-21.6	102.1	94.3-110.0
2010	235.6	230.2-241.0	1.5	0.7-2.4	19.1	15.6-22.5	106.8	98.7-114.8
2011	254.2	248.7-259.8	1.7	0.8-2.6	20.5	16.9-24.1	112.4	104.2-120.7
2012	285.8	280.0-291.7	1.9	1.0-2.9	22.8	19.0-26.6	115.1	106.8-123.5
2013	295.2	289.2-301.1	1.7	0.8-2.6	23.1	19.2-26.9	121.7	113.0-130.3
2014	301.4	295.4-307.3	1.4	0.6-2.3	21.2	17.5-24.9	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	324.0	317.9-330.1	2.0	1.0-3.1	26.2	22.1-30.4	118.3	109.7-126.9
2017	352.3	346.0-358.6	2.2	1.1-3.2	27.9	23.6-32.2	113.5	105.1-121.9
P for trend	<0.001	-	0.036	-	<0.001	-	0.008	-
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
2008	281.5	267.1-296.0	599.3	570.0-628.6	1301.0	1241.3-1360.7	2621.9	2492.6-2751.1
2009	262.4	248.7-276.1	527.5	500.8-554.1	1164.4	1109.6-1219.2	2109.4	1997.7-2221.1
2010	283.3	269.2-297.3	489.4	464.5-514.3	1157.9	1104.8-1211.0	2406.1	2290.5-2521.6
2011	270.1	256.6-283.6	556.6	530.8-582.5	1207.9	1155.2-1260.6	2500.0	2385.5-2614.5
2012	312.1	297.7-326.4	614.6	588.4-640.9	1286.6	1233.0-1340.2	2713.9	2598.0-2829.8
2013	313.0	298.8-327.2	582.7	558.1-607.4	1272.6	1219.9-1325.3	2885.5	2769.3-3001.7
2014	326.5	312.1-341.0	570.4	546.8-594.0	1254.4	1203.1-1305.7	2771.1	2660.7-2881.5
2015	315.0	300.9-329.1	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	1191.1	1142.3-1240.0	2877.3	2771.0-2983.6
2017	343.4	328.7-358.0	631.3	608.6-654.1	1299.6	1251.0-1348.2	3155.7	3046.3-3265.1
P for trend	<0.001	-	0.067	-	0.665	-	0.004	-

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

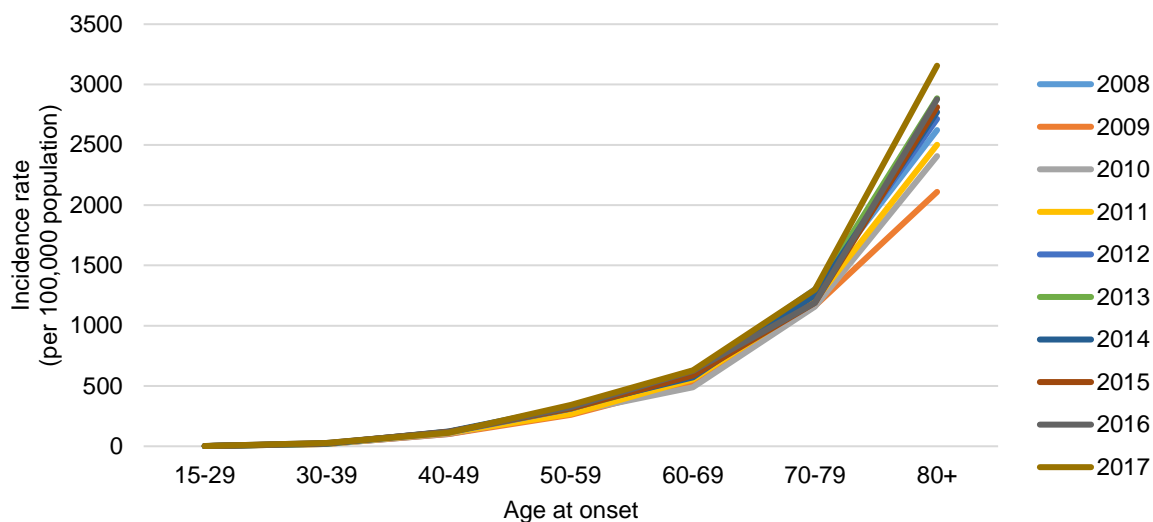
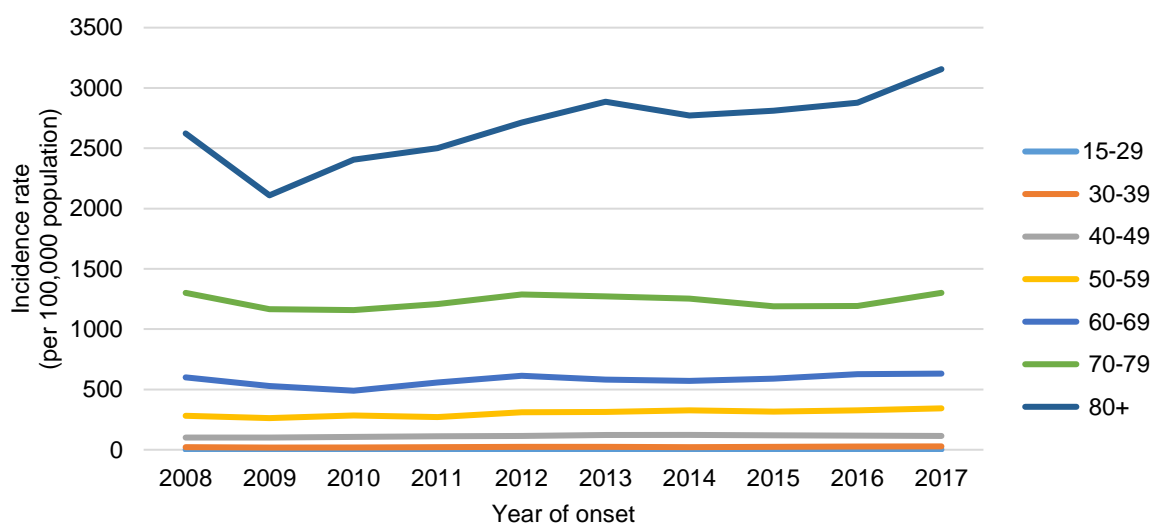


Figure 5.1.3b: Age-specific incidence rate (per 100,000 population) across years



Although the gender distribution was almost equal in the general population, there were more men suffering from AMI than women (Table 5.1.4). The rise in ASIR was significant for men ($p=0.003$) but not for women ($p=0.180$) over the past decade (Figure 5.1.4). The ASIR for men was consistently higher than women across the years. Men had an ASIR of 345.0 per 100,000 population, while women had an ASIR of 132.2 per 100,000 population in 2017.

Men are known to have higher risk of AMI compared to women. The underlying causes are multifactorial and related to the pathophysiological gender differences in AMI¹⁰. Furthermore, the prevalence of hypertension, hyperlipidemia, diabetes and smoking were higher among men than women in the general population in Singapore as shown by the National Population Health Survey 2017¹¹. In contrast, oestrogen has a protective effect on pre-menopausal women's hearts by causing women to have, relative to men, a lower systolic blood pressure, a lower level of low-density lipoprotein (bad) cholesterol and a higher level of high-density lipoprotein (good) cholesterol. Consequently, less cholesterol deposits build up in the arteries of pre-menopausal women. Hence, pre-menopausal women have a lower risk of developing cardiovascular diseases than post-menopausal women¹².

Table 5.1.4: Incidence number and rate (per 100,000 population) by gender

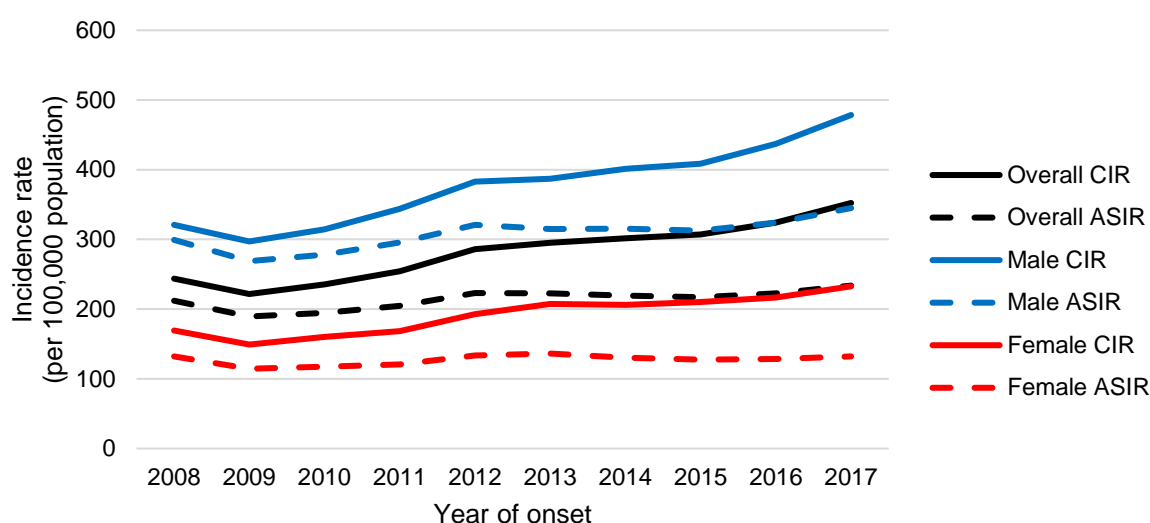
Male						
Year of onset	Number	%	CIR	95% CI	ASIR	95% CI
2008	4682	64.6	321.0	311.8-330.2	299.3	290.7-308.0
2009	4464	65.7	297.1	288.4-305.8	268.8	260.8-276.8
2010	4799	65.3	314.3	305.4-323.2	278.3	270.3-286.3
2011	5305	66.2	343.9	334.6-353.1	295.8	287.7-303.9
2012	5975	65.5	383.0	373.3-392.7	320.7	312.5-328.9
2013	6105	64.1	387.1	377.4-396.8	314.8	306.9-322.8
2014	6389	65.0	401.2	391.4-411.1	315.3	307.5-323.1
2015	6580	64.9	408.8	398.9-418.7	312.7	305.0-320.3
2016	7104	65.7	436.9	426.8-447.1	324.2	316.6-331.9
2017	7850	66.1	478.5	467.9-489.1	345.0	337.3-352.7
P for trend	-	-	<0.001	-	0.003	-
Female						
Year of onset	Number	%	CIR	95% CI	ASIR	95% CI
2008	2564	35.4	169.5	162.9-176.0	132.3	127.0-137.6
2009	2332	34.3	149.2	143.1-155.2	114.5	109.7-119.3
2010	2545	34.7	160.0	153.8-166.2	117.2	112.5-122.0
2011	2709	33.8	168.3	162.0-174.6	120.7	116.0-125.5
2012	3147	34.5	192.9	186.2-199.7	133.6	128.8-138.5
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	35.1	210.0	203.1-216.9	127.7	123.3-132.1
2016	3709	34.3	216.7	209.7-223.7	128.6	124.3-132.9
2017	4027	33.9	232.7	225.5-239.9	132.2	127.9-136.4
P for trend	-	-	<0.001	-	0.180	-

¹⁰ Mehta LS et al. Acute myocardial infarction in women. *Circulation* 2016; 133.

¹¹ National Population Health Survey 2017. Ministry of Health, Singapore.

¹² Risk Factors, Gender. Singapore Heart Foundation.

Figure 5.1.4: Incidence rate (per 100,000 population) by gender

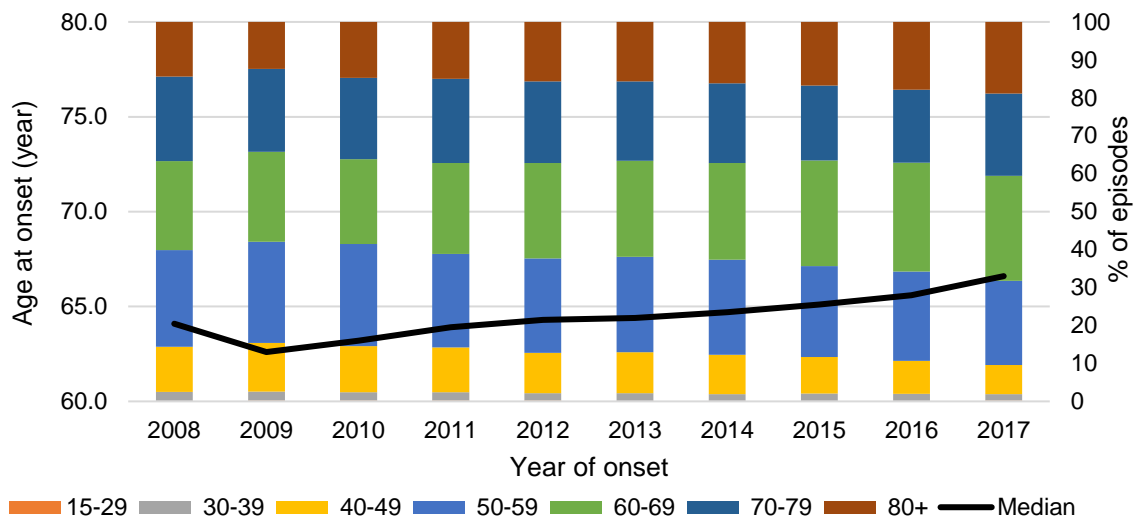


The median age at onset of AMI ranged from 62 to 67 years among men and it increased gradually over the past decade (Table 5.1.5a and Figure 5.1.5a). The highest proportion of AMI cases was found among the 60-69 years age group (27.7%) in 2017.

Table 5.1.5a: Median age (year) and age distribution (%) at onset among men

Year of onset	Median age		Age 15-29		Age 30-39		Age 40-49	
			Number	%	Number	%	Number	%
2008	64.1		8	0.2	107	2.3	559	11.9
2009	62.6		10	0.2	105	2.4	573	12.8
2010	63.2		9	0.2	105	2.2	584	12.2
2011	63.9		12	0.2	116	2.2	627	11.8
2012	64.3		11	0.2	120	2.0	632	10.6
2013	64.4		10	0.2	121	2.0	661	10.8
2014	64.7		10	0.2	110	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		15	0.2	134	1.7	606	7.7
Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2008	1193	25.5	1096	23.4	1045	22.3	674	14.4
2009	1188	26.6	1060	23.7	976	21.9	552	12.4
2010	1293	26.9	1074	22.4	1025	21.4	709	14.8
2011	1306	24.6	1273	24.0	1174	22.1	797	15.0
2012	1490	24.9	1500	25.1	1286	21.5	936	15.7
2013	1534	25.1	1546	25.3	1277	20.9	956	15.7
2014	1599	25.0	1631	25.5	1342	21.0	1033	16.2
2015	1575	23.9	1834	27.9	1298	19.7	1102	16.7
2016	1675	23.6	2036	28.7	1365	19.2	1271	17.9
2017	1736	22.1	2172	27.7	1705	21.7	1482	18.9

Figure 5.1.5a: Median age (year) and age distribution (%) at onset among men

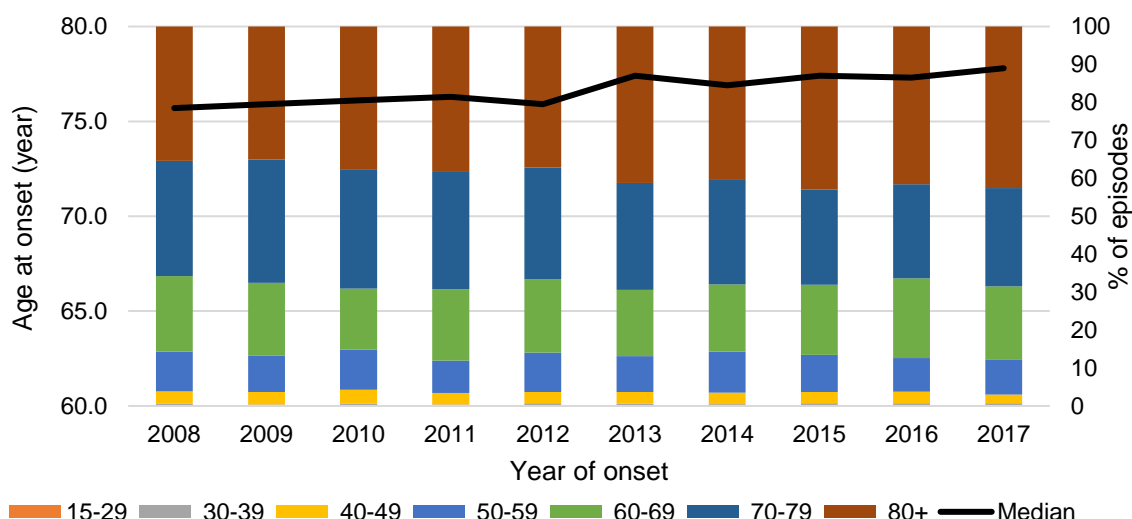


The median age at onset of AMI ranged from 75 to 78 years among women, 10 years older than the median age at onset among men (Table 5.1.5b and Figure 5.1.5b). Similar to men, there was a general upward trend in median age at onset among women over the past decade. The highest proportion of AMI cases was found among the oldest age group (42.6%) in 2017.

Table 5.1.5b: Median age (year) and age distribution (%) at onset among women

Year of onset	Median age	Age 15-29		Age 30-39		Age 40-49		
		Number	%	Number	%	Number	%	
2008	75.7	2	0.1	14	0.5	83	3.2	
2009	75.9	3	0.1	7	0.3	76	3.3	
2010	76.1	3	0.1	13	0.5	92	3.6	
2011	76.3	1	0.0	10	0.4	82	3.0	
2012	75.9	4	0.1	19	0.6	93	3.0	
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	21	0.6	114	3.1	
2017	77.8	2	0.0	28	0.7	92	2.3	
Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2008	267	10.4	512	20.0	779	30.4	907	35.4
2009	222	9.5	448	19.2	759	32.5	817	35.0
2010	270	10.6	410	16.1	801	31.5	956	37.6
2011	230	8.5	511	18.9	842	31.1	1033	38.1
2012	327	10.4	607	19.3	927	29.5	1170	37.2
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	374	9.3	774	19.2	1043	25.9	1714	42.6

Figure 5.1.5b: Median age (year) and age distribution (%) at onset among women



The ethnic distribution of the AMI episodes occurred in similar proportions to the ethnic composition of the general population (Table 5.1.6). The rise in ASIR over the past decade was significant among the Chinese ($p=0.014$) and Malays ($p=0.011$) (Figure 5.1.6). The Chinese consistently had a lower ASIR than the Malays and Indians across the years. The ASIR was 187.4, 453.4 and 447.0 per 100,000 population for the Chinese, Malays and Indians respectively in 2017.

The prevalence of hypertension, high low-density lipoprotein (bad) cholesterol, obesity and smoking were higher among the Malays, relative to the Chinese and Indians in the general population as shown by the National Health Survey 2010¹³. Although the prevalence of hypertension among the Indians were lower than the Chinese, the prevalence of diabetes among the Indians was higher the Chinese. Furthermore, the Indians have ethnic-specific risk for coronary artery disease^{14,15}. The high prevalence of AMI risk factors among the Malays and the combination of AMI risk factors in the backdrop of genetic predisposition to coronary artery disease among the Indians, are likely the reasons for their higher ASIR, relative to the Chinese.

¹³ National Health Survey 2010. Ministry of Health, Singapore.

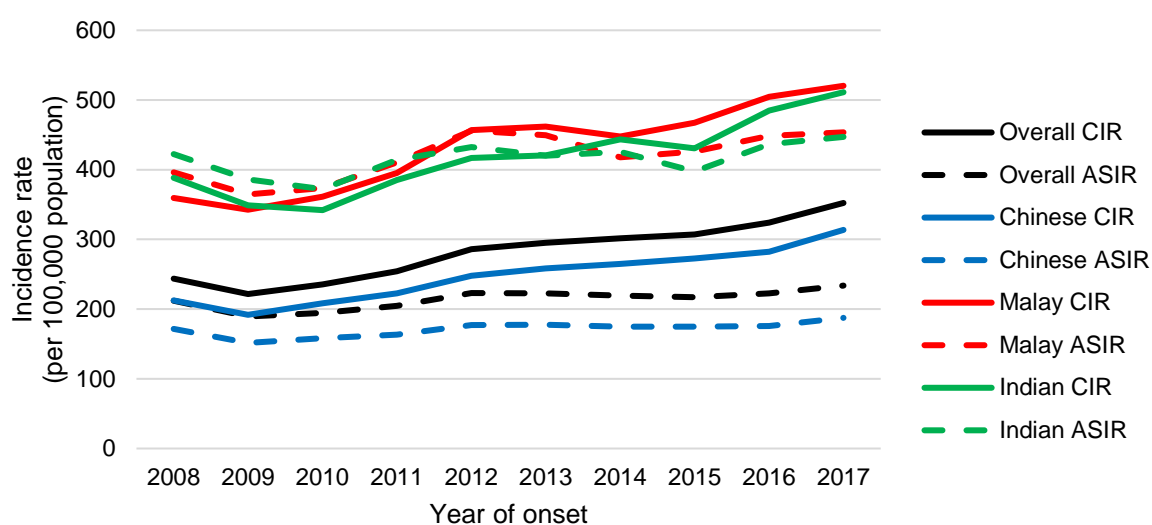
¹⁴ Mak KH et al. Ethnic differences in acute myocardial infarction in Singapore. *European Heart Journal* 2003; 24: 151-160.

¹⁵ Heng CK et al. Variations in the promoter region of the apolipoprotein A-1 gene influence plasma lipoprotein(a) levels in Asian Indian neonates from Singapore. *Pediatric Research* 2001; 49: 514-518.

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

Chinese						
Year of onset	Number	%	CIR	95% CI	ASIR	95% CI
2008	4820	66.5	212.7	206.7-218.7	171.7	166.8-176.6
2009	4453	65.5	191.8	186.2-197.4	151.5	147.0-156.0
2010	4906	66.8	208.3	202.4-214.1	158.2	153.7-162.7
2011	5296	66.1	222.4	216.4-228.4	163.4	158.9-167.9
2012	5981	65.6	248.0	241.8-254.3	176.9	172.3-181.5
2013	6308	66.2	258.6	252.2-265.0	177.5	173.0-181.9
2014	6520	66.3	264.6	258.2-271.0	175.0	170.7-179.3
2015	6801	67.1	272.8	266.3-279.3	175.0	170.8-179.3
2016	7117	65.8	282.4	275.8-288.9	175.6	171.4-179.8
2017	7985	67.2	313.7	306.8-320.5	187.4	183.2-191.7
P for trend	-	-	<0.001	-	0.014	-
Malay						
Year of onset	Number	%	CIR	95% CI	ASIR	95% CI
2008	1352	18.7	359.6	340.4-378.7	396.1	374.4-417.9
2009	1316	19.4	342.6	324.1-361.1	364.6	344.2-384.9
2010	1414	19.3	361.4	342.5-380.2	373.6	353.4-393.8
2011	1569	19.6	395.1	375.6-414.7	410.6	389.5-431.7
2012	1841	20.2	456.8	436.0-477.7	456.0	434.6-477.4
2013	1889	19.8	462.1	441.2-482.9	449.3	428.6-470.0
2014	1855	18.9	447.5	427.1-467.9	417.9	398.5-437.3
2015	1964	19.4	467.5	446.8-488.2	426.2	407.0-445.5
2016	2149	19.9	504.7	483.3-526.0	448.6	429.2-468.0
2017	2242	18.9	520.4	498.8-541.9	453.4	434.3-472.4
P for trend	-	-	<0.001	-	0.011	-
Indian						
Year of onset	Number	%	CIR	95% CI	ASIR	95% CI
2008	975	13.5	388.6	364.2-413.0	422.5	395.1-449.9
2009	935	13.8	348.8	326.4-371.1	386.0	360.4-411.5
2010	934	12.7	342.0	320.1-363.9	372.1	347.5-396.7
2011	1062	13.3	385.1	361.9-408.2	414.0	388.2-439.7
2012	1163	12.7	417.0	393.0-441.0	432.3	406.8-457.7
2013	1182	12.4	420.3	396.4-444.3	420.1	395.6-444.5
2014	1259	12.8	443.6	419.1-468.1	425.8	401.9-449.7
2015	1232	12.2	430.7	406.6-454.7	397.6	375.1-420.2
2016	1399	12.9	485.0	459.6-510.4	436.4	413.2-459.6
2017	1489	12.5	511.2	485.2-537.1	447.0	424.1-469.9
P for trend	-	-	<0.001	-	0.093	-

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

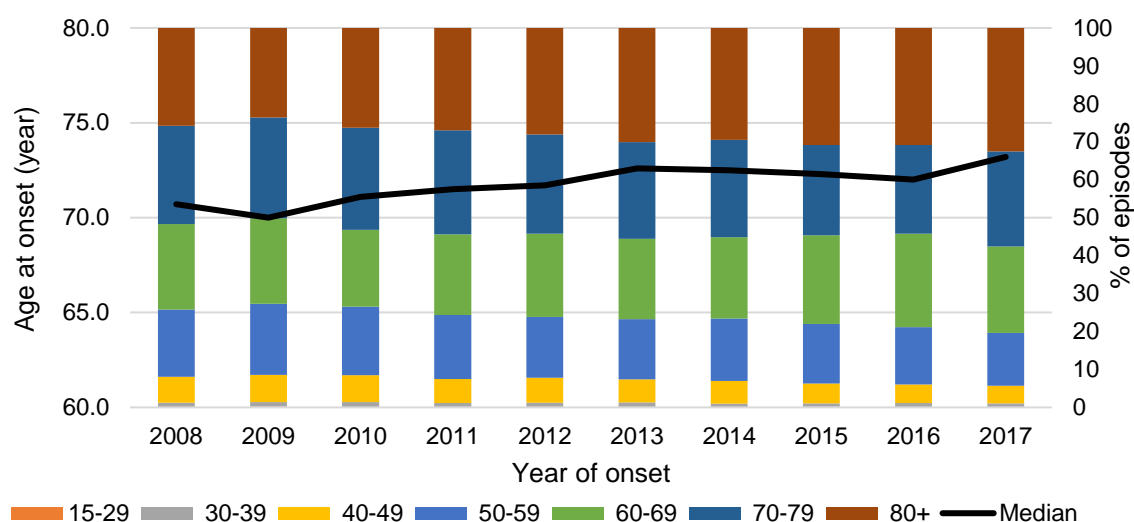


The median age at onset of AMI ranged from 70 to 74 years among the Chinese and it generally increased over the past decade (Table 5.1.7a and Figure 5.1.7a). The highest proportion of AMI cases was found among the oldest age group (32.6%) in 2017.

Table 5.1.7a: Median age (year) and age distribution (%) at onset among Chinese

Year of onset	Median age	Age 15-29		Age 30-39		Age 40-49		
		Number	%	Number	%	Number	%	
2008	70.7	4	0.1	54	1.1	332	6.9	
2009	70.0	8	0.2	53	1.2	320	7.2	
2010	71.1	3	0.1	67	1.4	346	7.1	
2011	71.5	5	0.1	55	1.0	337	6.4	
2012	71.7	10	0.2	66	1.1	392	6.6	
2013	72.6	8	0.1	75	1.2	381	6.0	
2014	72.5	6	0.1	59	0.9	389	6.0	
2015	72.3	9	0.1	66	1.0	353	5.2	
2016	72.0	4	0.1	80	1.1	344	4.8	
2017	73.2	7	0.1	80	1.0	371	4.6	
Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2008	854	17.7	1086	22.5	1245	25.8	1245	25.8
2009	833	18.7	1005	22.6	1184	26.6	1050	23.6
2010	887	18.1	994	20.3	1319	26.9	1290	26.3
2011	894	16.9	1123	21.2	1454	27.5	1428	27.0
2012	960	16.1	1308	21.9	1568	26.2	1677	28.0
2013	1002	15.9	1334	21.1	1610	25.5	1898	30.1
2014	1072	16.4	1398	21.4	1674	25.7	1922	29.5
2015	1066	15.7	1590	23.4	1619	23.8	2098	30.8
2016	1078	15.1	1750	24.6	1662	23.4	2199	30.9
2017	1106	13.9	1825	22.9	1995	25.0	2601	32.6

Figure 5.1.7a: Median age (year) and age distribution (%) at onset among Chinese

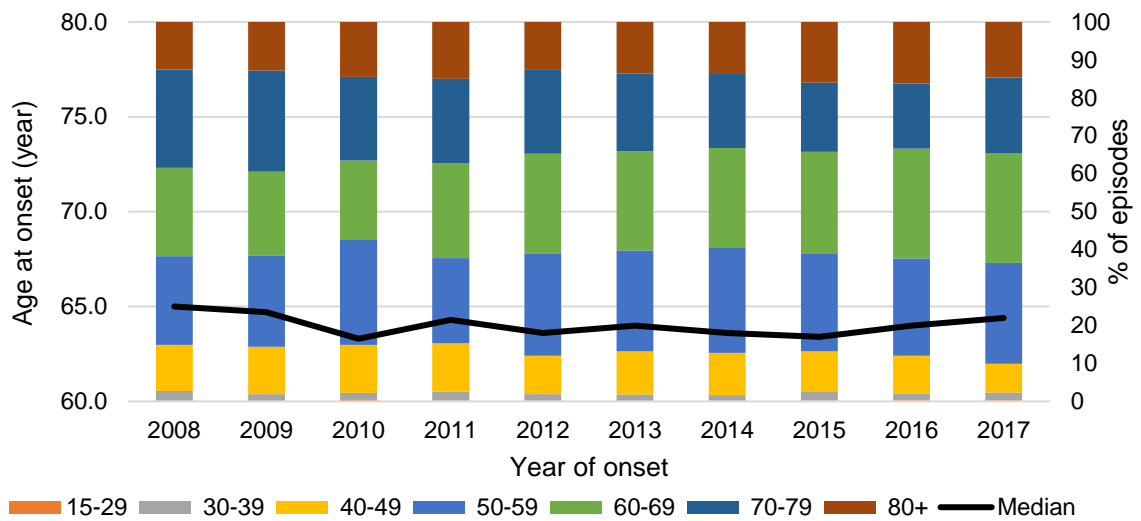


The median age at onset of AMI ranged from 63 to 65 years among the Malays, a few years younger than the median age at onset among the Chinese (Table 5.1.7b and Figure 5.1.7b). The highest proportion of AMI cases was found among the 60-69 years age group (28.9%) in 2017.

Table 5.1.7b: Median age (year) and age distribution (%) at onset among Malays

Year of onset	Median age	Age 15-29		Age 30-39		Age 40-49		
		Number	%	Number	%	Number	%	
2008	65.0	2	0.1	35	2.6	165	12.2	
2009	64.7	1	0.1	24	1.8	164	12.5	
2010	63.3	6	0.4	26	1.8	179	12.7	
2011	64.3	4	0.3	37	2.4	200	12.7	
2012	63.6	3	0.2	32	1.7	187	10.2	
2013	64.0	3	0.2	32	1.7	214	11.3	
2014	63.6	3	0.2	28	1.5	206	11.1	
2015	63.4	4	0.2	48	2.4	208	10.6	
2016	64.0	7	0.3	37	1.7	215	10.0	
2017	64.4	7	0.3	46	2.1	169	7.5	
Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2008	315	23.3	315	23.3	350	25.9	170	12.6
2009	316	24.0	292	22.2	351	26.7	168	12.8
2010	393	27.8	294	20.8	311	22.0	205	14.5
2011	351	22.4	393	25.0	349	22.2	235	15.0
2012	494	26.8	486	26.4	407	22.1	232	12.6
2013	503	26.6	493	26.1	387	20.5	257	13.6
2014	516	27.8	486	26.2	362	19.5	254	13.7
2015	507	25.8	524	26.7	359	18.3	314	16.0
2016	550	25.6	622	28.9	369	17.2	349	16.2
2017	597	26.6	648	28.9	447	19.9	328	14.6

Figure 5.1.7b: Median age (year) and age distribution (%) at onset among Malays

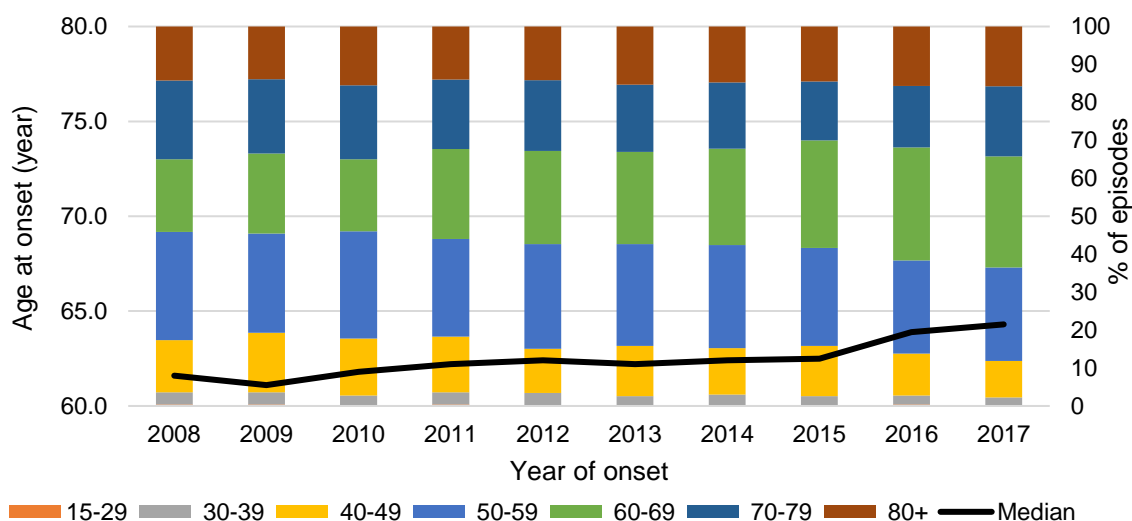


The median age at onset of AMI ranged from 61 to 65 years among the Indians. The median age at onset among the Indians was the youngest across the three ethnic groups and it increased gradually over the past decade (Table 5.1.7c and Figure 5.1.7c). The highest proportion of AMI cases was found among the 60-69 years age group (29.2%) in 2017.

Table 5.1.7c: Median age (year) and age distribution (%) at onset among Indians

Year of onset	Median age	Age 15-29		Age 30-39		Age 40-49		
		Number	%	Number	%	Number	%	
2008	61.6	4	0.4	31	3.2	134	13.7	
2009	61.1	4	0.4	30	3.2	146	15.6	
2010	61.8	2	0.2	24	2.6	140	15.0	
2011	62.2	4	0.4	34	3.2	156	14.7	
2012	62.4	2	0.2	38	3.3	135	11.6	
2013	62.2	2	0.2	29	2.5	156	13.2	
2014	62.4	2	0.2	36	2.9	154	12.2	
2015	62.5	0	0.0	32	2.6	163	13.2	
2016	63.9	5	0.4	33	2.4	155	11.1	
2017	64.3	2	0.1	32	2.1	143	9.6	
Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2008	278	28.5	187	19.2	202	20.7	139	14.3
2009	245	26.2	197	21.1	183	19.6	130	13.9
2010	264	28.3	177	19.0	182	19.5	145	15.5
2011	273	25.7	252	23.7	195	18.4	148	13.9
2012	321	27.6	286	24.6	216	18.6	165	14.2
2013	317	26.8	287	24.3	210	17.8	181	15.3
2014	342	27.2	320	25.4	219	17.4	186	14.8
2015	318	25.8	349	28.3	192	15.6	178	14.4
2016	344	24.6	416	29.7	227	16.2	219	15.7
2017	367	24.6	435	29.2	276	18.5	234	15.7

Figure 5.1.7c: Median age (year) and age distribution (%) at onset among Indians

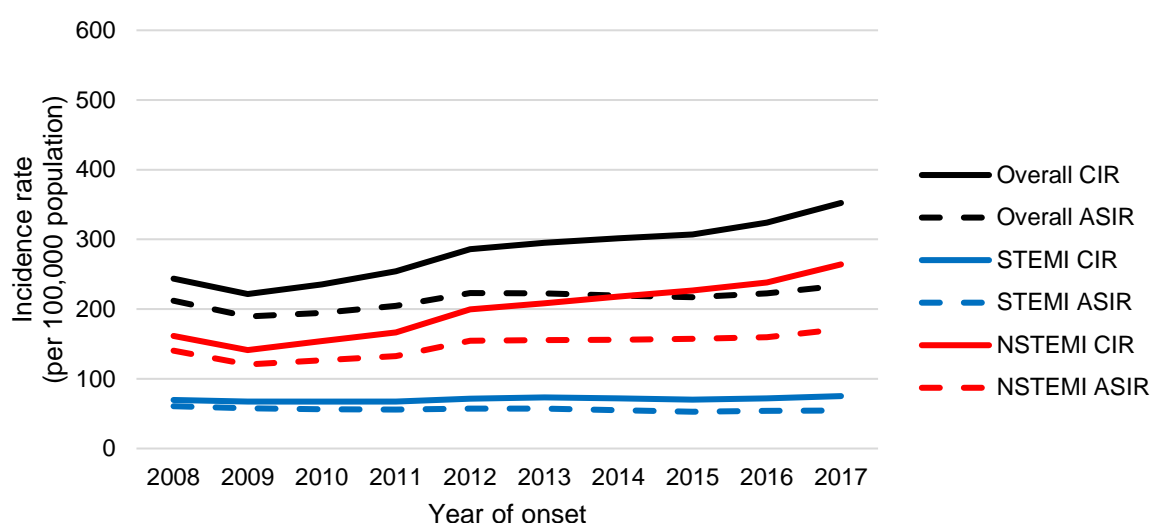


NSTEMI episodes were more common than STEMI episodes (Table 5.1.8). The ASIR for STEMI decreased significantly from 60.7 per 100,000 population in 2008 to 54.3 per 100,000 population in 2017 ($p=0.002$), while the ASIR for NSTEMI increased significantly from 140.5 per 100,000 population in 2008 to 171.4 per 100,000 population in 2017 ($p=0.002$) (Figure 5.1.8). The ASIR for NSTEMI was consistently higher than that of STEMI across the years. The possibility of a higher index of suspicion of AMI in critically ill patients, might lead to more testing and diagnosis of NSTEMI, leading to the higher incidence of NSTEMI.

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

STEMI						
Year of onset	Number	%	CIR	95% CI	ASIR	95% CI
2008	2068	28.5	69.6	66.6-72.6	60.7	58.0-63.4
2009	2069	30.4	67.5	64.6-70.4	57.9	55.4-60.4
2010	2099	28.6	67.3	64.5-70.2	56.5	54.0-59.0
2011	2127	26.5	67.5	64.6-70.3	55.9	53.5-58.3
2012	2275	24.9	71.3	68.4-74.2	57.3	54.9-59.7
2013	2362	24.8	73.1	70.2-76.1	57.2	54.9-59.6
2014	2344	23.8	71.8	68.9-74.7	55.1	52.8-57.4
2015	2308	22.8	69.9	67.1-72.8	52.8	50.6-55.0
2016	2406	22.3	72.1	69.2-75.0	53.9	51.7-56.1
2017	2535	21.3	75.2	72.3-78.1	54.3	52.2-56.5
P for trend	-	-	0.010	-	0.002	-
NSTEMI						
Year of onset	Number	%	CIR	95% CI	ASIR	95% CI
2008	4800	66.2	161.5	157.0-166.1	140.5	136.4-144.5
2009	4330	63.7	141.2	137.0-145.4	120.6	117.0-124.3
2010	4799	65.3	153.9	149.6-158.3	126.4	122.8-130.1
2011	5251	65.5	166.6	162.1-171.1	132.7	129.0-136.4
2012	6378	69.9	199.8	194.9-204.7	154.6	150.7-158.4
2013	6730	70.6	208.4	203.4-213.4	155.6	151.8-159.3
2014	7108	72.3	217.9	212.8-222.9	155.9	152.3-159.6
2015	7481	73.8	226.7	221.5-231.8	157.3	153.6-160.9
2016	7952	73.5	238.3	233.0-243.5	159.8	156.2-163.4
2017	8905	75.0	264.1	258.7-269.6	171.4	167.8-175.0
P for trend	-	-	<0.001	-	0.002	-

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

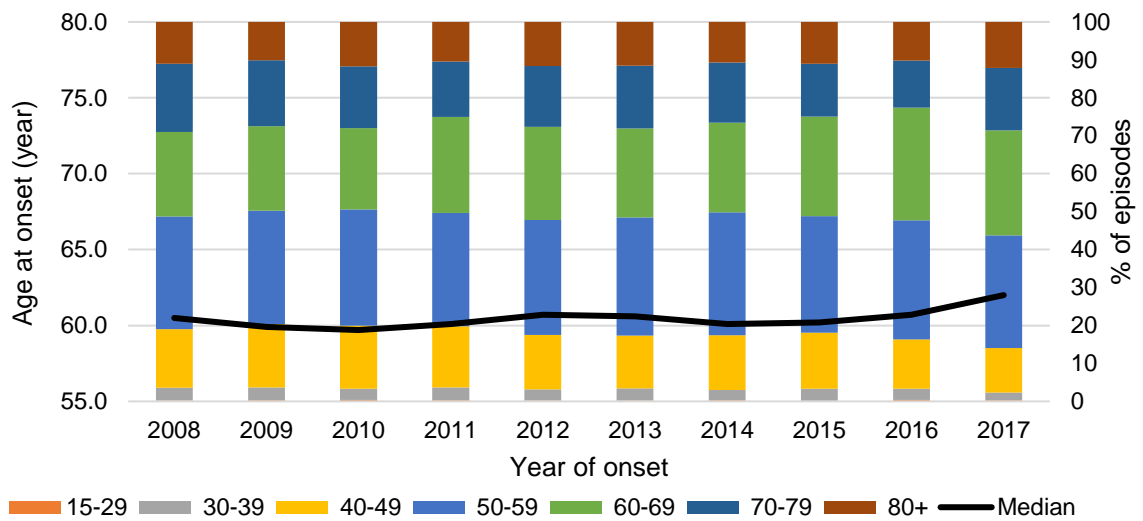


The median age at onset of STEMI ranged from 59 to 62 years among STEMI patients (Table 5.1.9a and Figure 5.1.9a). The highest proportion of AMI cases was found among the 50-59 years age group (29.7%) in 2017.

Table 5.1.9a: Median age (year) and age distribution (%) at onset among STEMI

Year of onset	Median age	Age 15-29		Age 30-39		Age 40-49		
		Number	%	Number	%	Number	%	
2008	60.5	4	0.2	70	3.4	320	15.5	
2009	59.9	7	0.3	69	3.3	346	16.7	
2010	59.7	9	0.4	62	3.0	348	16.6	
2011	60.1	7	0.3	72	3.4	342	16.1	
2012	60.7	5	0.2	67	2.9	326	14.3	
2013	60.6	5	0.2	76	3.2	329	13.9	
2014	60.1	8	0.3	62	2.6	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	2.1	298	11.8	
Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2008	613	29.6	461	22.3	372	18.0	228	11.0
2009	617	29.8	461	22.3	360	17.4	209	10.1
2010	643	30.6	449	21.4	342	16.3	246	11.7
2011	635	29.9	538	25.3	311	14.6	222	10.4
2012	689	30.3	559	24.6	365	16.0	264	11.6
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	753	29.7	700	27.6	417	16.4	308	12.1

Figure 5.1.9a: Median age (year) and age distribution (%) at onset among STEMI

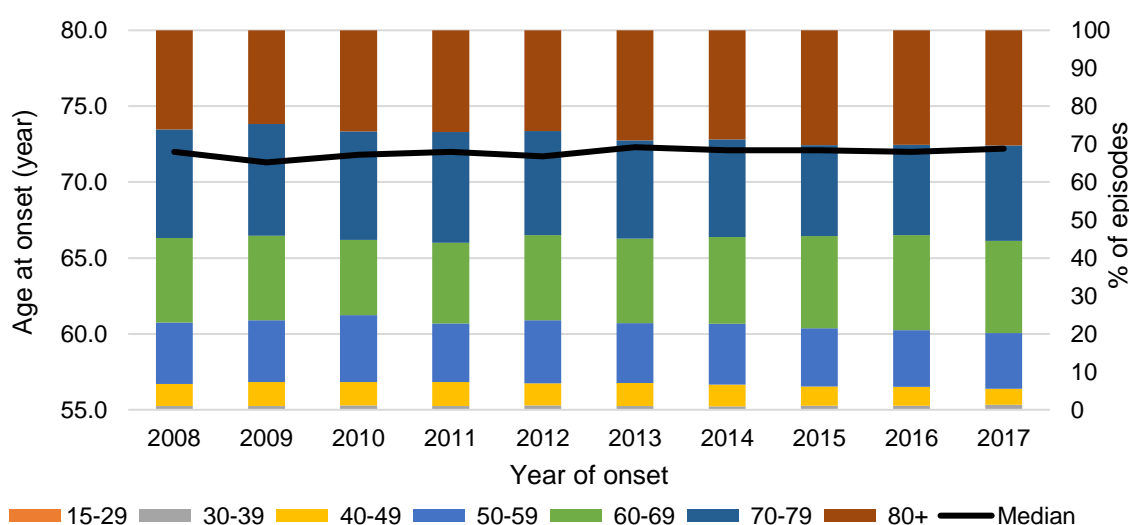


The median age at onset of NSTEMI ranged from 71 to 73 years among NSTEMI patients, 10 years older than the median age at onset among STEMI patients (Table 5.1.9b and Figure 5.1.9b). The highest proportion of AMI cases was found among the oldest age group (30.4%) in 2017.

Table 5.1.9b: Median age (year) and age distribution (%) at onset among NSTEMI

Year of onset	Median age	Age 15-29		Age 30-39		Age 40-49		
		Number	%	Number	%	Number	%	
2008	72.0	4	0.1	42	0.9	280	5.8	
2009	71.3	5	0.1	39	0.9	273	6.3	
2010	71.8	1	0.0	53	1.1	295	6.1	
2011	72.0	5	0.1	46	0.9	331	6.3	
2012	71.7	9	0.1	62	1.0	373	5.8	
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	10	0.1	104	1.2	381	4.3	
Year of onset	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2008	779	16.2	1070	22.3	1372	28.6	1253	26.1
2009	704	16.3	966	22.3	1275	29.4	1068	24.7
2010	847	17.6	953	19.9	1371	28.6	1279	26.7
2011	812	15.5	1115	21.2	1536	29.3	1406	26.8
2012	1059	16.6	1431	22.4	1749	27.4	1695	26.6
2013	1061	15.8	1502	22.3	1738	25.8	1954	29.0
2014	1141	16.1	1620	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	1890	23.8	2401	30.2
2017	1308	14.7	2162	24.3	2235	25.1	2705	30.4

Figure 5.1.9b: Median age (year) and age distribution (%) at onset among NSTEMI



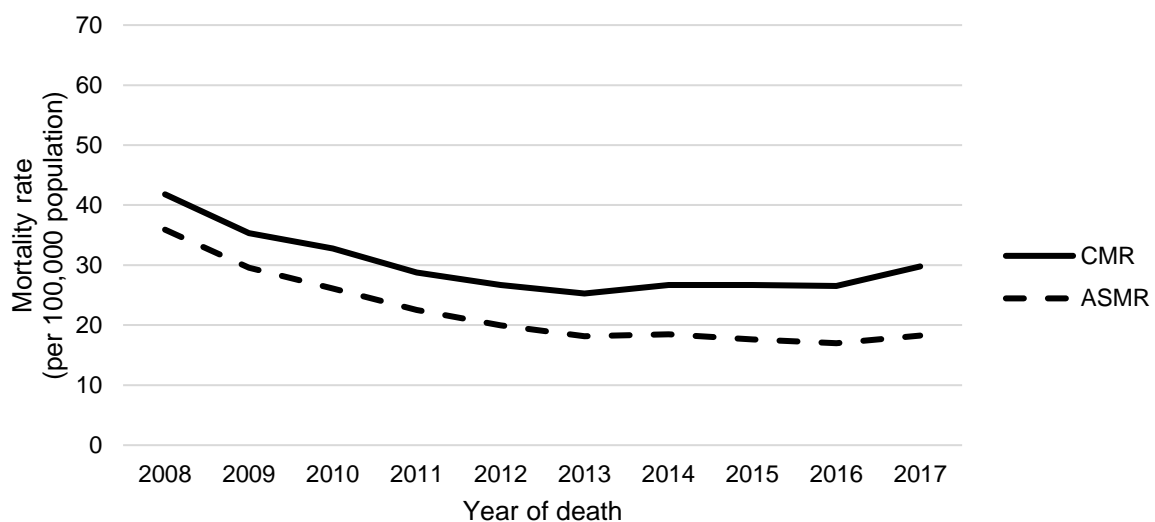
5.2 Mortality of AMI

The number of AMI deaths was 1,004 in 2017, a drop compared to 1,242 in 2008 (Table 5.2.1). Correspondingly, the crude mortality rate (CMR) declined significantly from 41.8 per 100,000 population in 2008 to 29.8 per 100,000 population in 2017 ($p=0.016$) (Figure 5.2.1). However, a slight rise in number of AMI deaths and CMR were observed since 2013. The rise in crude death numbers and rates are likely due to the rise in AMI incidence in recent years (Table 5.1.1). The ASMR declined significantly from 35.9 per 100,000 population in 2008 to 18.3 per 100,000 population in 2017 ($p<0.001$). This decreasing trend in ASMR is possibly due to improvement in AMI treatment.

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

Year of death	Number	CMR	95% CI	ASMR	95% CI
2008	1242	41.8	39.5-44.1	35.9	33.9-37.9
2009	1084	35.4	33.2-37.5	29.6	27.8-31.4
2010	1021	32.8	30.7-34.8	26.1	24.5-27.8
2011	907	28.8	26.9-30.6	22.5	21.0-24.0
2012	852	26.7	24.9-28.5	20.0	18.6-21.3
2013	816	25.3	23.5-27.0	18.2	16.9-19.4
2014	870	26.7	24.9-28.4	18.5	17.2-19.7
2015	880	26.7	24.9-28.4	17.6	16.4-18.8
2016	885	26.5	24.8-28.3	17.0	15.8-18.1
2017	1004	29.8	27.9-31.6	18.3	17.1-19.4
P for trend	-	0.016	-	<0.001	-

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



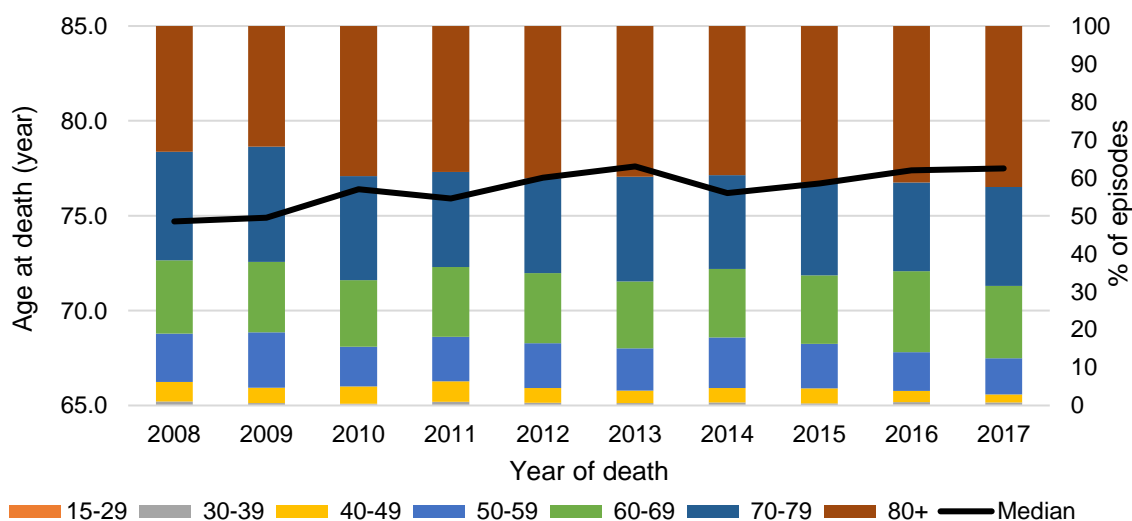
The median age at death ranged from 74 to 78 years (Table 5.2.2 and Figure 5.2.2). Notably, the proportion of AMI deaths in the oldest age group increased from 33.2% in 2008 to 42.4% in 2017.

Table 5.2.2: Median age (year) and age distribution (%) at death

Year of death	Median age	Age 15-29		Age 30-39		Age 40-49	
		Number	%	Number	%	Number	%
2008	74.7	1	0.1	12	1.0	64	5.2
2009	74.9	1	0.1	6	0.6	44	4.1
2010	76.4	2	0.2	3	0.3	46	4.5
2011	75.9	0	0.0	9	1.0	49	5.4
2012	77.0	1	0.1	5	0.6	33	3.9
2013	77.6	0	0.0	5	0.6	27	3.3
2014	76.2	1	0.1	6	0.7	33	3.8
2015	76.7	0	0.0	5	0.6	35	4.0
2016	77.4	2	0.2	6	0.7	26	2.9
2017	77.5	1	0.1	7	0.7	21	2.1

Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2008	158	12.7	240	19.3	355	28.6	412	33.2
2009	158	14.6	201	18.5	329	30.4	345	31.8
2010	107	10.5	179	17.5	280	27.4	404	39.6
2011	106	11.7	167	18.4	227	25.0	349	38.5
2012	101	11.9	157	18.4	213	25.0	342	40.1
2013	91	11.2	144	17.6	225	27.6	324	39.7
2014	116	13.3	157	18.0	215	24.7	342	39.3
2015	103	11.7	159	18.1	216	24.5	362	41.1
2016	90	10.2	189	21.4	207	23.4	365	41.2
2017	96	9.6	191	19.0	262	26.1	426	42.4

Figure 5.2.2: Median age (year) and age distribution (%) at death



The age-specific mortality rate increased with age (Table 5.2.3), with the oldest age group having the highest mortality rate (Figure 5.2.3a). Over the past decade, significant drop in mortality rates were observed for all the age groups aged 40 years or above (Figure 5.2.3b). The drop in mortality rate was fastest among the oldest age group.

Table 5.2.3: Age-specific mortality rate (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
2008	41.8	39.5-44.1	0.1	0.0-0.4	2.0	0.9-3.1	10.1	7.6-12.5
2009	35.4	33.2-37.5	0.1	0.0-0.4	1.0	0.2-1.8	6.9	4.9-9.0
2010	32.8	30.7-34.8	0.3	0.0-0.6	0.5	0.0-1.0	7.3	5.2-9.4
2011	28.8	26.9-30.6	0.0	-	1.5	0.5-2.4	7.8	5.6-9.9
2012	26.7	24.9-28.5	0.1	0.0-0.4	0.8	0.1-1.5	5.2	3.5-7.0
2013	25.3	23.5-27.0	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	26.7	24.9-28.4	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	1.0	0.2-1.8	4.2	2.6-5.9
2017	29.8	27.9-31.6	0.1	0.0-0.4	1.2	0.3-2.1	3.4	2.0-4.9
P for trend	0.016	-	0.766	-	0.645	-	0.001	-
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
2008	30.5	25.7-35.2	89.5	78.1-100.8	253.2	226.9-279.6	683.3	617.3-749.2
2009	29.4	24.8-34.0	70.3	60.6-80.0	220.8	196.9-244.7	531.6	475.5-587.7
2010	19.4	15.7-23.1	59.0	50.4-67.7	177.6	156.8-198.3	583.8	526.9-640.7
2011	18.6	15.1-22.2	52.1	44.2-60.0	136.0	118.3-153.7	476.8	426.8-526.8
2012	17.3	14.0-20.7	45.8	38.6-53.0	123.8	107.2-140.5	440.7	394.0-487.4
2013	15.3	12.2-18.5	39.1	32.7-45.5	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	16.9	13.6-20.1	37.6	31.8-43.4	117.5	101.8-133.2	387.4	347.5-427.3
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	40.9	35.1-46.7	123.9	108.9-138.9	420.6	380.7-460.6
P for trend	0.003	-	0.001	-	0.001	-	0.001	-

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

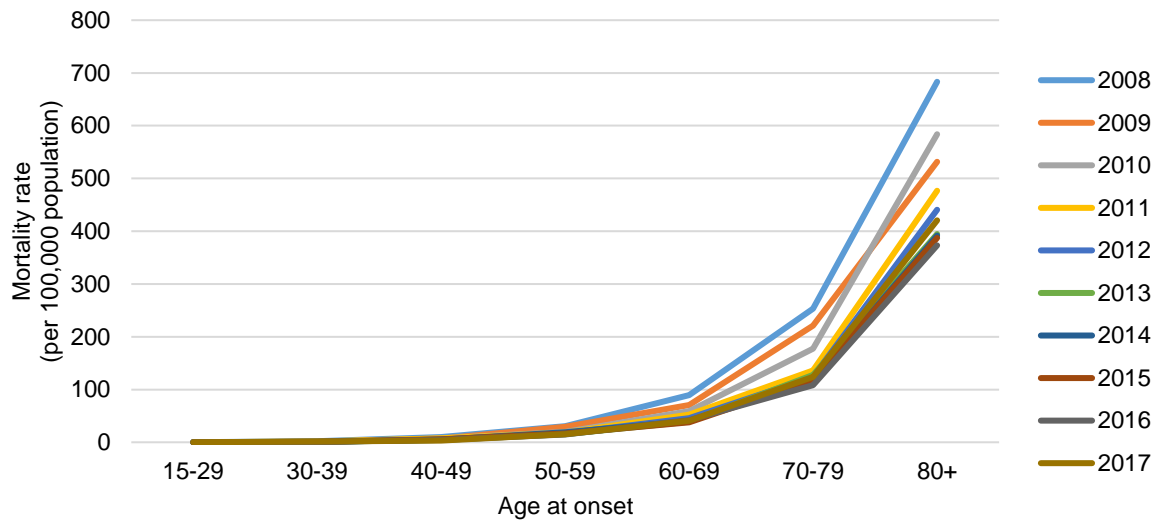
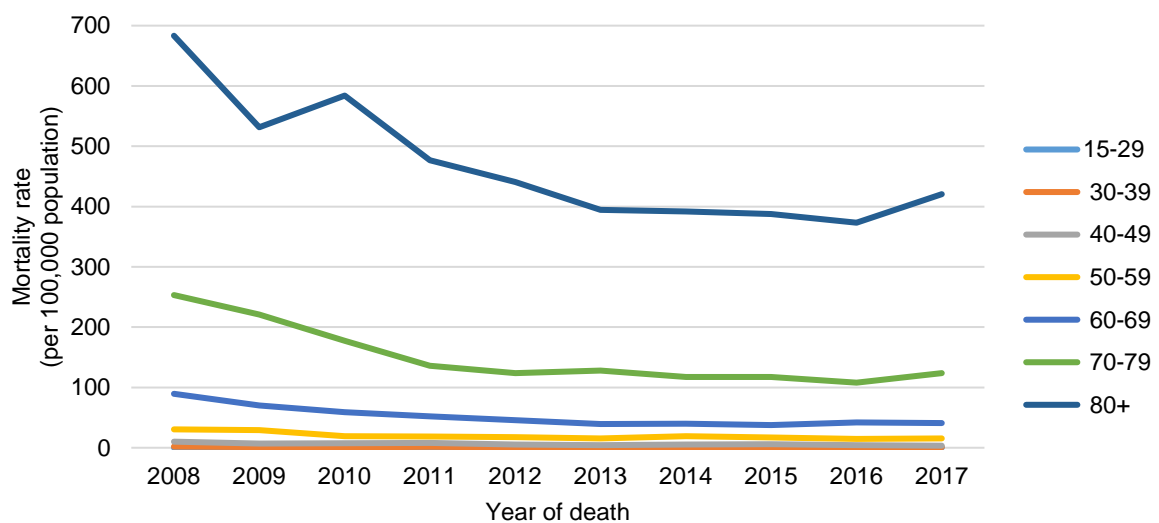


Figure 5.2.3b: Age-specific mortality rate (per 100,000 population) across years

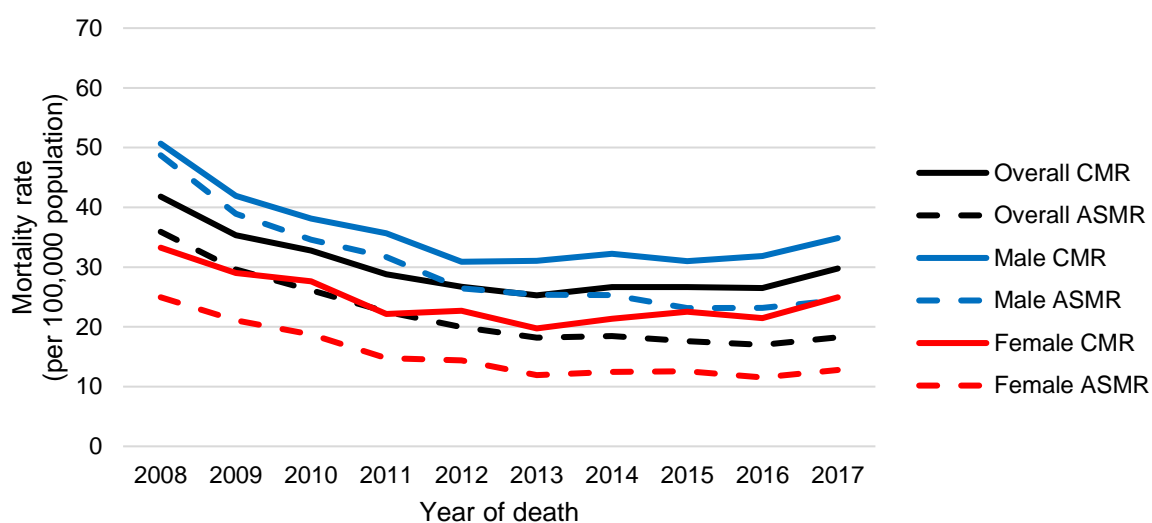


The ASMR declined significantly over the past decade for both genders ($p < 0.001$ for men and $p = 0.001$ for women) (Table 5.2.4 and Figure 5.2.4). As the ASIR was consistently higher among men than women across the years (Table 5.1.4), it is expected that the ASMR was also consistently higher among men than women. Men had an ASMR of 24.5 per 100,000 population, while women had an ASMR of 12.8 per 100,000 population in 2017.

Table 5.2.4: Mortality number and rate (per 100,000 population) by gender

Male						
Year of death	Number	%	CMR	95% CI	ASMR	95% CI
2008	739	59.5	50.7	47.0-54.3	48.7	45.1-52.3
2009	630	58.1	41.9	38.7-45.2	38.9	35.8-42.0
2010	582	57.0	38.1	35.0-41.2	34.6	31.7-37.4
2011	550	60.6	35.7	32.7-38.6	31.7	29.0-34.4
2012	482	56.6	30.9	28.1-33.7	26.4	24.0-28.8
2013	490	60.0	31.1	28.3-33.8	25.4	23.1-27.7
2014	513	59.0	32.2	29.4-35.0	25.3	23.1-27.5
2015	499	56.7	31.0	28.3-33.7	23.1	21.1-25.2
2016	518	58.5	31.9	29.1-34.6	23.2	21.1-25.2
2017	572	57.0	34.9	32.0-37.7	24.5	22.4-26.5
P for trend	-	-	0.013	-	<0.001	-
Female						
Year of death	Number	%	CMR	95% CI	ASMR	95% CI
2008	503	40.5	33.2	30.3-36.2	24.9	22.7-27.2
2009	454	41.9	29.0	26.4-31.7	21.1	19.1-23.1
2010	439	43.0	27.6	25.0-30.2	18.7	16.9-20.5
2011	357	39.4	22.2	19.9-24.5	14.8	13.2-16.4
2012	370	43.4	22.7	20.4-25.0	14.4	12.8-15.9
2013	326	40.0	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	381	43.3	22.5	20.3-24.8	12.6	11.2-13.9
2016	367	41.5	21.4	19.2-23.6	11.5	10.3-12.8
2017	432	43.0	25.0	22.6-27.3	12.8	11.5-14.1
P for trend	-	-	0.035	-	0.001	-

Figure 5.2.4: Mortality rate (per 100,000 population) by gender



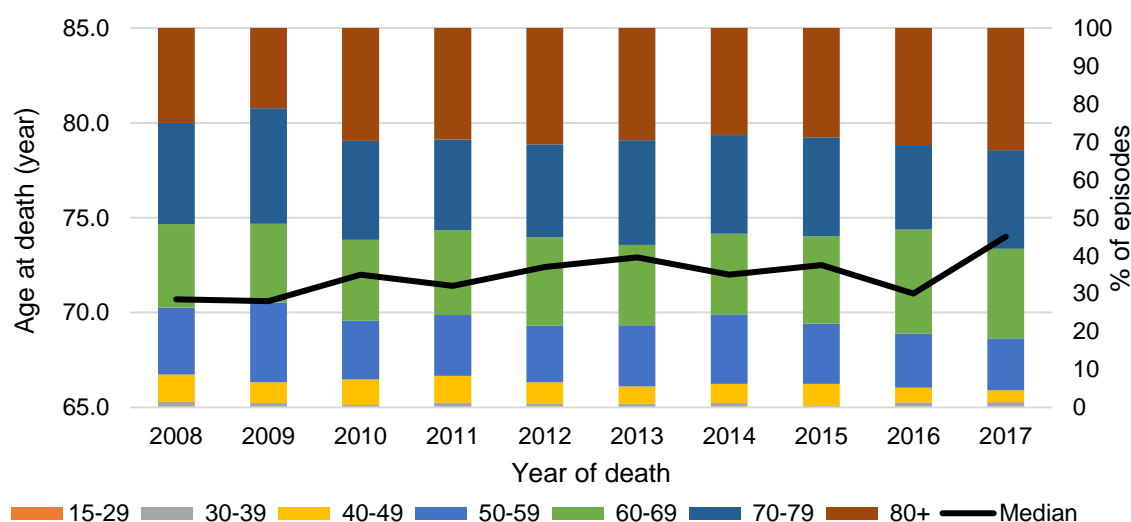
The median age at death ranged from 70 to 74 years among men (Table 5.2.5a and Figure 5.2.5a). The highest proportion of AMI deaths was observed among the oldest age group (32.2%) in 2017.

Table 5.2.5a: Median age (year) and age distribution (%) at death among men

Year of death	Median age	Age 15-29		Age 30-39		Age 40-49	
		Number	%	Number	%	Number	%
2008	70.7	1	0.1	10	1.4	53	7.2
2009	70.6	1	0.2	6	1.0	35	5.6
2010	72.0	1	0.2	3	0.5	39	6.7
2011	71.4	0	0.0	7	1.3	39	7.1
2012	72.4	1	0.2	4	0.8	27	5.6
2013	72.9	0	0.0	5	1.0	22	4.5
2014	72.0	1	0.2	5	1.0	26	5.1
2015	72.5	0	0.0	2	0.4	29	5.8
2016	71.0	1	0.2	6	1.2	20	3.9
2017	74.0	1	0.2	7	1.2	18	3.1

Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2008	130	17.6	163	22.1	197	26.7	185	25.0
2009	132	21.0	131	20.8	192	30.5	133	21.1
2010	90	15.5	124	21.3	152	26.1	173	29.7
2011	88	16.0	123	22.4	131	23.8	162	29.5
2012	72	14.9	112	23.2	118	24.5	148	30.7
2013	79	16.1	104	21.2	135	27.6	145	29.6
2014	94	18.3	109	21.2	133	25.9	145	28.3
2015	79	15.8	115	23.0	130	26.1	144	28.9
2016	74	14.3	142	27.4	115	22.2	160	30.9
2017	78	13.6	135	23.6	149	26.0	184	32.2

Figure 5.2.5a: Median age (year) and age distribution (%) at death among men

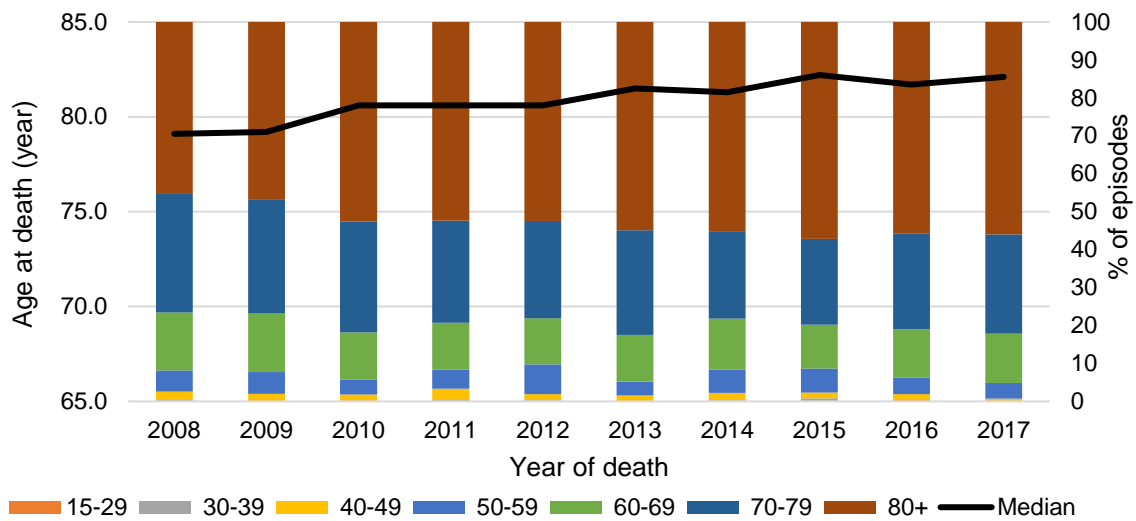


The median age at death ranged from 79 to 83 years among women, a few years older than the median age at death among men (Table 5.2.5b and Figure 5.2.5b). The highest proportion of AMI deaths was observed among the oldest age group (56.0%) in 2017.

Table 5.2.5b: Median age (year) and age distribution (%) at death among women

Year of death	Median age	Age 15-29		Age 30-39		Age 40-49		
		Number	%	Number	%	Number	%	
2008	79.1	0	0.0	2	0.4	11	2.2	
2009	79.2	0	0.0	0	0.0	9	2.0	
2010	80.6	1	0.2	0	0.0	7	1.6	
2011	80.6	0	0.0	2	0.6	10	2.8	
2012	80.6	0	0.0	1	0.3	6	1.6	
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	81.7	1	0.3	0	0.0	6	1.6	
2017	82.1	0	0.0	0	0.0	3	0.7	
Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2008	28	5.6	77	15.3	158	31.4	227	45.1
2009	26	5.7	70	15.4	137	30.2	212	46.7
2010	17	3.9	55	12.5	128	29.2	231	52.6
2011	18	5.0	44	12.3	96	26.9	187	52.4
2012	29	7.8	45	12.2	95	25.7	194	52.4
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	22.6	218	57.2
2016	16	4.4	47	12.8	92	25.1	205	55.9
2017	18	4.2	56	13.0	113	26.2	242	56.0

Figure 5.2.5b: Median age (year) and age distribution (%) at death among women

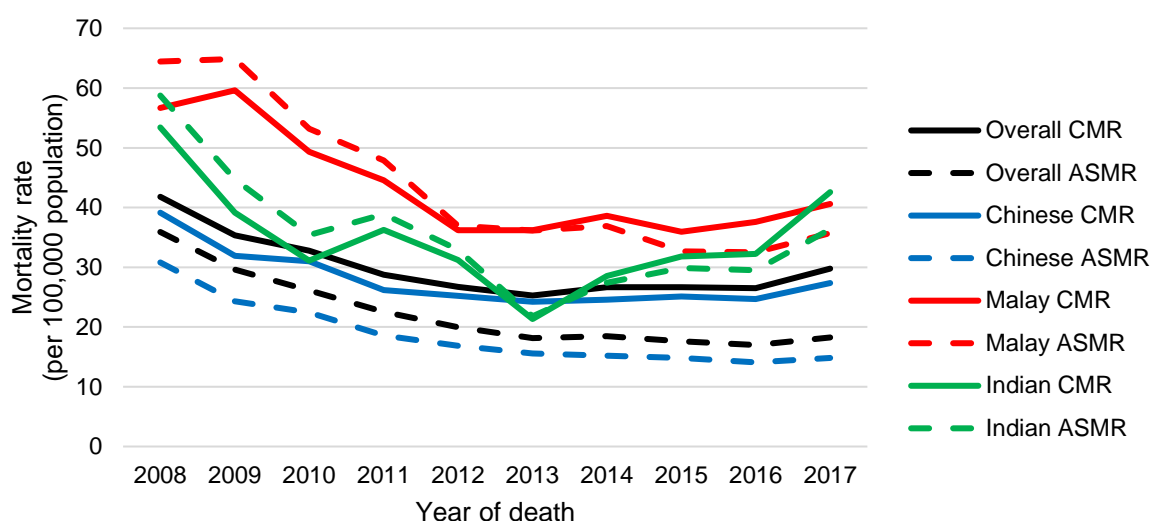


The ASMR showed a significant downward trend over the past decade for all the three ethnic groups ($p < 0.001$ for Chinese and Malays; $p = 0.048$ for Indians) (Table 5.2.6 and Figure 5.2.6). As the Chinese consistently had the lowest ASIR across the years (Table 5.1.6), they also consistently had the lowest ASMR. The ASMR of 14.8 per 100,000 population among the Chinese was much lower than the Malays (35.7 per 100,000 population) and Indians (36.4 per 100,000 population) in 2017.

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

Chinese						
Year of death	Number	%	CMR	95% CI	ASMR	95% CI
2008	887	71.4	39.1	36.6-41.7	30.8	28.7-32.9
2009	741	68.4	31.9	29.6-34.2	24.3	22.5-26.1
2010	730	71.5	31.0	28.7-33.2	22.4	20.8-24.1
2011	623	68.7	26.2	24.1-28.2	18.6	17.1-20.1
2012	608	71.4	25.2	23.2-27.2	16.9	15.5-18.3
2013	591	72.4	24.2	22.3-26.2	15.6	14.3-16.8
2014	606	69.7	24.6	22.6-26.6	15.2	14.0-16.4
2015	626	71.1	25.1	23.1-27.1	14.8	13.6-16.0
2016	622	70.3	24.7	22.7-26.6	14.1	12.9-15.2
2017	696	69.3	27.3	25.3-29.4	14.8	13.7-16.0
P for trend	-	-	0.014	-	<0.001	-
Malay						
Year of death	Number	%	CMR	95% CI	ASMR	95% CI
2008	213	17.1	56.6	49.0-64.3	64.4	55.5-73.4
2009	229	21.1	59.6	51.9-67.3	64.9	56.1-73.6
2010	193	18.9	49.3	42.4-56.3	53.2	45.4-61.0
2011	177	19.5	44.6	38.0-51.1	47.9	40.5-55.2
2012	146	17.1	36.2	30.4-42.1	37.0	30.8-43.2
2013	148	18.1	36.2	30.4-42.0	36.1	30.1-42.1
2014	160	18.4	38.6	32.6-44.6	36.9	31.0-42.7
2015	151	17.2	35.9	30.2-41.7	32.7	27.3-38.0
2016	160	18.1	37.6	31.8-43.4	32.5	27.3-37.7
2017	175	17.4	40.6	34.6-46.6	35.7	30.3-41.1
P for trend	-	-	0.006	-	<0.001	-
Indian						
Year of death	Number	%	CMR	95% CI	ASMR	95% CI
2008	134	10.8	53.4	44.4-62.5	58.7	48.4-69.1
2009	105	9.7	39.2	31.7-46.7	44.7	35.8-53.6
2010	85	8.3	31.1	24.5-37.7	35.4	27.6-43.2
2011	100	11.0	36.3	29.2-43.4	38.9	30.9-46.8
2012	87	10.2	31.2	24.6-37.7	32.9	25.8-40.0
2013	60	7.4	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	124	12.4	42.6	35.1-50.1	36.4	29.9-42.9
P for trend	-	-	0.357	-	0.048	-

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

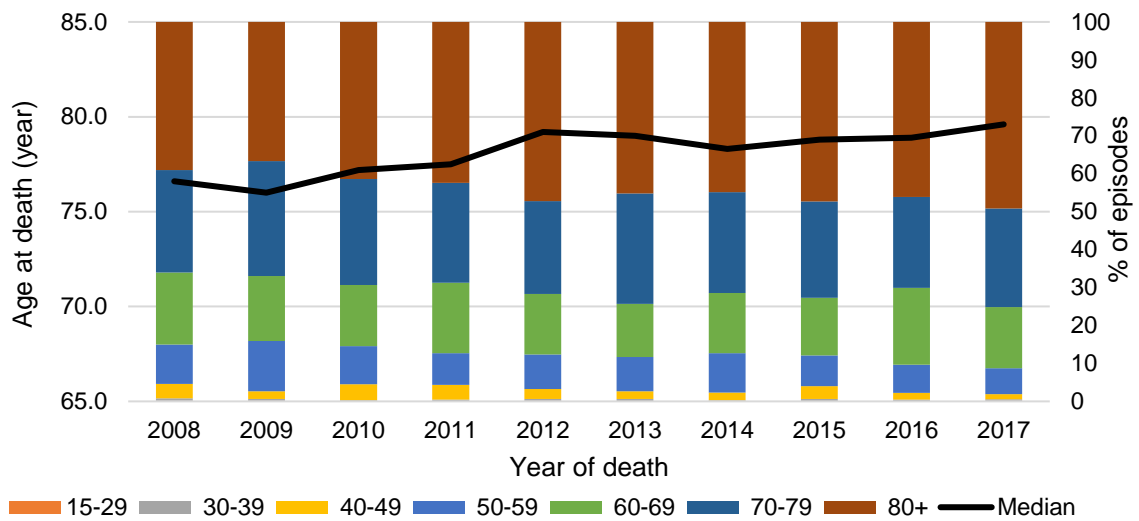


The median age at death ranged from 76 to 80 years among the Chinese (Table 5.2.7a and Figure 5.2.7a). The highest proportion of AMI deaths was observed among the oldest age group (49.1%) in 2017.

Table 5.2.7a: Median age (year) and age distribution (%) at death among Chinese

Year of death	Median age	Age 15-29		Age 30-39		Age 40-49		
		Number	%	Number	%	Number	%	
2008	76.6	1	0.1	6	0.7	34	3.8	
2009	76.0	1	0.1	4	0.5	15	2.0	
2010	77.2	0	0.0	2	0.3	31	4.2	
2011	77.5	0	0.0	3	0.5	24	3.9	
2012	79.2	1	0.2	3	0.5	16	2.6	
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	78.8	0	0.0	4	0.6	21	3.4	
2016	78.9	0	0.0	3	0.5	11	1.8	
2017	79.6	1	0.1	3	0.4	9	1.3	
Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2008	92	10.4	168	18.9	240	27.1	346	39.0
2009	98	13.2	127	17.1	224	30.2	272	36.7
2010	73	10.0	118	16.2	204	27.9	302	41.4
2011	52	8.3	116	18.6	164	26.3	264	42.4
2012	55	9.0	97	16.0	149	24.5	287	47.2
2013	53	9.0	83	14.0	172	29.1	267	45.2
2014	63	10.4	96	15.8	161	26.6	272	44.9
2015	51	8.1	95	15.2	159	25.4	296	47.3
2016	46	7.4	126	20.3	149	24.0	287	46.1
2017	48	6.9	112	16.1	181	26.0	342	49.1

Figure 5.2.7a: Median age (year) and age distribution (%) at death among Chinese

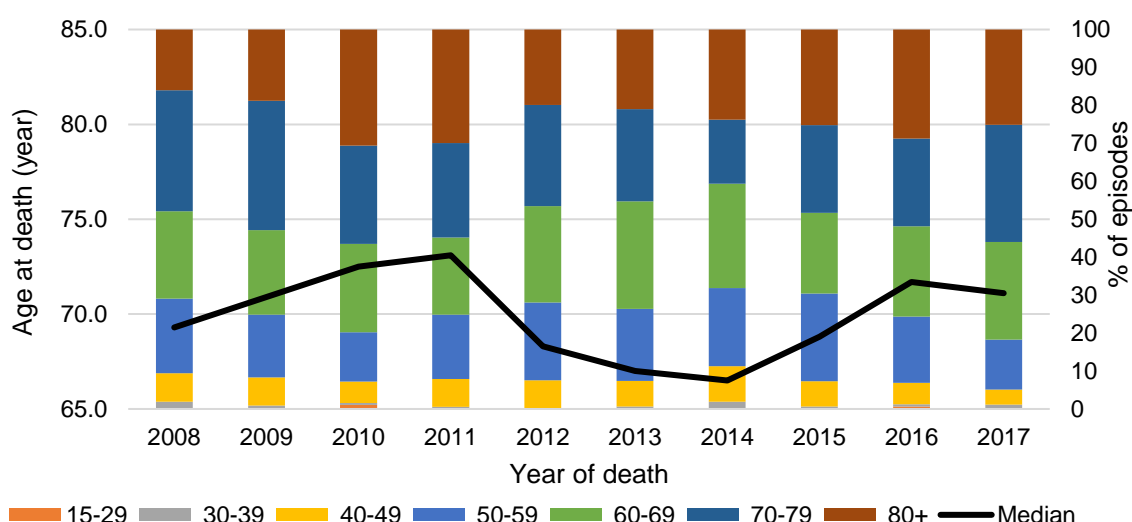


The median age at death ranged from 66 to 72 years among the Malays, a few years younger than the median age at death among the Chinese (Table 5.2.7b and Figure 5.2.7b). The highest proportion of AMI deaths was observed among the 70-79 age group (30.9%) in 2017.

Table 5.2.7b: Median age (year) and age distribution (%) at death among Malays

Year of death	Median age	Age 15-29		Age 30-39		Age 40-49		
		Number	%	Number	%	Number	%	
2008	69.3	0	0.0	4	1.9	16	7.5	
2009	70.9	0	0.0	2	0.9	17	7.4	
2010	72.5	2	1.0	1	0.5	11	5.7	
2011	73.1	0	0.0	1	0.6	13	7.3	
2012	68.3	0	0.0	0	0.0	11	7.5	
2013	67.0	0	0.0	1	0.7	10	6.8	
2014	66.5	0	0.0	3	1.9	15	9.4	
2015	68.8	0	0.0	1	0.7	10	6.6	
2016	71.7	1	0.6	1	0.6	9	5.6	
2017	71.1	0	0.0	2	1.1	7	4.0	
Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2008	42	19.7	49	23.0	68	31.9	34	16.0
2009	38	16.6	51	22.3	78	34.1	43	18.8
2010	25	13.0	45	23.3	50	25.9	59	30.6
2011	30	16.9	36	20.3	44	24.9	53	29.9
2012	30	20.5	37	25.3	39	26.7	29	19.9
2013	28	18.9	42	28.4	36	24.3	31	20.9
2014	33	20.6	44	27.5	27	16.9	38	23.8
2015	35	23.2	32	21.2	35	23.2	38	25.2
2016	28	17.5	38	23.8	37	23.1	46	28.8
2017	23	13.1	45	25.7	54	30.9	44	25.1

Figure 5.2.7b: Median age (year) and age distribution (%) at death among Malays

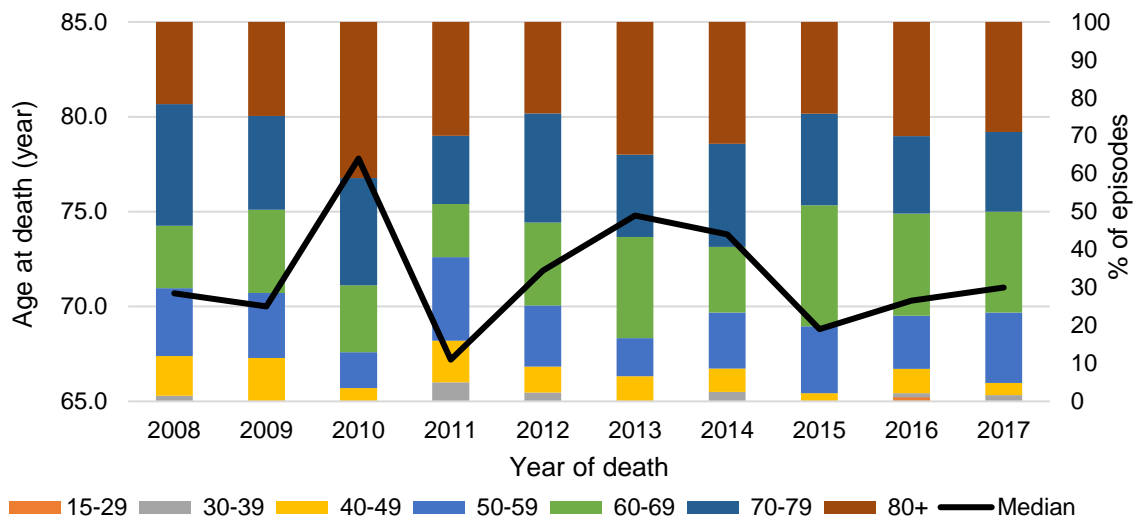


The median age at death ranged from 67 to 78 years among the Indians, close to the median age at death among the Malays but a few years younger than the Chinese (Table 5.2.7c and Figure 5.2.7c). The highest proportion of AMI deaths was observed among the oldest age group (29.0%) in 2017.

Table 5.2.7c: Median age (year) and age distribution (%) at death among Indians

Year of death	Median age	Age 15-29		Age 30-39		Age 40-49		
		Number	%	Number	%	Number	%	
2008	70.7	0	0.0	2	1.5	14	10.4	
2009	70.0	0	0.0	0	0.0	12	11.4	
2010	77.8	0	0.0	0	0.0	3	3.5	
2011	67.2	0	0.0	5	5.0	11	11.0	
2012	71.9	0	0.0	2	2.3	6	6.9	
2013	74.8	0	0.0	0	0.0	4	6.7	
2014	73.8	0	0.0	2	2.5	5	6.2	
2015	68.8	0	0.0	0	0.0	2	2.2	
2016	70.3	1	1.1	1	1.1	6	6.5	
2017	71.0	0	0.0	2	1.6	4	3.2	
Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2008	24	17.9	22	16.4	43	32.1	29	21.6
2009	18	17.1	23	21.9	26	24.8	26	24.8
2010	8	9.4	15	17.6	24	28.2	35	41.2
2011	22	22.0	14	14.0	18	18.0	30	30.0
2012	14	16.1	19	21.8	25	28.7	21	24.1
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	18.5	33	26.6	26	21.0	36	29.0

Figure 5.2.7c: Median age (year) and age distribution (%) at death among Indians

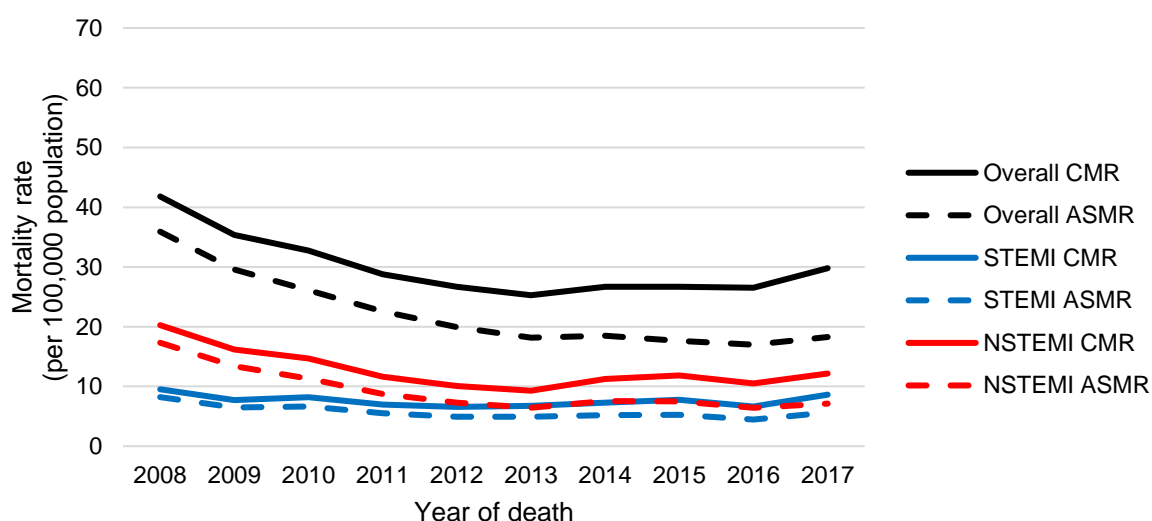


The ASMR among STEMI patients declined significantly from 8.2 per 100,000 population in 2008 to 5.6 per 100,000 population in 2017 ($p=0.013$) (Table 5.2.8 and Figure 5.2.8). Similarly, the ASMR among NSTEMI patients declined significantly from 17.3 per 100,000 population in 2008 to 7.1 per 100,000 population in 2017 ($p=0.002$). As the ASIR was consistently higher among the NSTEMI patients across the years (Table 5.1.8), the ASMR of NSTEMI patients was also consistently higher than their STEMI counterparts.

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

STEMI						
Year of death	Number	%	CMR	95% CI	ASMR	95% CI
2008	283	22.8	9.5	8.4-10.6	8.2	7.2-9.2
2009	236	21.8	7.7	6.7-8.7	6.5	5.6-7.3
2010	255	25.0	8.2	7.2-9.2	6.6	5.8-7.5
2011	219	24.1	6.9	6.0-7.9	5.5	4.8-6.3
2012	210	24.6	6.6	5.7-7.5	4.9	4.2-5.6
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	29.2	7.8	6.8-8.7	5.3	4.6-5.9
2016	221	25.0	6.6	5.7-7.5	4.5	3.9-5.1
2017	291	29.0	8.6	7.6-9.6	5.6	5.0-6.3
P for trend	-	-	0.393	-	0.013	-
NSTEMI						
Year of death	Number	%	CMR	95% CI	ASMR	95% CI
2008	602	48.5	20.3	18.6-21.9	17.3	15.9-18.7
2009	496	45.8	16.2	14.8-17.6	13.4	12.2-14.6
2010	457	44.8	14.7	13.3-16.0	11.3	10.3-12.4
2011	366	40.4	11.6	10.4-12.8	8.7	7.8-9.6
2012	322	37.8	10.1	9.0-11.2	7.3	6.5-8.1
2013	300	36.8	9.3	8.2-10.3	6.4	5.7-7.2
2014	367	42.2	11.2	10.1-12.4	7.5	6.8-8.3
2015	390	44.3	11.8	10.6-13.0	7.5	6.8-8.3
2016	350	39.5	10.5	9.4-11.6	6.4	5.7-7.1
2017	411	40.9	12.2	11.0-13.4	7.1	6.4-7.9
P for trend	-	-	0.029	-	0.002	-

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

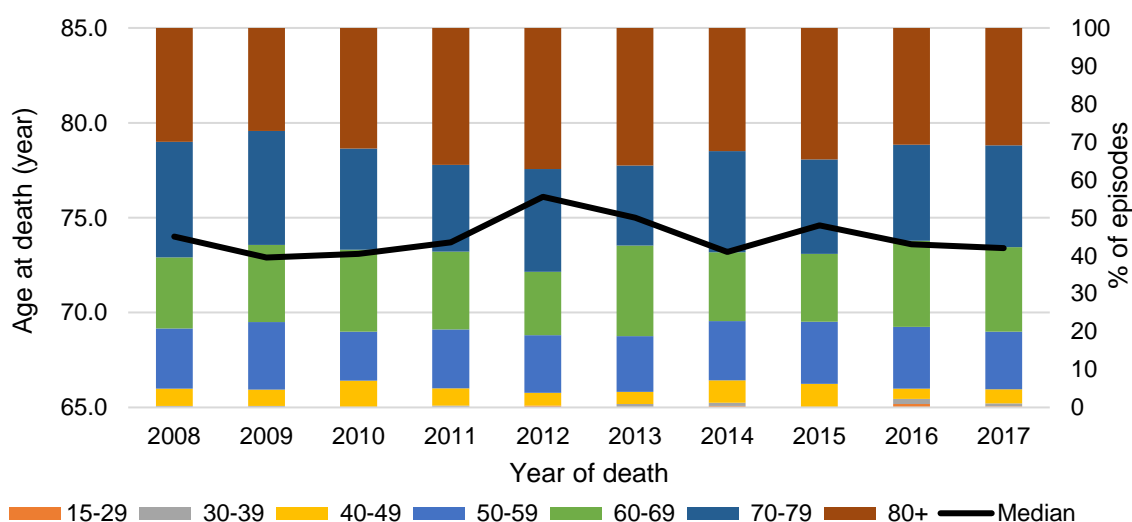


The median age at death ranged from 72 to 77 years among STEMI patients (Table 5.2.9a and Figure 5.2.9a). The highest proportion of AMI deaths was observed among the oldest age group (30.9%) in 2017.

Table 5.2.9a: Median age (year) and age distribution (%) at death among STEMI

Year of death	Median age	Age 15-29		Age 30-39		Age 40-49		
		Number	%	Number	%	Number	%	
2008	74.0	0	0.0	1	0.4	13	4.6	
2009	72.9	0	0.0	1	0.4	10	4.2	
2010	73.1	0	0.0	0	0.0	18	7.1	
2011	73.7	0	0.0	1	0.5	10	4.6	
2012	76.1	1	0.5	0	0.0	7	3.3	
2013	75.0	0	0.0	2	0.9	7	3.2	
2014	73.2	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	73.4	1	0.3	2	0.7	11	3.8	
Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2008	45	15.9	53	18.7	86	30.4	85	30.0
2009	42	17.8	48	20.3	71	30.1	64	27.1
2010	33	12.9	55	21.6	68	26.7	81	31.8
2011	34	15.5	45	20.5	50	22.8	79	36.1
2012	32	15.2	35	16.7	57	27.1	78	37.1
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

Figure 5.2.9a: Median age (year) and age distribution (%) at death among STEMI

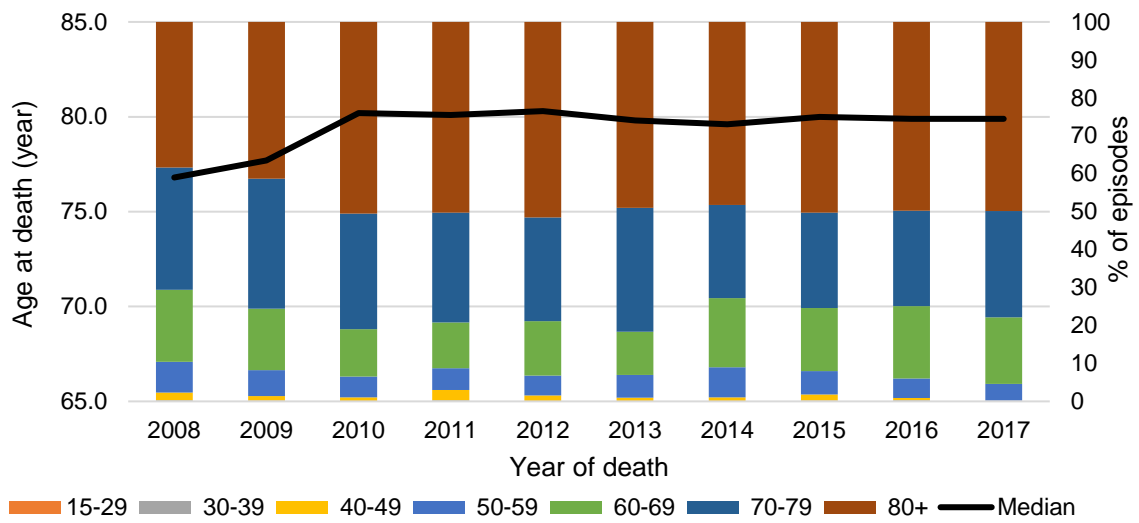


The median age at death ranged from 76 to 81 years among NSTEMI patients, a few years older than the median age at death among STEMI patients (Table 5.2.9b and Figure 5.2.9b). The highest proportion of AMI deaths was observed among the oldest age group (49.9%) in 2017.

Table 5.2.9b: Median age (year) and age distribution (%) at death among NSTEMI

Year of death	Median age	Age 15-29		Age 30-39		Age 40-49		
		Number	%	Number	%	Number	%	
2008	76.8	0	0.0	2	0.3	12	2.0	
2009	77.7	0	0.0	1	0.2	6	1.2	
2010	80.2	0	0.0	0	0.0	5	1.1	
2011	80.1	0	0.0	1	0.3	10	2.7	
2012	80.3	0	0.0	0	0.0	5	1.6	
2013	79.8	0	0.0	0	0.0	3	1.0	
2014	79.6	0	0.0	0	0.0	4	1.1	
2015	80.0	0	0.0	1	0.3	6	1.5	
2016	79.9	0	0.0	1	0.3	2	0.6	
2017	79.9	0	0.0	1	0.2	0	0.0	
Year of death	Age 50-59		Age 60-69		Age 70-79		Age 80+	
	Number	%	Number	%	Number	%	Number	%
2008	49	8.1	114	18.9	194	32.2	231	38.4
2009	34	6.9	80	16.1	170	34.3	205	41.3
2010	25	5.5	57	12.5	139	30.4	231	50.5
2011	21	5.7	44	12.0	106	29.0	184	50.3
2012	17	5.3	46	14.3	88	27.3	166	51.6
2013	18	6.0	34	11.3	98	32.7	147	49.0
2014	29	7.9	67	18.3	90	24.5	177	48.2
2015	24	6.2	65	16.7	98	25.1	196	50.3
2016	18	5.1	67	19.1	88	25.1	174	49.7
2017	18	4.4	72	17.5	115	28.0	205	49.9

Figure 5.2.9b: Median age (year) and age distribution (%) at death among NSTEMI



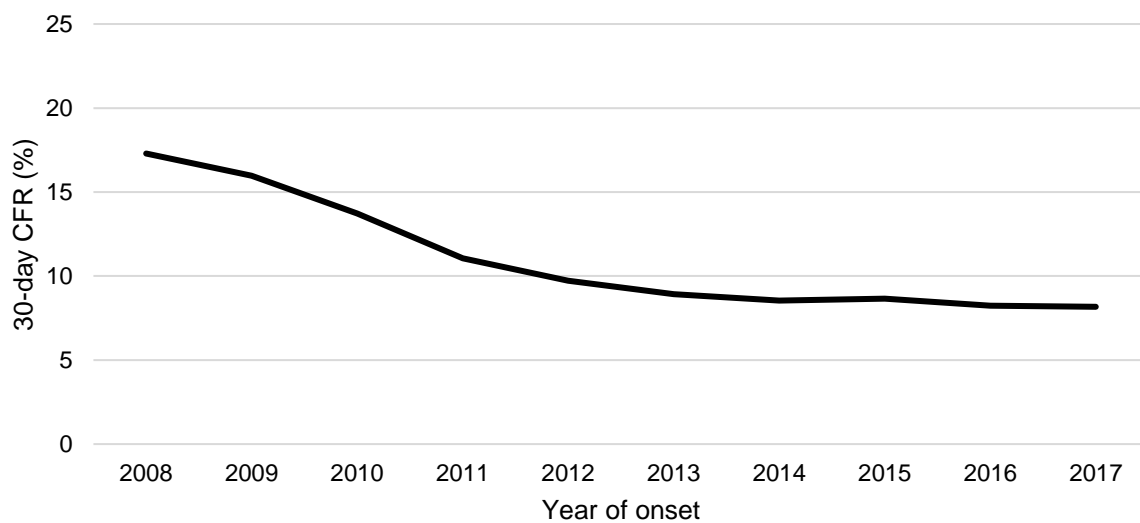
5.3 30-Day Case Fatality

The number of AMI deaths within 30 days from onset fell from 1,182 in 2008 to 907 in 2017 (Table 5.3.1 and Figure 5.3.1). Similarly, the CFR decreased significantly from 17.3% in 2008 to 8.2% in 2017 ($p < 0.001$). Higher rates of revascularization and pharmacotherapy are likely to have contributed to the decreasing trend in case fatality.

Table 5.3.1: Case fatality number and rate (%)

Year of onset	Number	CFR	95% CI
2008	1182	17.3	16.3-18.3
2009	1021	16.0	15.0-17.0
2010	949	13.7	12.9-14.6
2011	831	11.1	10.3-11.8
2012	824	9.7	9.1-10.4
2013	786	8.9	8.3-9.5
2014	784	8.5	7.9-9.1
2015	820	8.7	8.1-9.2
2016	833	8.2	7.7-8.8
2017	907	8.2	7.6-8.7
P for trend	-	<0.001	-

Figure 5.3.1: Case fatality rate (%)



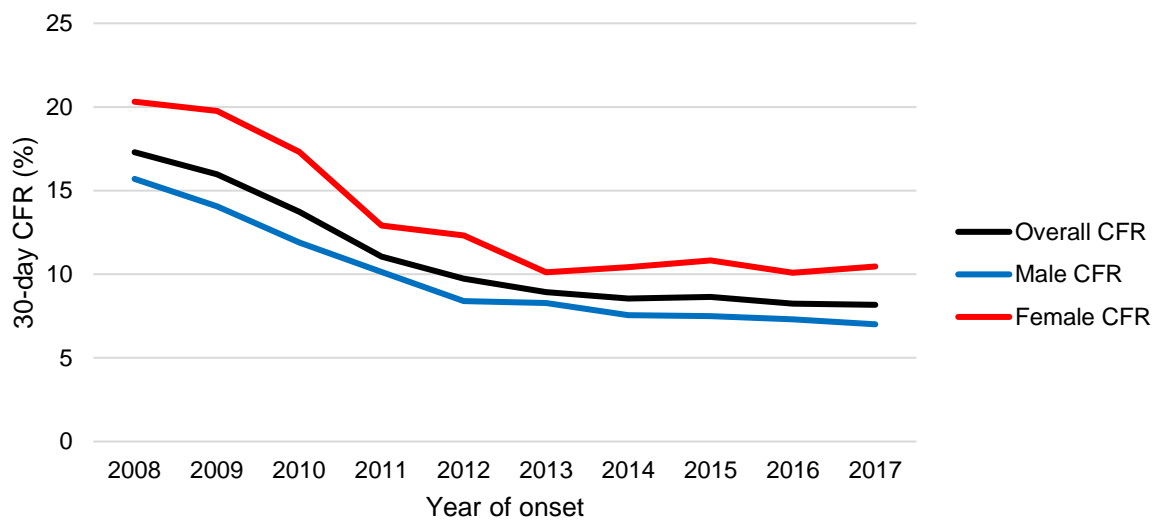
The CFR fell significantly over the years for both genders ($p < 0.001$ for both) (Table 5.3.2 and Figure 5.3.2). Although the ASMR for men was consistently higher than women across the years (Table 5.2.4), the CFR for men was consistently lower than women. The CFR was 7.0% for men and 10.5% for women in 2017. As women tended to have AMI at an older age than men (Tables 5.1.5a and 5.1.5b), they were likely to have more co-morbidities when AMI happened, making them more susceptible to the contraindications of revascularization or declining revascularization. Lower rate of revascularization of the blocked arteries could have led to the higher CFR among women¹⁶.

Table 5.3.2: Case fatality number and rate (%) by gender

Male				
Year of onset	Number	%	CFR	95% CI
2008	702	59.4	15.7	14.5-16.9
2009	596	58.4	14.1	12.9-15.2
2010	543	57.2	11.9	10.9-12.9
2011	509	61.3	10.1	9.3-11.0
2012	468	56.8	8.4	7.6-9.2
2013	474	60.3	8.3	7.5-9.0
2014	455	58.0	7.6	6.9-8.3
2015	464	56.6	7.5	6.8-8.2
2016	487	58.5	7.3	6.7-7.9
2017	515	56.8	7.0	6.4-7.6
P for trend	-	-	<0.001	-
Female				
Year of onset	Number	%	CFR	95% CI
2008	480	40.6	20.3	18.5-22.1
2009	425	41.6	19.8	17.9-21.6
2010	406	42.8	17.3	15.6-19.0
2011	322	38.7	12.9	11.5-14.3
2012	356	43.2	12.3	11.0-13.6
2013	312	39.7	10.1	9.0-11.2
2014	329	42.0	10.4	9.3-11.5
2015	356	43.4	10.8	9.7-12.0
2016	346	41.5	10.1	9.0-11.2
2017	392	43.2	10.5	9.4-11.5
P for trend	-	-	<0.001	-

¹⁶ Berger JS et al. Sex differences in mortality following acute coronary syndromes. JAMA 2009; 302(8): 874-882.

Figure 5.3.2: Case fatality rate (%) by gender

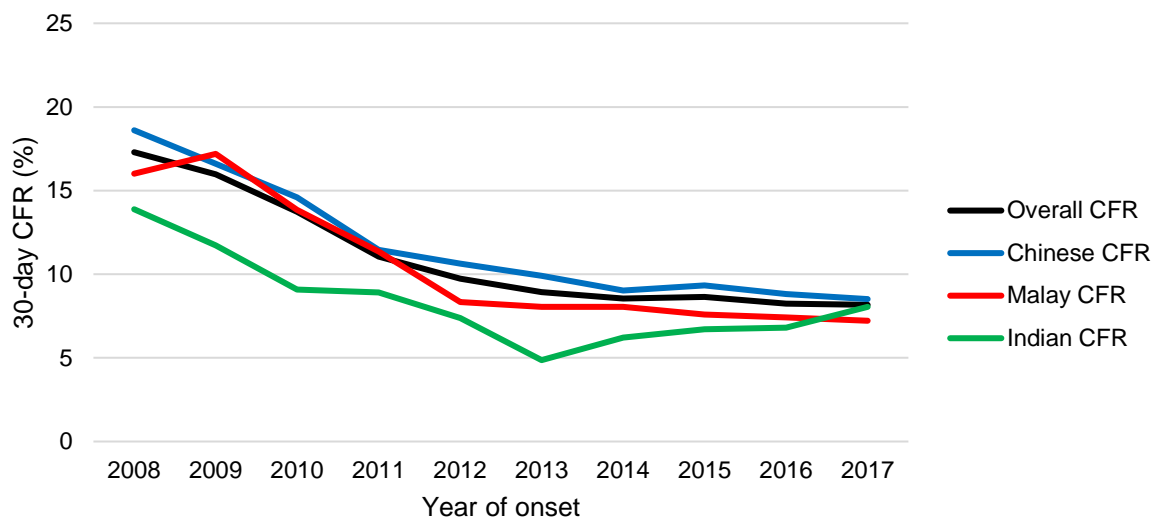


The CFR fell significantly over the years for all the three ethnic groups ($p < 0.001$ for Chinese and Malays; $p = 0.024$ for Indians) (Table 5.3.3 and Figure 5.3.3). Although the Chinese generally had the lowest ASMR among the three ethnic groups (Table 5.2.6), they generally had the highest CFR across the years. The CFR was 8.5%, 7.2% and 8.1% for the Chinese, Malays and Indians respectively in 2017. This is likely due to the Chinese being older at the onset of AMI than the Malays and Indians (Tables 5.1.7a to 5.1.7c).

Table 5.3.3: Case fatality number and rate (%) by ethnicity

Chinese				
Year of onset	Number	%	CFR	95% CI
2008	848	71.7	18.6	17.4-19.9
2009	698	68.4	16.6	15.4-17.8
2010	675	71.1	14.6	13.5-15.7
2011	570	68.6	11.5	10.5-12.4
2012	592	71.8	10.6	9.8-11.5
2013	578	73.5	9.9	9.1-10.7
2014	549	70.0	9.0	8.3-9.8
2015	593	72.3	9.3	8.6-10.1
2016	587	70.5	8.8	8.1-9.5
2017	638	70.3	8.5	7.9-9.2
P for trend	-	-	<0.001	-
Malay				
Year of onset	Number	%	CFR	95% CI
2008	202	17.1	16.0	13.8-18.2
2009	212	20.8	17.2	14.9-19.5
2010	182	19.2	13.8	11.8-15.9
2011	167	20.1	11.4	9.6-13.1
2012	140	17.0	8.3	6.9-9.7
2013	139	17.7	8.1	6.7-9.4
2014	140	17.9	8.0	6.7-9.4
2015	140	17.1	7.6	6.3-8.9
2016	149	17.9	7.4	6.2-8.6
2017	149	16.4	7.2	6.1-8.4
P for trend	-	-	<0.001	-
Indian				
Year of onset	Number	%	CFR	95% CI
2008	128	10.8	13.9	11.5-16.3
2009	102	10.0	11.7	9.4-14.0
2010	80	8.4	9.1	7.1-11.1
2011	88	10.6	8.9	7.0-10.8
2012	80	9.7	7.4	5.8-9.0
2013	54	6.9	4.9	3.6-6.2
2014	73	9.3	6.2	4.8-7.6
2015	77	9.4	6.7	5.2-8.2
2016	88	10.6	6.8	5.4-8.2
2017	112	12.3	8.1	6.6-9.5
P for trend	-	-	0.024	-

Figure 5.3.3: Case fatality rate (%) by ethnicity

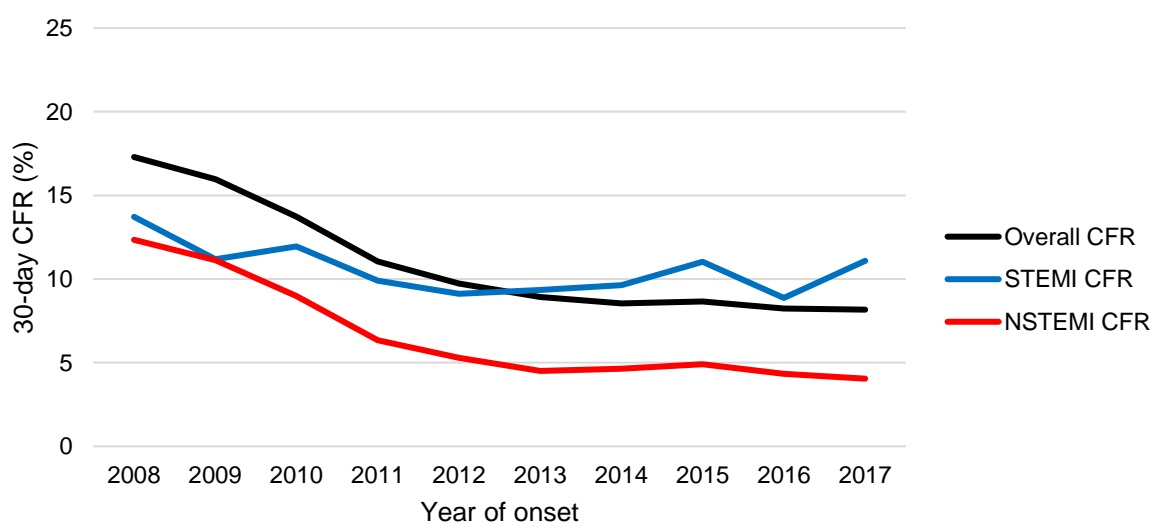


While the CFR for STEMI patients fluctuated over the years, it fell significantly for NSTEMI patients ($p < 0.001$) (Table 5.3.4 and Figure 5.3.4). Although STEMI patients consistently had lower ASMR than NSTEMI patients across the years (Table 5.2.8), the CFR among STEMI patients was consistently higher than NSTEMI patients. The CFR was 11.1% and 4.0% for STEMI and NSTEMI patients respectively in 2017. A plausible reason is that compared to NSTEMI, STEMI is more severe and likely to be fatal if intervention was not provided promptly.

Table 5.3.4: Case fatality number and rate (%) by AMI subtype

STEMI				
Year of onset	Number	%	CFR	95% CI
2008	276	23.4	13.7	12.1-15.3
2009	224	21.9	11.2	9.7-12.6
2010	245	25.8	12.0	10.5-13.4
2011	205	24.7	9.9	8.5-11.3
2012	201	24.4	9.1	7.9-10.4
2013	213	27.1	9.3	8.1-10.6
2014	219	27.9	9.6	8.4-10.9
2015	249	30.4	11.0	9.7-12.4
2016	208	25.0	8.9	7.7-10.1
2017	273	30.1	11.1	9.8-12.4
P for trend	-	-	0.113	-
NSTEMI				
Year of onset	Number	%	CFR	95% CI
2008	549	46.4	12.3	11.3-13.4
2009	444	43.5	11.1	10.1-12.2
2010	397	41.8	9.0	8.1-9.9
2011	306	36.8	6.3	5.6-7.0
2012	306	37.1	5.3	4.7-5.9
2013	274	34.9	4.5	4.0-5.0
2014	303	38.6	4.6	4.1-5.2
2015	338	41.2	4.9	4.4-5.4
2016	316	37.9	4.3	3.8-4.8
2017	332	36.6	4.0	3.6-4.5
P for trend	-	-	<0.001	-

Figure 5.3.4: Case fatality rate (%) by AMI subtype

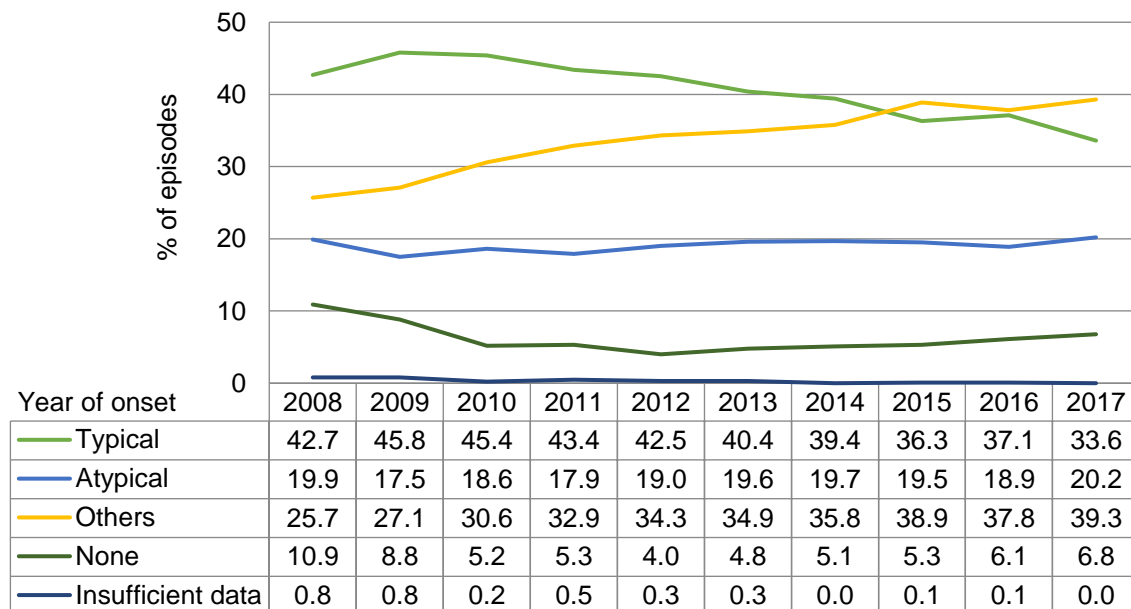


5.4 Symptoms

Clinical presentation has consequences on triage categorization, diagnostic tests prescription and disease management. Symptoms of AMI are considered to be typical when chest pain was continuous and characterized by a duration of at least 20 minutes. Atypical symptoms are defined as chest pain of short duration and/or intermittent with each bout lasting for less than 20 minutes, or pain at unusual sites such as upper abdomen, arm, jaw and neck. Symptoms are classified as others when they were well described, but did not satisfy the criteria for typical or atypical. It includes symptoms due to a definite non-cardiac cause, a definite non-atherosclerotic cardiac cause and collapse, whereby patients complained of symptoms before death. Data are deemed to be insufficient when symptoms were not stated in the case notes or electronic medical records, or lacking in details on description and duration of symptoms.

Most of the patients experienced typical symptoms of AMI in earlier years (Figure 5.4.1). However, symptoms that were neither typical nor atypical became almost as common in later years. The proportion of patients with typical symptoms dropped from 42.7% in 2008 to 33.6% in 2017. The proportion of patients with other symptoms that were neither typical nor atypical, rose from 25.7% in 2008 to 39.3% in 2017. STEMI patients are likely to have typical symptoms, whereas NSTEMI patients tend to have non-typical symptoms¹⁷. The drop in proportion of patients with typical symptoms is likely caused by the drop in proportion of STEMI patients over the years (Table 5.1.8).

Figure 5.4.1: Types of symptoms (%)

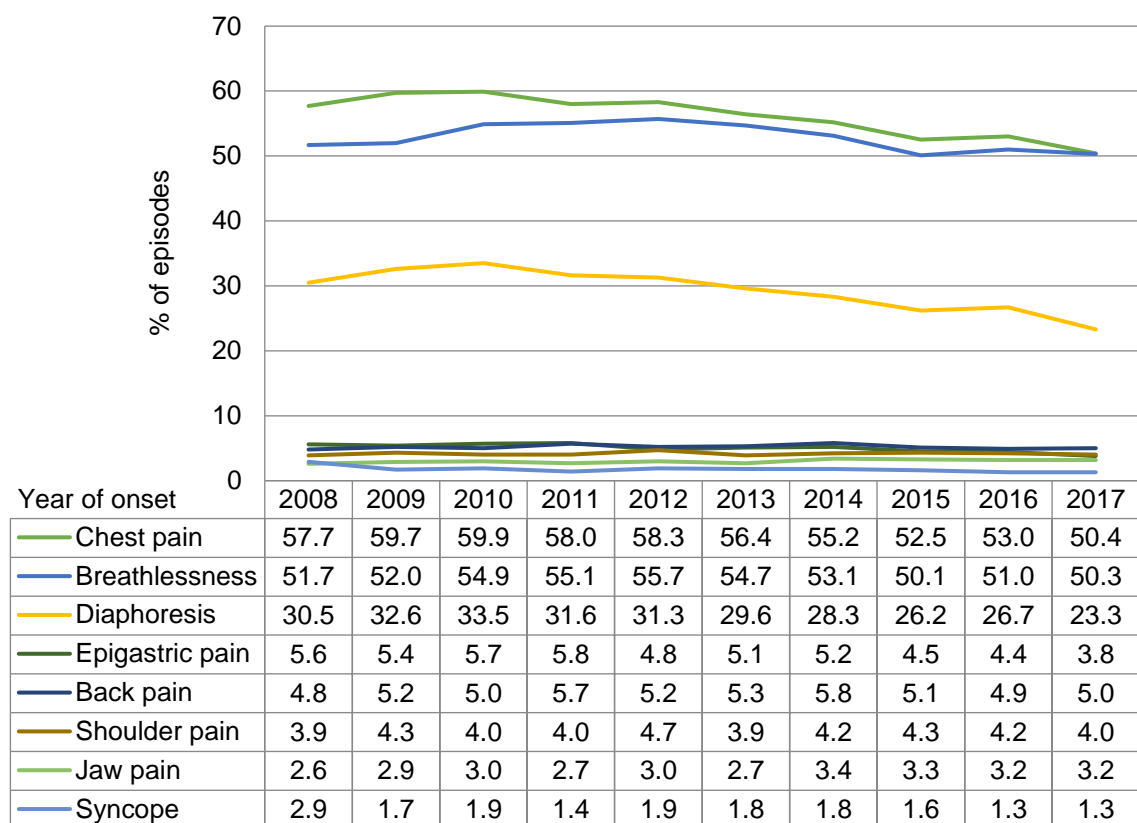


¹⁷ Kirchberger I et al. Patient-reported symptoms in acute myocardial infarction: differences related to ST-segment elevation. *Journal of Internal Medicine* 2011; 270(1): 58-64.

Consistently across the years, the common presenting symptoms of AMI were chest pain, breathlessness and diaphoresis. While half of the patients in 2017 had chest pain (50.4%) and breathlessness (50.3%) accompanying the onset of AMI, about a quarter of them (23.3%) had diaphoresis (Figure 5.4.2). The proportions of patients with chest pain and diaphoresis dropped gradually from 2012 onwards. As STEMI patients are more likely to experience these two symptoms compared to NSTEMI patients, the drop in proportion of STEMI patients (Table 5.1.8) likely resulted in the drop in proportions of patients who encountered chest pain and diaphoresis over the years.

As a patient could have multiple symptoms, the percentages in Figure 5.4.2 will not add up to 100% for each year.

Figure 5.4.2: Presenting symptoms (%)

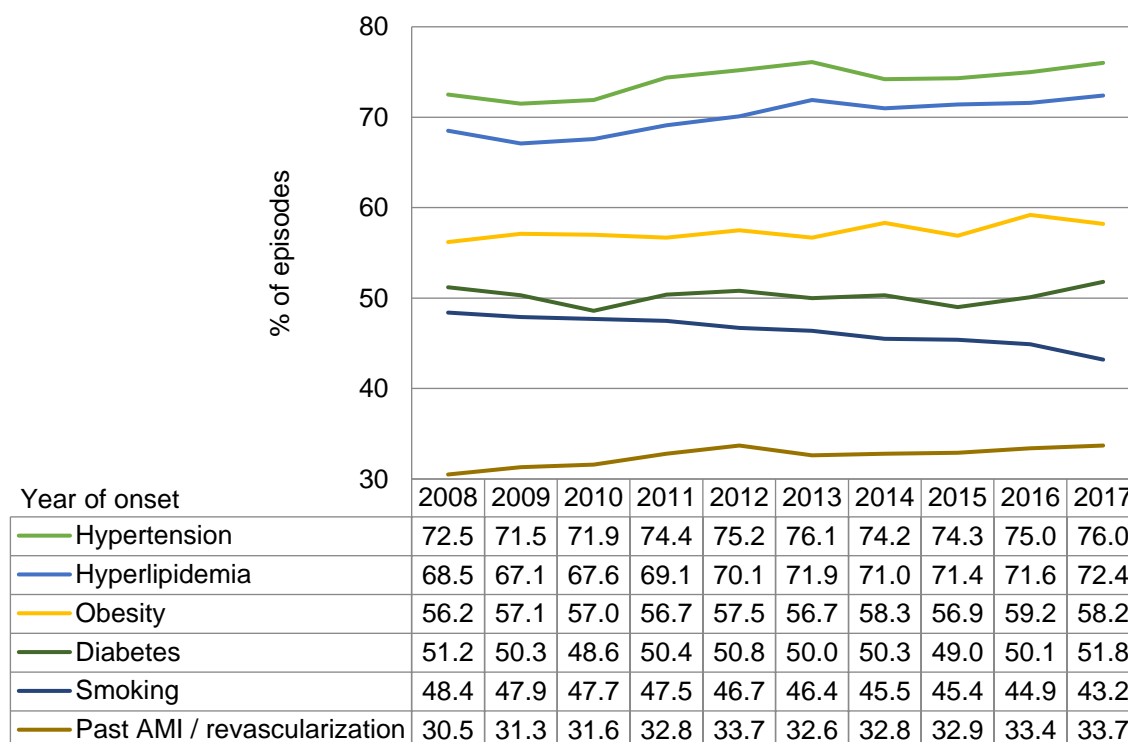


5.5 Risk Factors

Hypertension, hyperlipidemia, diabetes, smoking and obesity are well established modifiable risk factors of AMI¹⁸. Hypertension, hyperlipidemia and diabetes are defined as positive if there was history of the condition or if it was newly diagnosed during the index admission. Obesity refers to body mass index (BMI) of 23 kg/m² or above as increased risk for cardiovascular disease and diabetes is found among Asian populations with this BMI range¹⁹. Smoking includes former and current smoker on admission. Past AMI or revascularization (CABG or PCI) includes history of AMI and revascularization done for any heart disease. As a patient could have multiple risk factors, the percentages in Figure 5.5.1 will not add up to 100% for each year.

Hypertension and hyperlipidemia were consistently the two most common risk factors among AMI patients across the years (Figure 5.5.1). 76.0% of the patients in 2017 had hypertension and 72.4% had hyperlipidemia. Obesity, diabetes and smoking were also prevalent among AMI patients in 2017, with 58.2%, 51.8% and 43.2% of them being obese, diabetic and smokers respectively. The proportions of patients with hypertension, hyperlipidemia and history of AMI or revascularization rose slightly, while the proportion of patients who smoked dropped slightly over the years.

Figure 5.5.1: Risk factors (%)



¹⁸ Salim Y et al. Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *Lancet* 2014; 364: 937-952.

¹⁹ WHO expert consultation. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. *Lancet* 2004; 363: 157-163.

5.6 Door-to-balloon (DTB) time among STEMI

DTB time refers to the time from the 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 first medical contact time and the start time of primary PCI by the hospitals will affect the accuracy of DTB time. The targeted DTB time recommended by the American Heart Association is within 90 minutes²⁰.

Patients who were admitted for a non-AMI condition but developed AMI during hospitalization, patients who were transferred to another hospital, and patients who experienced non-system delays²¹, 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 improved from 84 (IQR 64 – 111) minutes in 2008 to 54 (IQR 43 – 68) minutes in 2017 (Figure 5.6.1). The proportion of STEMI with DTB time of 90 minutes or less improved from 58.3% in 2008 to 94.8% in 2017. This improvement was largely driven by the efficiency in the healthcare delivery system comprising of the early response teams and the hospitals.

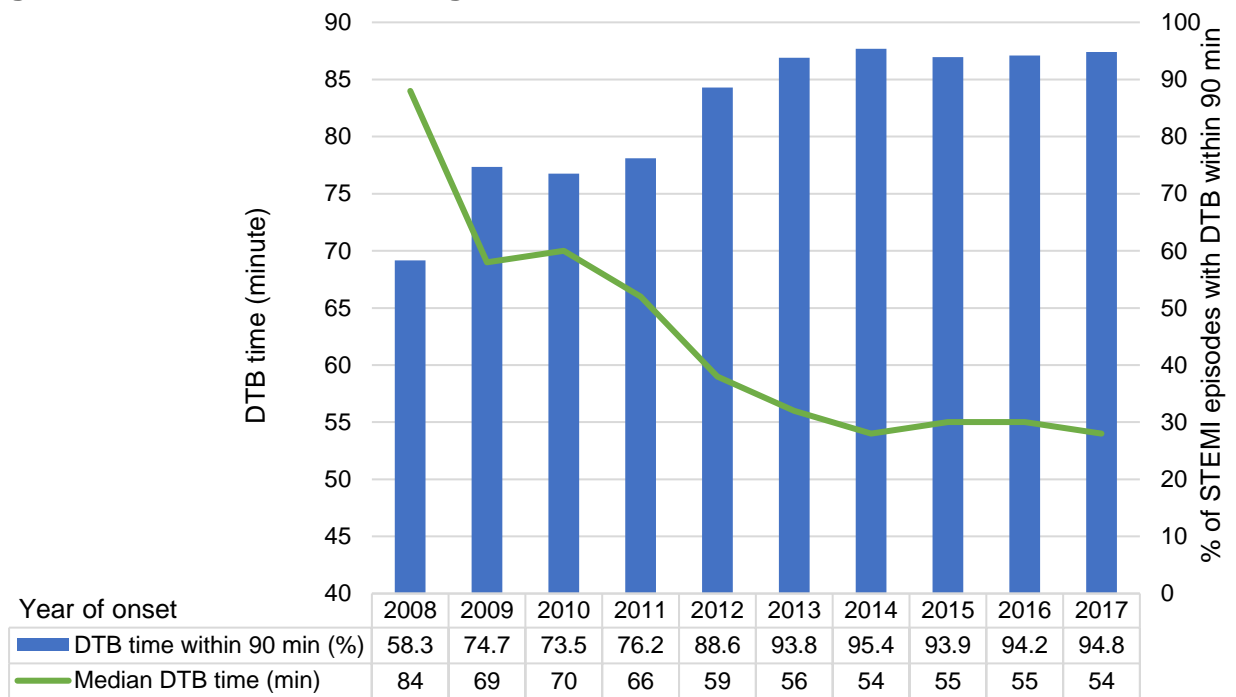
²⁰ Antman EM et al. ACC/AHA guidelines for the management of patients with ST-elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines (Committee to revise the 1999 guidelines for the management of patients with acute myocardial infarction). *Journal of American College of Cardiology* 2004; 94: 722-774.

²¹ 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, late presentation, delayed consent.

System delay refers to delay in primary PCI due to hospital's system. It includes: delay in the process leading to the start of primary PCI, CATH laboratory being occupied, procedure difficulty, uptriage, missed diagnosis, unknown reason.

Figure 5.6.3: DTB time among STEMI



6. CONCLUSION

The top contributor to disease burden in Singapore was cardiovascular diseases and they accounted for one-fifth of the total disease and injury burden in 2010²². It is therefore important for individuals with high risk of AMI to take preventive action. One can reduce his/her chances of developing AMI by adopting a healthy lifestyle, such as eating all food in moderation and opting for healthier products, exercising and maintaining a healthy weight, avoiding smoking, going for health screening and follow-ups, and controlling blood pressure, cholesterol and glucose levels well. For individuals with symptoms of AMI, early intervention plays a crucial role in prognosis. For individuals who survived an AMI, appropriate medication and healthy lifestyle can prevent recurrence of AMI or associated complication such as heart failure and death.

²² Singapore Burden of Disease Report 2010. Ministry of Health, Singapore.