



Singapore Myocardial Infarction Registry Annual Report 2016

**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 6,817 episodes in 2007 to 10,728 episodes in 2016. The age-standardized incidence rate (ASIR) also increased from 208.9 per 100,000 population in 2007 to 220.8 per 100,000 population in 2016. However, the rise in ASIR was not significant.

The number of AMI deaths was 885 in 2016, a drop compared to 1,109 in 2007. The age-standardized mortality rate (ASMR) declined significantly from 33.5 per 100,000 population in 2007 to 17.0 per 100,000 population in 2016. The number of AMI deaths within 30 days from onset fell from 1,076 in 2007 to 832 in 2016. Similarly, the 30-day case fatality rate (CFR) decreased significantly from 16.7% in 2007 to 8.3% in 2016.

The common presenting symptoms of AMI were chest pain, breathlessness and diaphoresis. While about half of the patients had chest pain (53.2%) and breathlessness (51.0%) accompanying the onset of AMI in 2016, about a quarter of them (26.8%) had diaphoresis.

Hypertension and hyperlipidemia were consistently the two most common risk factors among the AMI patients across the years. In 2016, 75.0% of the patients had hypertension and 71.6% of them had hyperlipidemia.

The median door-to-balloon (DTB) time improved from 95 minutes in 2007 to 55 minutes in 2016. The proportion of ST-segment elevation myocardial infarction (STEMI) with DTB time of 90 minutes or less improved from 45.5% in 2007 to 94.3% in 2016.

3. INTRODUCTION

Ischaemic heart disease was the third most common cause of hospitalization in 2015, accounting for 3.1% of all discharges in Singapore¹. It was also the third most common cause of death in 2016, accounting for 17.0% 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. As delayed treatment can lead to irreversible heart damage, early intervention plays a crucial role in the prognosis of AMI.

Singapore's population is rapidly ageing. The proportion of residents aged 65 years or above has increased from 8.5% in 2007 to 13.0% in 2017³. Like many other diseases, old age is a risk factor of AMI. Other common risk factors for AMI are hypertension, hyperlipidaemia and diabetes. However, these risk factors are preventable with a healthy lifestyle.

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

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

³ SingStat Population Trends. Department of Statistics, Singapore.

4. METHODOLOGY

The National Registry of Diseases Office (NRDO) collects and analyses epidemiological data to support national disease management plans, policy formulation and programme planning.

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 had been certified by the general practitioners in Singapore. Legislation mandated notification from all hospitals from September 2012 onwards.

Data sources

The SMIR receives AMI case notifications from:

1. All hospitals via the Hospital In-patient Discharge Summary and the cardiac biomarkers (such as Troponins T and Troponin I) list.
2. The MOH via the Mediclaims list and the Casemix & Subvention list.
3. The Death Registry from 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 from 2007 to 2011, while the ICD-10 American 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' National Registration Identification Card (NRIC) numbers as identifiers.

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 hospitals. 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 episode⁴. 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

⁴ Tunstall-Pedoe H et al. Myocardial infarction and coronary deaths in the World Health Organisation MONICA project. *Circulation* 1994; 90: 583-612.

Heart Association⁵. In particular, type 2 AMI episodes were eventually combined with NSTEMI episodes in this report as their clinical characteristics are similar⁶.

The vital status of all patients registered in the SMIR were updated till 31 July 2017 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) annually⁷. The Segi World population estimates used for age standardization are available on the World Health Organization website⁸.

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.

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 report focuses on only Singapore residents, aged 15 years and above, diagnosed with AMI episodes from 2007 to 2016 as they stood on 1 November 2017. All findings in this report except mortality and case fatality, were based on episodes.

⁵ American College of Cardiology Foundation. Universal definition of myocardial infarction. *Journal of the American College of Cardiology* 2007; 50(22): 2173-2195.

⁶ Stein YG et al. Type-II myocardial infarction – patient characteristics, management and outcomes. *PLoS One* 2014; 9(1): e84285.

⁷ SingStat Table Builder, Population and Population Structure, Annual Population, Singapore Residents by age group, ethnic group and sex. Department of Statistics, Singapore.

⁸ 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

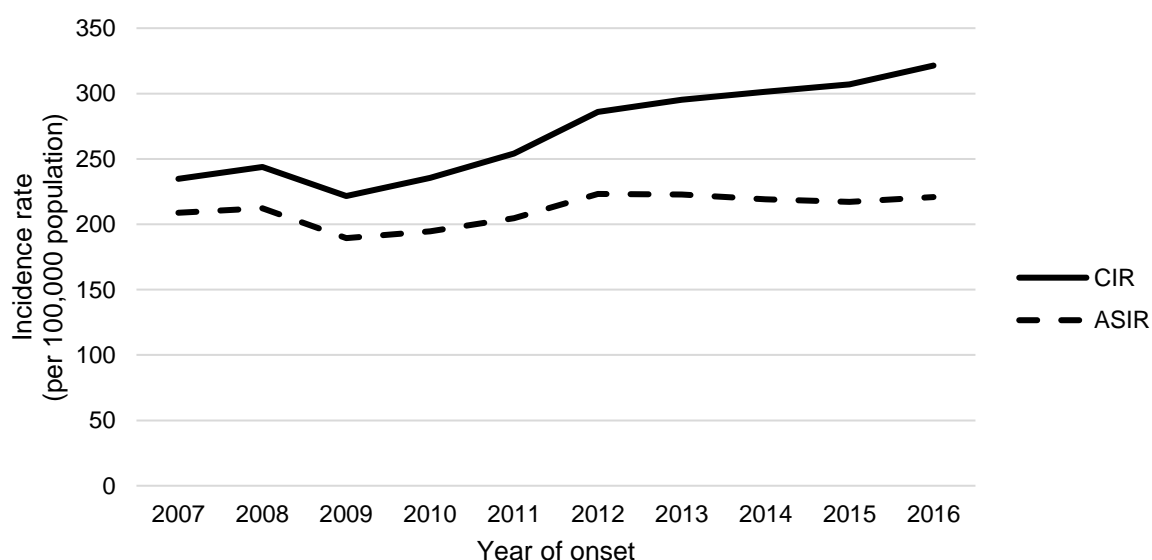
5.1 Incidence of AMI

The number of AMI episodes increased from 6,817 episodes in 2007 to 10,728 episodes in 2016 (Table 5.1.1). Similarly, the crude incidence rate (CIR) increased significantly from 234.7 per 100,000 population in 2007 to 321.4 per 100,000 population in 2016 ($p < 0.001$) (Figure 5.1.1). Taking into account of Singapore's ageing population, the ASIR also increased over the years, from 208.9 per 100,000 population in 2007 to 220.8 per 100,000 population in 2016. However, the rise in ASIR was not significant ($p = 0.066$), and hence the rise in number and CIR is likely due to Singapore's ageing population.

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

| Year of onset | Number | CIR | 95% CI | ASIR | 95% CI |
|---------------|--------|--------|-------------|-------|-------------|
| 2007 | 6817 | 234.7 | 229.2-240.3 | 208.9 | 203.9-214.0 |
| 2008 | 7247 | 243.9 | 238.3-249.5 | 212.2 | 207.3-217.2 |
| 2009 | 6795 | 221.6 | 216.3-226.9 | 189.4 | 184.8-194.0 |
| 2010 | 7345 | 235.6 | 230.2-241.0 | 194.6 | 190.0-199.1 |
| 2011 | 8013 | 254.2 | 248.6-259.8 | 204.7 | 200.1-209.2 |
| 2012 | 9123 | 285.9 | 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 | 9832 | 301.3 | 295.4-307.3 | 219.2 | 214.8-223.6 |
| 2015 | 10131 | 307.0 | 301.0-313.0 | 217.2 | 212.8-221.5 |
| 2016 | 10728 | 321.4 | 315.4-327.5 | 220.8 | 216.6-225.1 |
| P for trend | - | <0.001 | - | 0.066 | - |

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



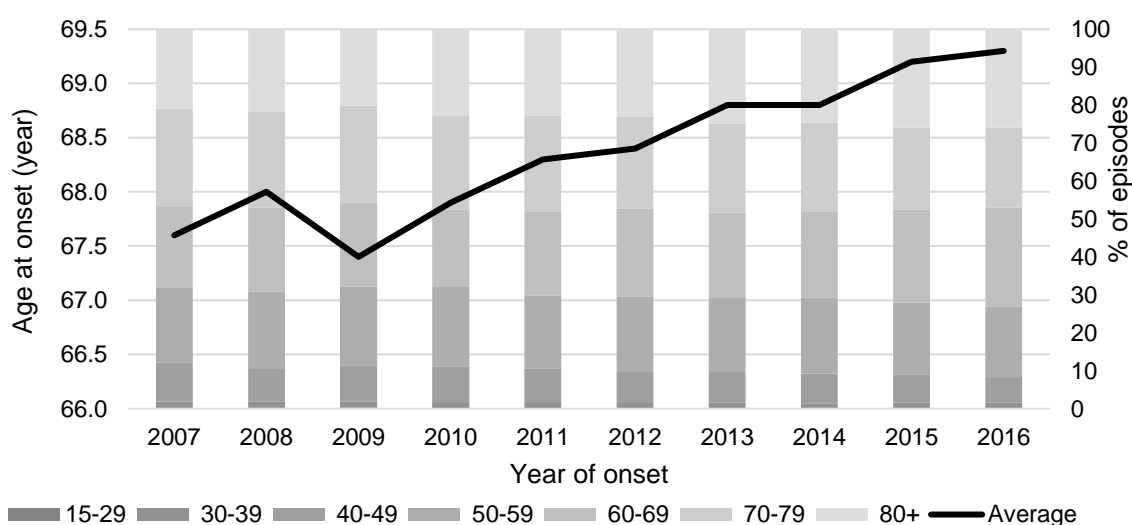
The average age at onset ranged from 67 to 70 years and it increased gradually over the years (Table 5.1.2 and Figure 5.1.2). About 7 in 10 of the patients were aged 60 years or above.

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

| Year of onset | Average age | Age 15-29 | | Age 30-39 | | Age 40-49 | |
|---------------|-------------|-----------|-----|-----------|-----|-----------|------|
| | | Number | % | Number | % | Number | % |
| 2007 | 67.6 | 10 | 0.1 | 117 | 1.7 | 704 | 10.3 |
| 2008 | 68.0 | 10 | 0.1 | 121 | 1.7 | 642 | 8.9 |
| 2009 | 67.4 | 13 | 0.2 | 112 | 1.6 | 649 | 9.6 |
| 2010 | 67.9 | 12 | 0.2 | 118 | 1.6 | 676 | 9.2 |
| 2011 | 68.3 | 13 | 0.2 | 126 | 1.6 | 709 | 8.8 |
| 2012 | 68.4 | 15 | 0.2 | 139 | 1.5 | 725 | 7.9 |
| 2013 | 68.8 | 13 | 0.1 | 139 | 1.5 | 765 | 8.0 |
| 2014 | 68.8 | 11 | 0.1 | 126 | 1.3 | 768 | 7.8 |
| 2015 | 69.2 | 13 | 0.1 | 148 | 1.5 | 742 | 7.3 |
| 2016 | 69.3 | 16 | 0.1 | 154 | 1.4 | 724 | 6.7 |

| Year of onset | Age 50-59 | | Age 60-69 | | Age 70-79 | | Age 80+ | |
|---------------|-----------|------|-----------|------|-----------|------|---------|------|
| | Number | % | Number | % | Number | % | Number | % |
| 2007 | 1352 | 19.8 | 1456 | 21.4 | 1751 | 25.7 | 1427 | 20.9 |
| 2008 | 1461 | 20.2 | 1608 | 22.2 | 1824 | 25.2 | 1581 | 21.8 |
| 2009 | 1410 | 20.8 | 1507 | 22.2 | 1735 | 25.5 | 1369 | 20.1 |
| 2010 | 1563 | 21.3 | 1484 | 20.2 | 1826 | 24.9 | 1666 | 22.7 |
| 2011 | 1536 | 19.2 | 1784 | 22.3 | 2016 | 25.2 | 1829 | 22.8 |
| 2012 | 1818 | 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 | 2239 | 22.8 | 2297 | 23.4 | 2419 | 24.6 |
| 2015 | 1922 | 19.0 | 2489 | 24.6 | 2189 | 21.6 | 2628 | 25.9 |
| 2016 | 1994 | 18.6 | 2795 | 26.1 | 2262 | 21.1 | 2783 | 25.9 |

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



The age-specific incidence rate increased with age (Table 5.1.3) and the oldest age group had the highest incidence rate (Figure 5.1.3a). There was a rise in incidence rate from 2009 to 2013 among the oldest age group, but it plateaued from 2013 onwards (Figure 5.1.3b).

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 |
| 2007 | 234.7 | 229.2-240.3 | 1.4 | 0.5-2.2 | 19.6 | 16.1-23.2 | 110.6 | 102.5-118.8 |
| 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 | 216.3-226.9 | 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 | 248.6-259.8 | 1.7 | 0.8-2.6 | 20.5 | 16.9-24.1 | 112.4 | 104.2-120.7 |
| 2012 | 285.9 | 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 | 301.3 | 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 | 321.4 | 315.4-327.5 | 2.0 | 1.0-3.1 | 26.2 | 22.1-30.4 | 117.8 | 109.2-126.4 |
| P for trend | <0.001 | - | 0.064 | - | 0.002 | - | 0.005 | - |
| 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 |
| 2007 | 270.4 | 256.0-284.8 | 584.0 | 554.0-614.0 | 1293.2 | 1232.6-1353.8 | 2530.1 | 2398.9-2661.4 |
| 2008 | 281.7 | 267.3-296.2 | 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 | 527.1 | 500.5-553.7 | 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 | 2407.5 | 2291.9-2523.1 |
| 2011 | 270.1 | 256.6-283.6 | 556.6 | 530.8-582.5 | 1207.9 | 1155.2-1260.6 | 2498.6 | 2384.1-2613.1 |
| 2012 | 312.3 | 297.9-326.6 | 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 | 570.2 | 546.5-593.8 | 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 | 324.1 | 309.9-338.4 | 621.3 | 598.3-644.3 | 1179.7 | 1131.0-1228.3 | 2845.6 | 2739.9-2951.4 |
| P for trend | 0.001 | - | 0.300 | - | 0.415 | - | 0.032 | - |

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

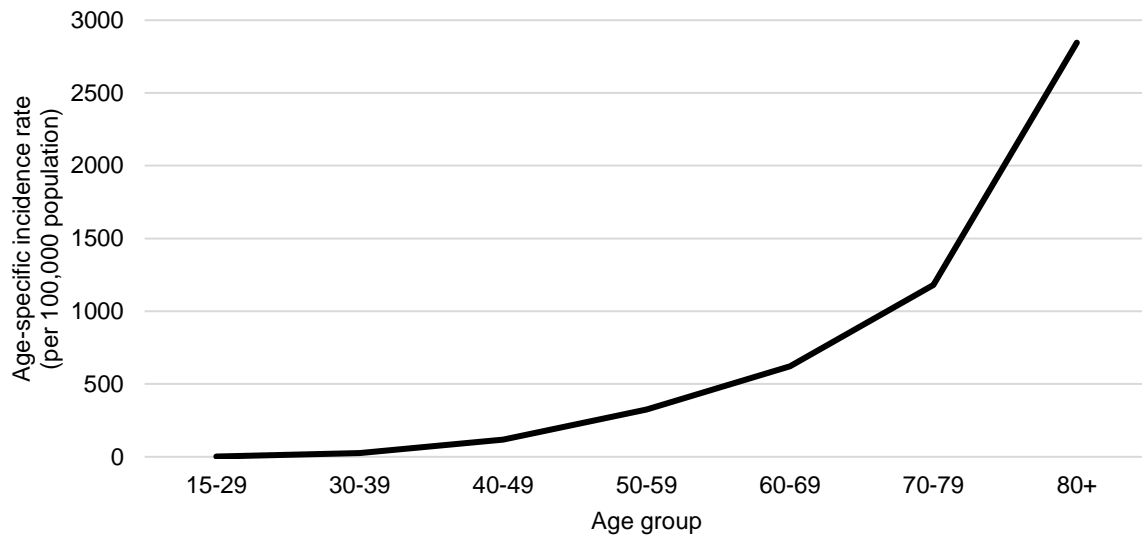
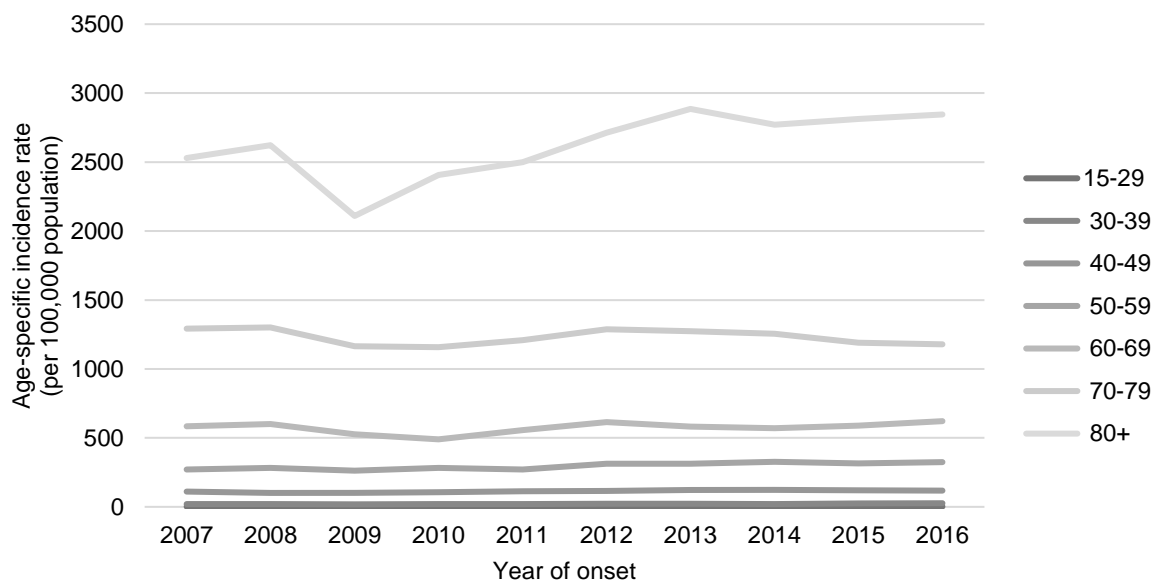


Figure 5.1.3b: Age-specific incidence rate (per 100,000 population) across years



Although gender distribution was almost equal among the general population, there were more men suffering from AMI than women (Table 5.1.4). The rise in ASIR over the years was significant for men ($p=0.025$) but not for women ($p=0.502$) (Figure 5.1.4). The ASIR for men was consistently higher than that for women across the years. Men had an ASIR of 321.9 per 100,000 population, while women had an ASIR of 127.6 per 100,000 population in 2016.

Male gender is a well-known predictor of heart disease. The underlying causes are multifactorial and related to the pathophysiological gender differences in AMI⁹. Furthermore, the prevalence of hypertension, total cholesterol and diabetes were higher among men than women in the general population as shown by the National Health Survey 2010¹⁰. 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 women¹¹.

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

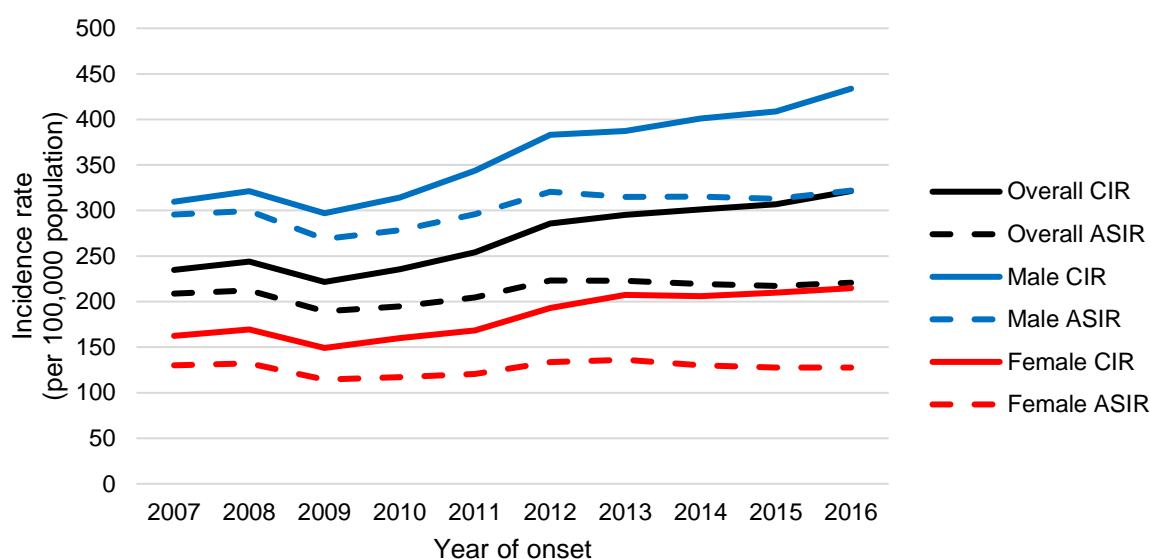
| Male | | | | | | |
|---------------|--------|------|--------|-------------|-------|-------------|
| Year of onset | Number | % | CIR | 95% CI | ASIR | 95% CI |
| 2007 | 4420 | 64.8 | 309.8 | 300.7-318.9 | 295.5 | 286.6-304.3 |
| 2008 | 4683 | 64.6 | 321.1 | 311.9-330.3 | 299.4 | 290.7-308.1 |
| 2009 | 4463 | 65.7 | 297.0 | 288.3-305.7 | 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 | 6106 | 64.1 | 387.2 | 377.5-396.9 | 314.9 | 306.9-322.8 |
| 2014 | 6388 | 65.0 | 401.2 | 391.3-411.0 | 315.3 | 307.5-323.0 |
| 2015 | 6580 | 64.9 | 408.8 | 398.9-418.7 | 312.7 | 305.0-320.3 |
| 2016 | 7052 | 65.7 | 433.7 | 423.6-443.9 | 321.9 | 314.3-329.5 |
| P for trend | - | - | <0.001 | - | 0.025 | - |
| Female | | | | | | |
| Year of onset | Number | % | CIR | 95% CI | ASIR | 95% CI |
| 2007 | 2397 | 35.2 | 162.3 | 155.8-168.8 | 130.2 | 124.8-135.5 |
| 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 | 2546 | 34.7 | 160.1 | 153.8-166.3 | 117.3 | 112.5-122.0 |
| 2011 | 2708 | 33.8 | 168.2 | 161.9-174.6 | 120.7 | 116.0-125.5 |
| 2012 | 3148 | 34.5 | 193.0 | 186.2-199.7 | 133.7 | 128.8-138.5 |
| 2013 | 3425 | 35.9 | 207.3 | 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 | 3676 | 34.3 | 214.8 | 207.8-221.7 | 127.6 | 123.2-131.9 |
| P for trend | - | - | 0.001 | - | 0.502 | - |

⁹ Mehta LS et al. Acute myocardial infarction in women. *Circulation* 2016; 133.

¹⁰ National Health Survey 2010. Ministry of Health, Singapore.

¹¹ Risk Factors, Gender. Singapore Heart Foundation.

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

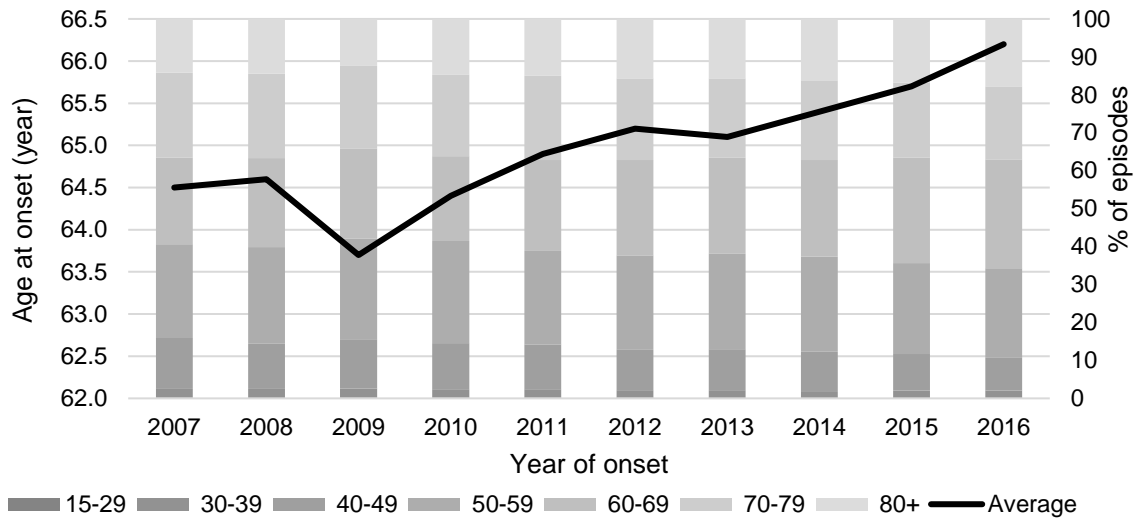


The average age at onset ranged from 63 to 67 years among men and it increased gradually over the years (Table 5.1.5a and Figure 5.1.5a). The majority of the male patients were aged 50 to 69 years (23.7% and 28.7% in the 50-59 and 60-69 age groups respectively in 2016).

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

| Year of onset | Average age | Age 15-29 | | Age 30-39 | | Age 40-49 | | |
|---------------|-------------|-----------|-----------|-----------|-----------|-----------|---------|------|
| | | Number | % | Number | % | Number | % | |
| 2007 | 64.5 | 8 | 0.2 | 103 | 2.3 | 591 | 13.4 | |
| 2008 | 64.6 | 8 | 0.2 | 107 | 2.3 | 559 | 11.9 | |
| 2009 | 63.7 | 10 | 0.2 | 105 | 2.4 | 573 | 12.8 | |
| 2010 | 64.4 | 9 | 0.2 | 105 | 2.2 | 584 | 12.2 | |
| 2011 | 64.9 | 12 | 0.2 | 116 | 2.2 | 627 | 11.8 | |
| 2012 | 65.2 | 11 | 0.2 | 120 | 2.0 | 632 | 10.6 | |
| 2013 | 65.1 | 10 | 0.2 | 121 | 2.0 | 661 | 10.8 | |
| 2014 | 65.4 | 10 | 0.2 | 110 | 1.7 | 664 | 10.4 | |
| 2015 | 65.7 | 8 | 0.1 | 126 | 1.9 | 637 | 9.7 | |
| 2016 | 66.2 | 11 | 0.2 | 133 | 1.9 | 609 | 8.6 | |
| Year of onset | Age 50-59 | | Age 60-69 | | Age 70-79 | | Age 80+ | |
| | Number | % | Number | % | Number | % | Number | % |
| 2007 | 1093 | 24.7 | 1011 | 22.9 | 988 | 22.4 | 626 | 14.2 |
| 2008 | 1194 | 25.5 | 1096 | 23.4 | 1045 | 22.3 | 674 | 14.4 |
| 2009 | 1188 | 26.6 | 1059 | 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 | 1547 | 25.3 | 1277 | 20.9 | 956 | 15.7 |
| 2014 | 1599 | 25.0 | 1630 | 25.5 | 1342 | 21.0 | 1033 | 16.2 |
| 2015 | 1575 | 23.9 | 1834 | 27.9 | 1298 | 19.7 | 1102 | 16.7 |
| 2016 | 1668 | 23.7 | 2022 | 28.7 | 1353 | 19.2 | 1256 | 17.8 |

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

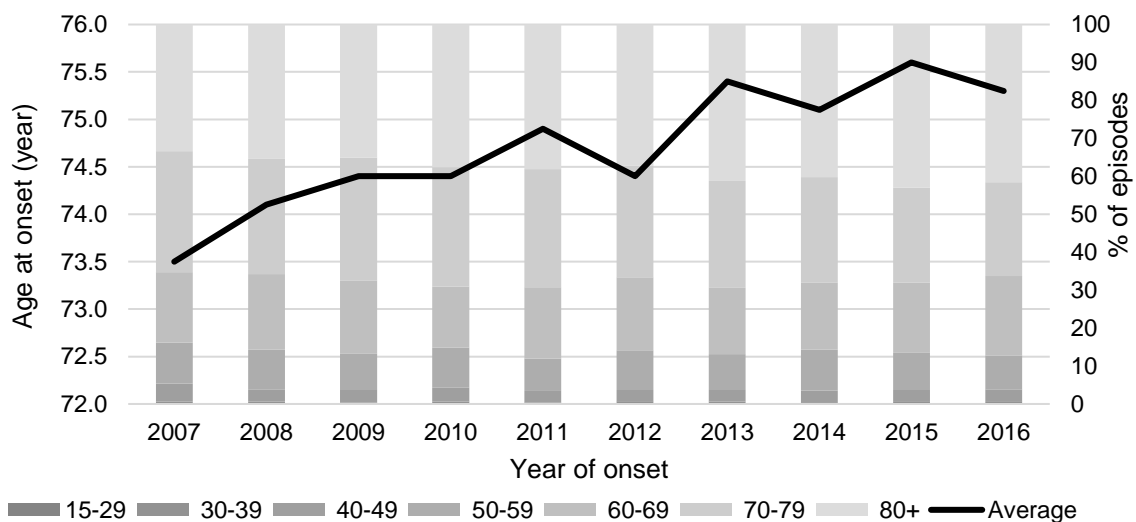


The average age at onset ranged from 73 to 76 years among women, almost a decade older than the average age at onset among men (Table 5.1.5b and Figure 5.1.5b). The majority of the female patients were aged 80 years or above, with 41.5% in this age group in 2016.

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

| Year of onset | Average age | Age 15-29 | | Age 30-39 | | Age 40-49 | | |
|---------------|-------------|-----------|-----------|-----------|-----------|-----------|---------|------|
| | | Number | % | Number | % | Number | % | |
| 2007 | 73.5 | 2 | 0.1 | 14 | 0.6 | 113 | 4.7 | |
| 2008 | 74.1 | 2 | 0.1 | 14 | 0.5 | 83 | 3.2 | |
| 2009 | 74.4 | 3 | 0.1 | 7 | 0.3 | 76 | 3.3 | |
| 2010 | 74.4 | 3 | 0.1 | 13 | 0.5 | 92 | 3.6 | |
| 2011 | 74.9 | 1 | 0.0 | 10 | 0.4 | 82 | 3.0 | |
| 2012 | 74.4 | 4 | 0.1 | 19 | 0.6 | 93 | 3.0 | |
| 2013 | 75.4 | 3 | 0.1 | 18 | 0.5 | 104 | 3.0 | |
| 2014 | 75.1 | 1 | 0.0 | 16 | 0.5 | 104 | 3.0 | |
| 2015 | 75.6 | 5 | 0.1 | 22 | 0.6 | 105 | 3.0 | |
| 2016 | 75.3 | 5 | 0.1 | 21 | 0.6 | 115 | 3.1 | |
| Year of onset | Age 50-59 | | Age 60-69 | | Age 70-79 | | Age 80+ | |
| | Number | % | Number | % | Number | % | Number | % |
| 2007 | 259 | 10.8 | 445 | 18.6 | 763 | 31.8 | 801 | 33.4 |
| 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 | 957 | 37.6 |
| 2011 | 230 | 8.5 | 511 | 18.9 | 842 | 31.1 | 1032 | 38.1 |
| 2012 | 328 | 10.4 | 607 | 19.3 | 927 | 29.4 | 1170 | 37.2 |
| 2013 | 325 | 9.5 | 598 | 17.5 | 964 | 28.1 | 1413 | 41.3 |
| 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 | 326 | 8.9 | 773 | 21.0 | 909 | 24.7 | 1527 | 41.5 |

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



Similar to the general population's ethnic distribution, most of the AMI episodes occurred among the Chinese, followed by the Malays, then the Indians (Table 5.1.6). The rise in ASIR over the years was significant among the Malays only ($p=0.006$) (Figure 5.1.6). The Chinese consistently had a lower ASIR than the Malays and Indians across the years. In 2016, the ASIR was 174.4, 445.6 and 429.9 per 100,000 population for the Chinese, Malays and Indians respectively.

The prevalence of hypertension, high total cholesterol and diabetes were higher among the Malays, relative to the Chinese and Indians in the general population as shown by the National Health Survey 2010¹². Although the prevalence of hypertension and high total cholesterol 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^{13,14}.

¹² National Health Survey 2010. Ministry of Health, Singapore.

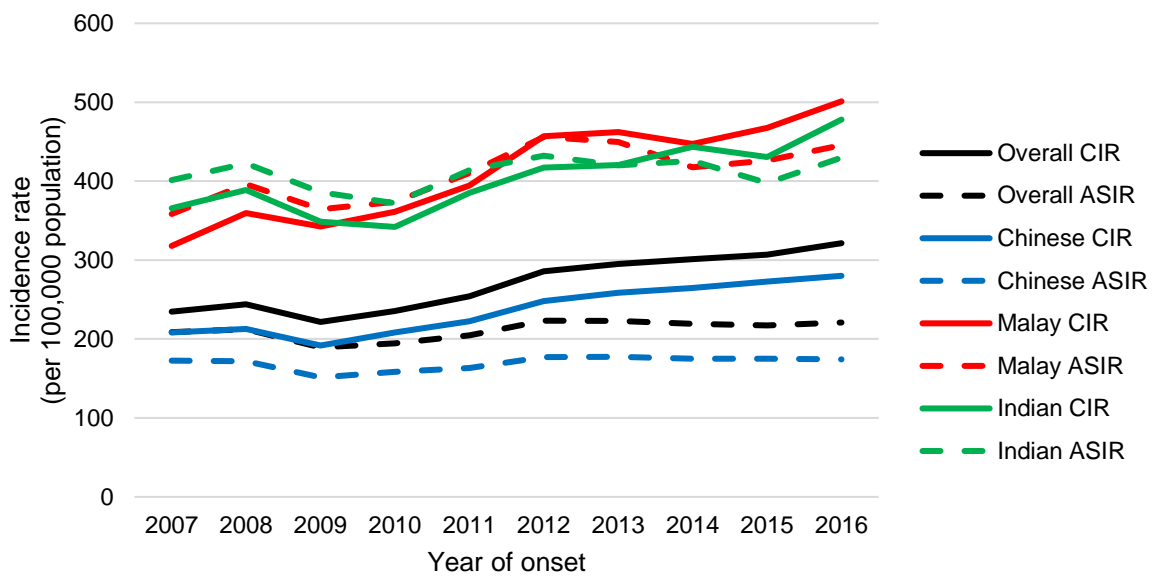
¹³ Mak KH et al. Ethnic differences in acute myocardial infarction in Singapore. *European Heart Journal* 2003; 24: 151-160.

¹⁴ 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 |
| 2007 | 4630 | 67.9 | 208.1 | 202.1-214.1 | 172.6 | 167.6-177.7 |
| 2008 | 4821 | 66.5 | 212.7 | 206.7-218.7 | 171.7 | 166.8-176.7 |
| 2009 | 4452 | 65.5 | 191.8 | 186.1-197.4 | 151.5 | 146.9-156.0 |
| 2010 | 4907 | 66.8 | 208.3 | 202.5-214.1 | 158.3 | 153.7-162.8 |
| 2011 | 5296 | 66.1 | 222.4 | 216.4-228.4 | 163.4 | 158.9-167.9 |
| 2012 | 5982 | 65.6 | 248.1 | 241.8-254.4 | 176.9 | 172.4-181.5 |
| 2013 | 6307 | 66.2 | 258.5 | 252.2-264.9 | 177.4 | 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 | 7059 | 65.8 | 280.1 | 273.5-286.6 | 174.4 | 170.2-178.5 |
| P for trend | - | - | <0.001 | - | 0.172 | - |
| Malay | | | | | | |
| Year of onset | Number | % | CIR | 95% CI | ASIR | 95% CI |
| 2007 | 1170 | 17.2 | 317.9 | 299.7-336.2 | 358.4 | 337.2-379.7 |
| 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 | 1567 | 19.6 | 394.6 | 375.1-414.1 | 410.1 | 389.0-431.3 |
| 2012 | 1841 | 20.2 | 456.8 | 436.0-477.7 | 456.0 | 434.6-477.4 |
| 2013 | 1890 | 19.8 | 462.3 | 441.5-483.2 | 449.6 | 428.9-470.3 |
| 2014 | 1853 | 18.8 | 447.0 | 426.7-467.4 | 417.5 | 398.1-436.9 |
| 2015 | 1964 | 19.4 | 467.5 | 446.8-488.2 | 426.2 | 407.0-445.5 |
| 2016 | 2134 | 19.9 | 501.1 | 479.9-522.4 | 445.6 | 426.2-464.9 |
| P for trend | - | - | <0.001 | - | 0.006 | - |
| Indian | | | | | | |
| Year of onset | Number | % | CIR | 95% CI | ASIR | 95% CI |
| 2007 | 883 | 13.0 | 365.5 | 341.4-389.6 | 401.3 | 373.9-428.7 |
| 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 | 1379 | 12.9 | 478.0 | 452.8-503.3 | 429.9 | 406.8-453.0 |
| P for trend | - | - | 0.002 | - | 0.251 | - |

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

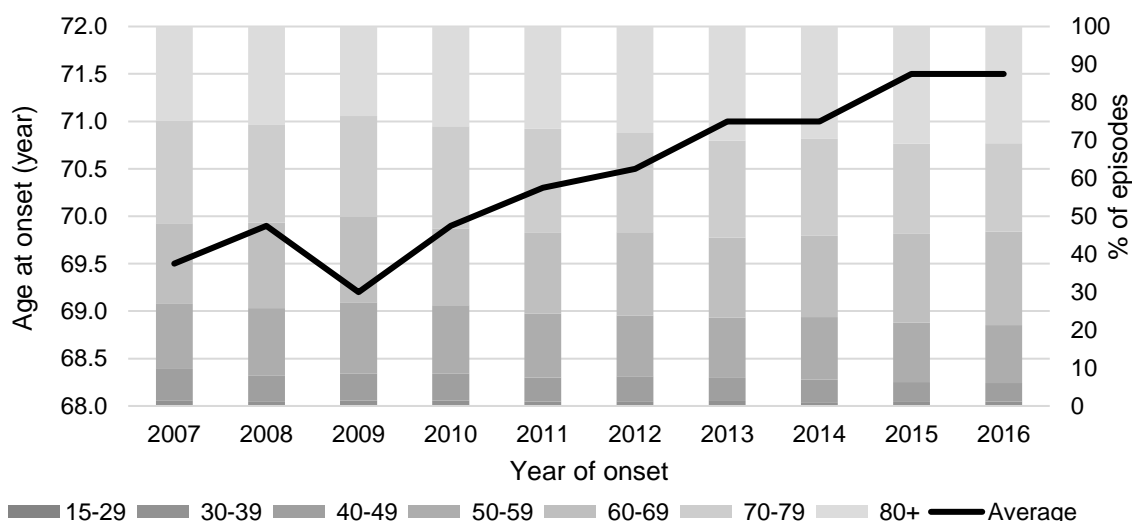


The average age at onset ranged from 69 to 72 years among the Chinese and it increased gradually over the years (Table 5.1.7a and Figure 5.1.7a). The majority of the Chinese patients were aged 80 years or above, with 30.7% in this age group in 2016.

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

| Year of onset | Average age | Age 15-29 | | Age 30-39 | | Age 40-49 | | |
|---------------|-------------|-----------|-----------|-----------|-----------|-----------|---------|------|
| | | Number | % | Number | % | Number | % | |
| 2007 | 69.5 | 2 | 0.0 | 69 | 1.5 | 380 | 8.2 | |
| 2008 | 69.9 | 4 | 0.1 | 54 | 1.1 | 332 | 6.9 | |
| 2009 | 69.2 | 8 | 0.2 | 53 | 1.2 | 320 | 7.2 | |
| 2010 | 69.9 | 3 | 0.1 | 67 | 1.4 | 346 | 7.1 | |
| 2011 | 70.3 | 5 | 0.1 | 55 | 1.0 | 337 | 6.4 | |
| 2012 | 70.5 | 10 | 0.2 | 66 | 1.1 | 392 | 6.6 | |
| 2013 | 71.0 | 8 | 0.1 | 75 | 1.2 | 381 | 6.0 | |
| 2014 | 71.0 | 6 | 0.1 | 59 | 0.9 | 389 | 6.0 | |
| 2015 | 71.5 | 9 | 0.1 | 66 | 1.0 | 353 | 5.2 | |
| 2016 | 71.5 | 4 | 0.1 | 80 | 1.1 | 343 | 4.9 | |
| Year of onset | Age 50-59 | | Age 60-69 | | Age 70-79 | | Age 80+ | |
| | Number | % | Number | % | Number | % | Number | % |
| 2007 | 803 | 17.3 | 976 | 21.1 | 1248 | 27.0 | 1152 | 24.9 |
| 2008 | 855 | 17.7 | 1086 | 22.5 | 1245 | 25.8 | 1245 | 25.8 |
| 2009 | 833 | 18.7 | 1004 | 22.6 | 1184 | 26.6 | 1050 | 23.6 |
| 2010 | 887 | 18.1 | 994 | 20.3 | 1319 | 26.9 | 1291 | 26.3 |
| 2011 | 894 | 16.9 | 1124 | 21.2 | 1454 | 27.5 | 1427 | 26.9 |
| 2012 | 961 | 16.1 | 1308 | 21.9 | 1568 | 26.2 | 1677 | 28.0 |
| 2013 | 1002 | 15.9 | 1333 | 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 | 15.3 | 1738 | 24.6 | 1646 | 23.3 | 2170 | 30.7 |

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

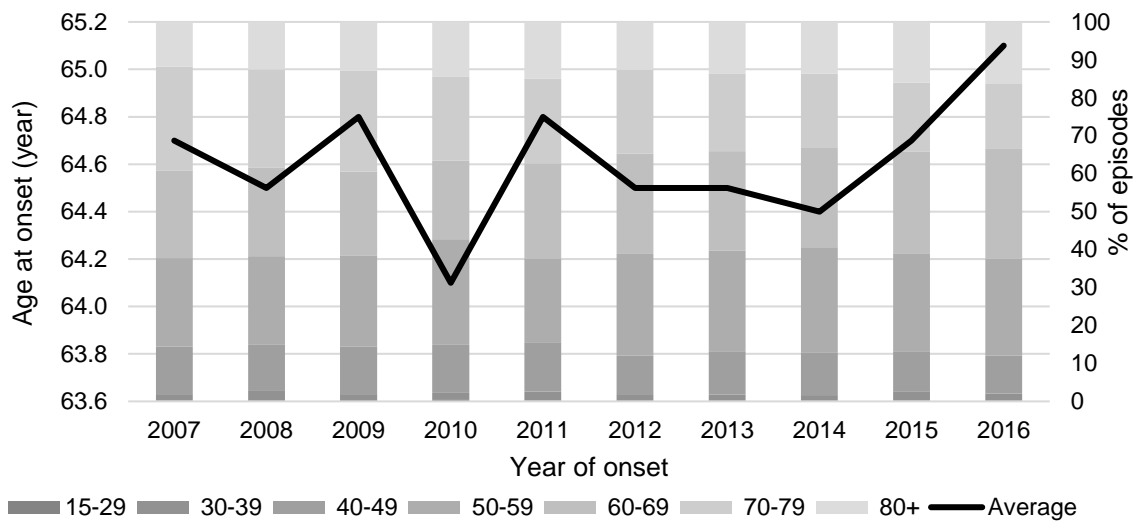


The average age at onset ranged from 64 to 66 years among the Malays, a few years younger than the average age at onset among the Chinese (Table 5.1.7b and Figure 5.1.7b). The majority of the Malay patients were aged 50 to 69 years (25.5% and 29.0% in the 50-59 and 60-69 age groups respectively in 2016).

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

| Year of onset | Average age | | Age 15-29 | | Age 30-39 | | Age 40-49 | |
|---------------|-------------|------|-----------|------|-----------|------|-----------|------|
| | | | Number | % | Number | % | Number | % |
| 2007 | 64.7 | | 3 | 0.3 | 19 | 1.6 | 147 | 12.6 |
| 2008 | 64.5 | | 2 | 0.1 | 35 | 2.6 | 165 | 12.2 |
| 2009 | 64.8 | | 1 | 0.1 | 24 | 1.8 | 164 | 12.5 |
| 2010 | 64.1 | | 6 | 0.4 | 26 | 1.8 | 179 | 12.7 |
| 2011 | 64.8 | | 4 | 0.3 | 37 | 2.4 | 200 | 12.8 |
| 2012 | 64.5 | | 3 | 0.2 | 32 | 1.7 | 187 | 10.2 |
| 2013 | 64.5 | | 3 | 0.2 | 32 | 1.7 | 214 | 11.3 |
| 2014 | 64.4 | | 3 | 0.2 | 28 | 1.5 | 206 | 11.1 |
| 2015 | 64.7 | | 4 | 0.2 | 48 | 2.4 | 208 | 10.6 |
| 2016 | 65.1 | | 7 | 0.3 | 37 | 1.7 | 214 | 10.0 |
| Year of onset | Age 50-59 | | Age 60-69 | | Age 70-79 | | Age 80+ | |
| | Number | % | Number | % | Number | % | Number | % |
| 2007 | 273 | 23.3 | 270 | 23.1 | 320 | 27.4 | 138 | 11.8 |
| 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 | 350 | 22.3 | 392 | 25.0 | 349 | 22.3 | 235 | 15.0 |
| 2012 | 494 | 26.8 | 486 | 26.4 | 407 | 22.1 | 232 | 12.6 |
| 2013 | 503 | 26.6 | 494 | 26.1 | 387 | 20.5 | 257 | 13.6 |
| 2014 | 516 | 27.8 | 485 | 26.2 | 362 | 19.5 | 253 | 13.7 |
| 2015 | 507 | 25.8 | 524 | 26.7 | 359 | 18.3 | 314 | 16.0 |
| 2016 | 544 | 25.5 | 618 | 29.0 | 368 | 17.2 | 346 | 16.2 |

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

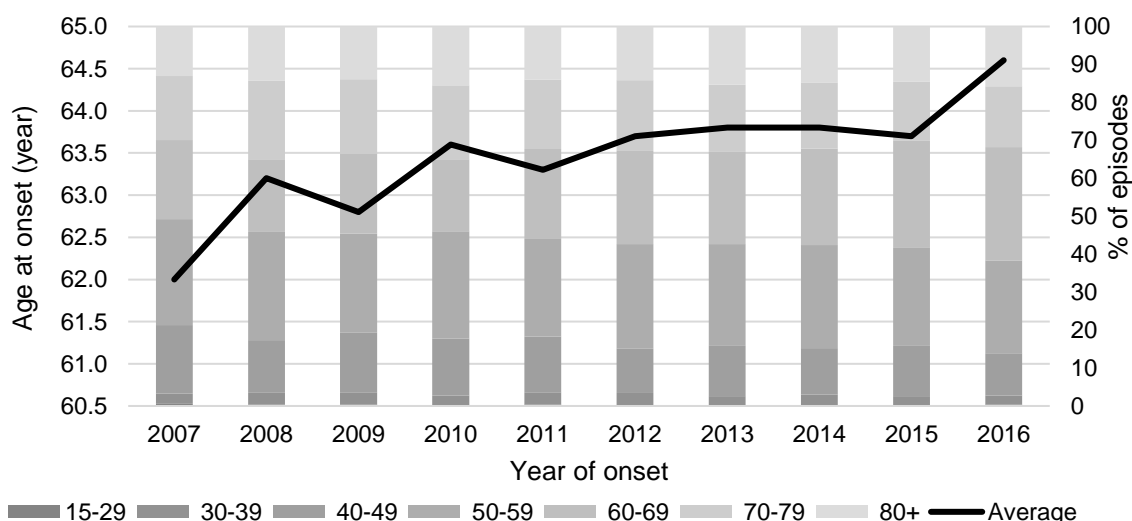


The average age at onset ranged from 62 to 65 years among the Indians. The average age at onset among the Indians was the youngest across the three main ethnic groups and it increased gradually over the years (Table 5.1.7c and Figure 5.1.7c). The majority of the Indian patients were aged 50 to 69 years (24.4% and 29.9% in the 50-59 and 60-69 age groups respectively in 2016).

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

| Year of onset | Average age | Age 15-29 | | Age 30-39 | | Age 40-49 | | |
|---------------|-------------|-----------|-----------|-----------|-----------|-----------|---------|------|
| | | Number | % | Number | % | Number | % | |
| 2007 | 62.0 | 5 | 0.6 | 24 | 2.7 | 159 | 18.0 | |
| 2008 | 63.2 | 4 | 0.4 | 31 | 3.2 | 134 | 13.7 | |
| 2009 | 62.8 | 4 | 0.4 | 30 | 3.2 | 146 | 15.6 | |
| 2010 | 63.6 | 2 | 0.2 | 24 | 2.6 | 140 | 15.0 | |
| 2011 | 63.3 | 4 | 0.4 | 34 | 3.2 | 156 | 14.7 | |
| 2012 | 63.7 | 2 | 0.2 | 38 | 3.3 | 135 | 11.6 | |
| 2013 | 63.8 | 2 | 0.2 | 29 | 2.5 | 156 | 13.2 | |
| 2014 | 63.8 | 2 | 0.2 | 36 | 2.9 | 154 | 12.2 | |
| 2015 | 63.7 | 0 | 0.0 | 32 | 2.6 | 163 | 13.2 | |
| 2016 | 64.6 | 5 | 0.4 | 33 | 2.4 | 154 | 11.2 | |
| Year of onset | Age 50-59 | | Age 60-69 | | Age 70-79 | | Age 80+ | |
| | Number | % | Number | % | Number | % | Number | % |
| 2007 | 247 | 28.0 | 184 | 20.8 | 149 | 16.9 | 115 | 13.0 |
| 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 | 337 | 24.4 | 412 | 29.9 | 221 | 16.0 | 217 | 15.7 |

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

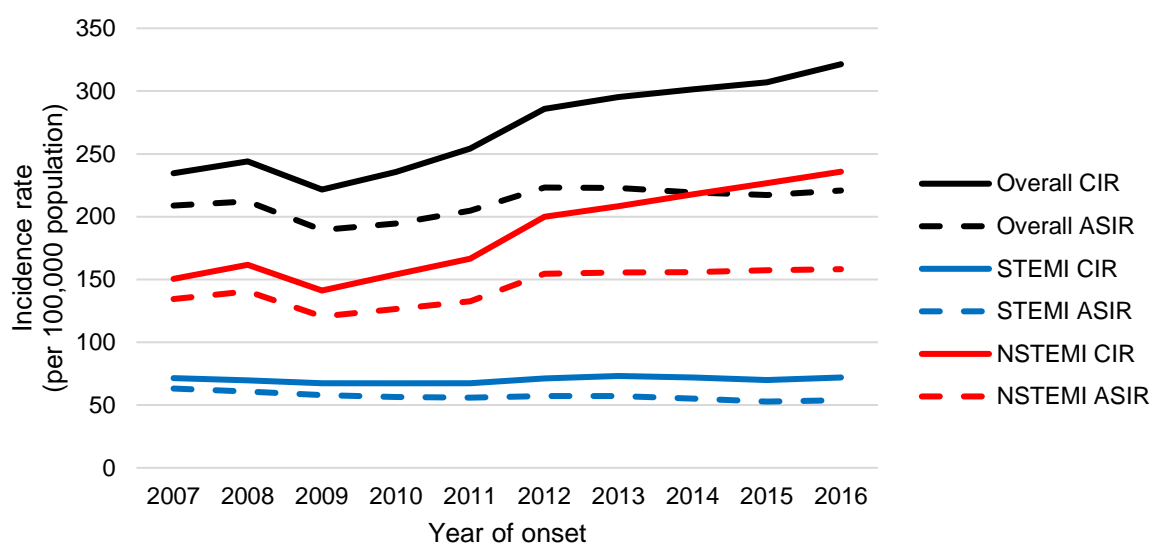


NSTEMI episodes were more common than STEMI episodes (Table 5.1.8). The ASIR of STEMI decreased significantly from 63.1 per 100,000 population in 2007 to 53.8 per 100,000 population in 2016 ($p<0.001$), while the ASIR of NSTEMI increased significantly from 134.5 per 100,000 population in 2007 to 158.2 per 100,000 population in 2016 ($p=0.008$) (Figure 5.1.8). The ASIR of NSTEMI was consistently higher than that of STEMI across the years. As NSTEMI may be precipitated by other underlying co-morbidities in elderly patients, Singapore's ageing population is likely a contributory factor to the higher incidence of NSTEMI than STEMI.

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 |
| 2007 | 2077 | 30.5 | 71.5 | 68.4-74.6 | 63.1 | 60.4-65.9 |
| 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 | 2403 | 22.4 | 72.0 | 69.1-74.9 | 53.8 | 51.6-56.0 |
| P for trend | - | - | 0.220 | - | <0.001 | - |
| NSTEMI | | | | | | |
| Year of onset | Number | % | CIR | 95% CI | ASIR | 95% CI |
| 2007 | 4371 | 64.1 | 150.5 | 146.1-155.0 | 134.5 | 130.5-138.6 |
| 2008 | 4801 | 66.2 | 161.6 | 157.0-166.1 | 140.5 | 136.5-144.6 |
| 2009 | 4329 | 63.7 | 141.2 | 137.0-145.4 | 120.6 | 116.9-124.2 |
| 2010 | 4799 | 65.3 | 153.9 | 149.6-158.3 | 126.4 | 122.8-130.1 |
| 2011 | 5250 | 65.5 | 166.5 | 162.0-171.1 | 132.7 | 129.0-136.4 |
| 2012 | 6379 | 69.9 | 199.9 | 195.0-204.8 | 154.6 | 150.8-158.5 |
| 2013 | 6729 | 70.6 | 208.4 | 203.4-213.4 | 155.5 | 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 | 7870 | 73.4 | 235.8 | 230.6-241.0 | 158.2 | 154.6-161.8 |
| P for trend | - | - | <0.001 | - | 0.008 | - |

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

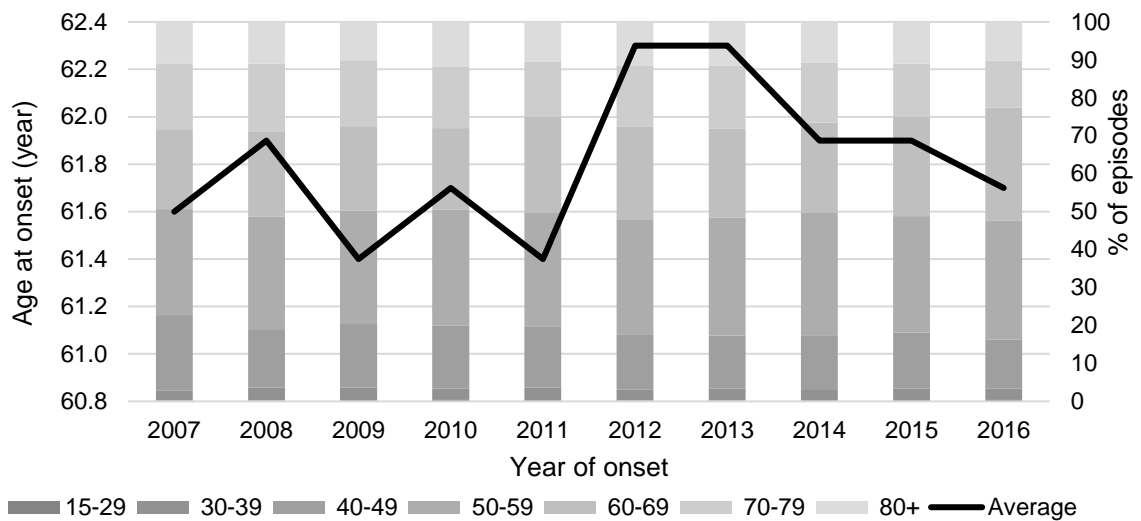


The average age at onset ranged from 61 to 63 years among STEMI (Table 5.1.9a and Figure 5.1.9a). The majority of the STEMI patients were aged 50 to 69 years (31.4% and 29.7% in the 50-59 and 60-69 age groups respectively in 2016).

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

| Year of onset | Average age | Age 15-29 | | Age 30-39 | | Age 40-49 | | |
|---------------|-------------|-----------|-----------|-----------|-----------|-----------|---------|------|
| | | Number | % | Number | % | Number | % | |
| 2007 | 61.6 | 4 | 0.2 | 57 | 2.7 | 412 | 19.8 | |
| 2008 | 61.9 | 4 | 0.2 | 70 | 3.4 | 320 | 15.5 | |
| 2009 | 61.4 | 7 | 0.3 | 69 | 3.3 | 346 | 16.7 | |
| 2010 | 61.7 | 9 | 0.4 | 62 | 3.0 | 348 | 16.6 | |
| 2011 | 61.4 | 7 | 0.3 | 72 | 3.4 | 342 | 16.1 | |
| 2012 | 62.3 | 5 | 0.2 | 67 | 2.9 | 326 | 14.3 | |
| 2013 | 62.3 | 5 | 0.2 | 76 | 3.2 | 329 | 13.9 | |
| 2014 | 61.9 | 8 | 0.3 | 62 | 2.6 | 338 | 14.4 | |
| 2015 | 61.9 | 3 | 0.1 | 74 | 3.2 | 340 | 14.7 | |
| 2016 | 61.7 | 9 | 0.4 | 71 | 3.0 | 312 | 13.0 | |
| Year of onset | Age 50-59 | | Age 60-69 | | Age 70-79 | | Age 80+ | |
| | Number | % | Number | % | Number | % | Number | % |
| 2007 | 580 | 27.9 | 432 | 20.8 | 364 | 17.5 | 228 | 11.0 |
| 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 | 755 | 31.4 | 714 | 29.7 | 298 | 12.4 | 244 | 10.2 |

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

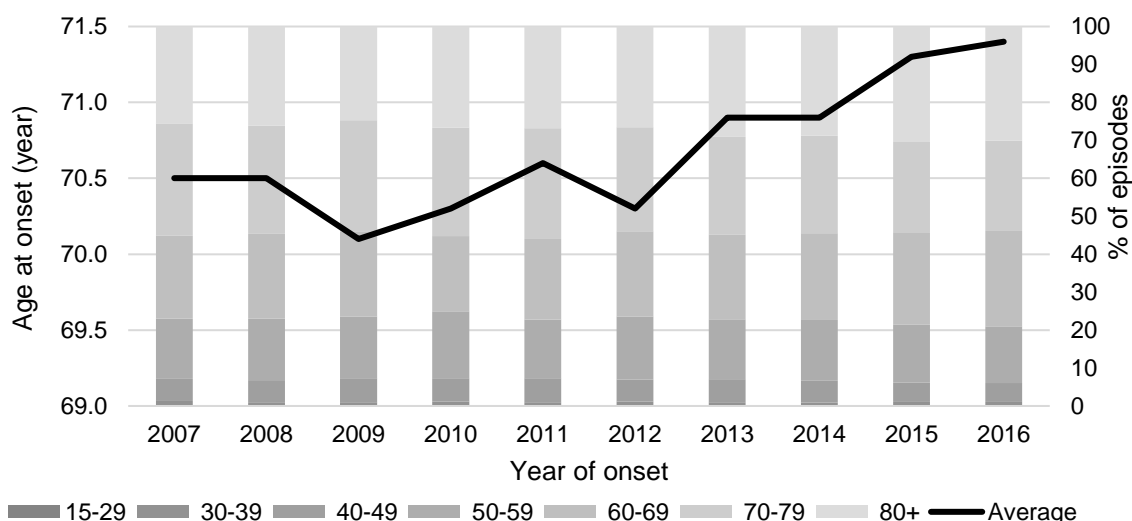


The average age at onset ranged from 70 to 72 years among NSTEMI, almost a decade older than the average age at onset among STEMI and it increased gradually over the years (Table 5.1.9b and Figure 5.1.9b). The majority of the NSTEMI patients were aged 80 years or above, with 30.1% in this age group in 2016.

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

| Year of onset | Average age | Age 15-29 | | Age 30-39 | | Age 40-49 | | |
|---------------|-------------|-----------|-----------|-----------|-----------|-----------|---------|------|
| | | Number | % | Number | % | Number | % | |
| 2007 | 70.5 | 5 | 0.1 | 53 | 1.2 | 255 | 5.8 | |
| 2008 | 70.5 | 4 | 0.1 | 42 | 0.9 | 280 | 5.8 | |
| 2009 | 70.1 | 5 | 0.1 | 39 | 0.9 | 273 | 6.3 | |
| 2010 | 70.3 | 1 | 0.0 | 53 | 1.1 | 295 | 6.1 | |
| 2011 | 70.6 | 5 | 0.1 | 46 | 0.9 | 331 | 6.3 | |
| 2012 | 70.3 | 9 | 0.1 | 62 | 1.0 | 373 | 5.8 | |
| 2013 | 70.9 | 8 | 0.1 | 60 | 0.9 | 407 | 6.0 | |
| 2014 | 70.9 | 3 | 0.0 | 59 | 0.8 | 411 | 5.8 | |
| 2015 | 71.3 | 10 | 0.1 | 67 | 0.9 | 381 | 5.1 | |
| 2016 | 71.4 | 7 | 0.1 | 79 | 1.0 | 390 | 5.0 | |
| Year of onset | Age 50-59 | | Age 60-69 | | Age 70-79 | | Age 80+ | |
| | Number | % | Number | % | Number | % | Number | % |
| 2007 | 693 | 15.9 | 953 | 21.8 | 1295 | 29.6 | 1117 | 25.6 |
| 2008 | 780 | 16.2 | 1070 | 22.3 | 1372 | 28.6 | 1253 | 26.1 |
| 2009 | 704 | 16.3 | 965 | 22.3 | 1275 | 29.5 | 1068 | 24.7 |
| 2010 | 847 | 17.6 | 953 | 19.9 | 1371 | 28.6 | 1279 | 26.7 |
| 2011 | 812 | 15.5 | 1115 | 21.2 | 1535 | 29.2 | 1406 | 26.8 |
| 2012 | 1060 | 16.6 | 1431 | 22.4 | 1749 | 27.4 | 1695 | 26.6 |
| 2013 | 1061 | 15.8 | 1501 | 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 | 1177 | 15.0 | 1977 | 25.1 | 1869 | 23.7 | 2371 | 30.1 |

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



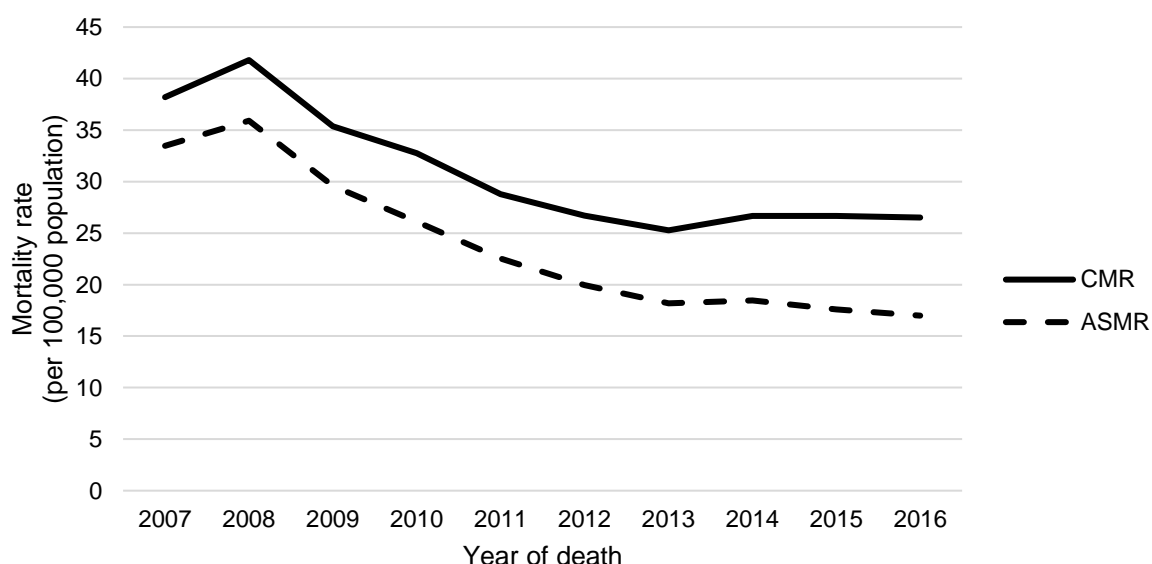
5.2 Mortality of AMI

The number of AMI deaths was 885 in 2016, a drop compared to 1,109 in 2007 (Table 5.2.1). Correspondingly, the crude mortality rate (CMR) declined significantly from 38.2 per 100,000 population in 2007 to 26.5 per 100,000 population in 2016 ($p=0.001$) (Figure 5.2.1). However, a slight rise in number of AMI deaths and CMR were observed from 2013 onwards. 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 33.5 per 100,000 population in 2007 to 17.0 per 100,000 population in 2016 ($p<0.001$). 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 |
|---------------|--------|-------|-----------|--------|-----------|
| 2007 | 1109 | 38.2 | 35.9-40.4 | 33.5 | 31.5-35.5 |
| 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 |
| P for trend | - | 0.001 | - | <0.001 | - |

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



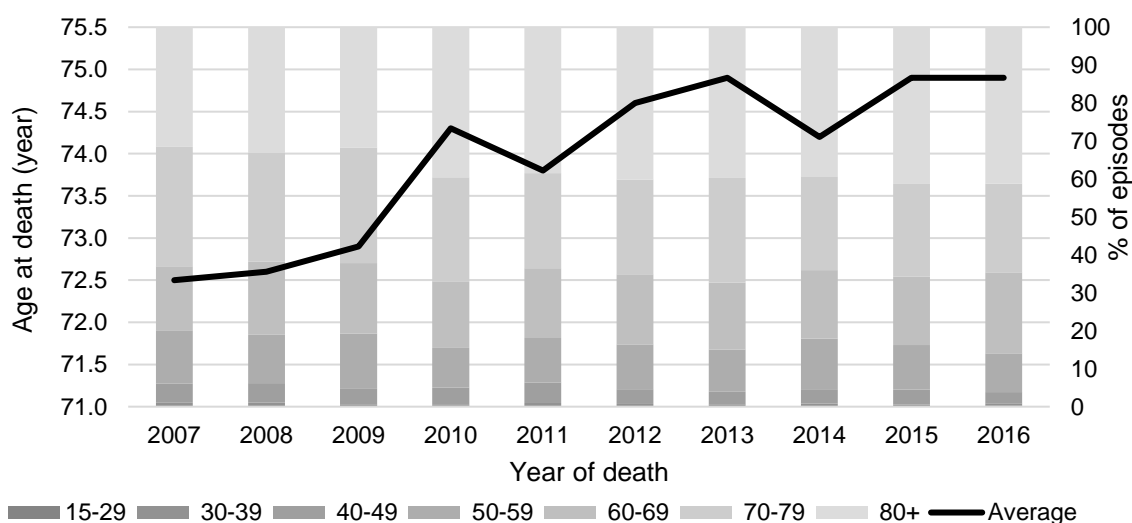
The average age at death ranged from 72 to 75 years (Table 5.2.2 and Figure 5.2.2). About 6 in 10 of the patients died at age 70 years or above.

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

| Year of death | Average age | Age 15-29 | | Age 30-39 | | Age 40-49 | |
|---------------|-------------|-----------|-----|-----------|-----|-----------|-----|
| | | Number | % | Number | % | Number | % |
| 2007 | 72.5 | 1 | 0.1 | 12 | 1.1 | 55 | 5.0 |
| 2008 | 72.6 | 1 | 0.1 | 12 | 1.0 | 64 | 5.2 |
| 2009 | 72.9 | 1 | 0.1 | 6 | 0.6 | 44 | 4.1 |
| 2010 | 74.3 | 2 | 0.2 | 3 | 0.3 | 46 | 4.5 |
| 2011 | 73.8 | 0 | 0.0 | 9 | 1.0 | 49 | 5.4 |
| 2012 | 74.6 | 1 | 0.1 | 5 | 0.6 | 33 | 3.9 |
| 2013 | 74.9 | 0 | 0.0 | 5 | 0.6 | 27 | 3.3 |
| 2014 | 74.2 | 1 | 0.1 | 6 | 0.7 | 33 | 3.8 |
| 2015 | 74.9 | 0 | 0.0 | 5 | 0.6 | 35 | 4.0 |
| 2016 | 74.9 | 2 | 0.2 | 6 | 0.7 | 26 | 2.9 |

| Year of death | Age 50-59 | | Age 60-69 | | Age 70-79 | | Age 80+ | |
|---------------|-----------|------|-----------|------|-----------|------|---------|------|
| | Number | % | Number | % | Number | % | Number | % |
| 2007 | 155 | 14.0 | 187 | 16.9 | 349 | 31.5 | 350 | 31.6 |
| 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 |

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



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). There was a drop in overall mortality rate from 2010 onwards and the drop in mortality rate for patients aged 70 years or above was higher than those aged below 70 years (Figure 5.2.3b).

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 |
| 2007 | 38.2 | 35.9-40.4 | 0.1 | 0.0-0.4 | 2.0 | 0.9-3.2 | 8.6 | 6.4-10.9 |
| 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 | 0.0-0.0 | 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 | 0.0-0.0 | 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 | 0.0-0.0 | 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 | 1.0 | 0.2-1.8 | 4.2 | 2.6-5.9 |
| P for trend | 0.001 | - | 0.317 | - | 0.145 | - | 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 |
| 2007 | 31.0 | 26.1-35.9 | 75.0 | 64.3-85.8 | 257.8 | 230.7-284.8 | 620.6 | 555.6-685.6 |
| 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 |
| P for trend | 0.001 | - | <0.001 | - | <0.001 | - | <0.001 | - |

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

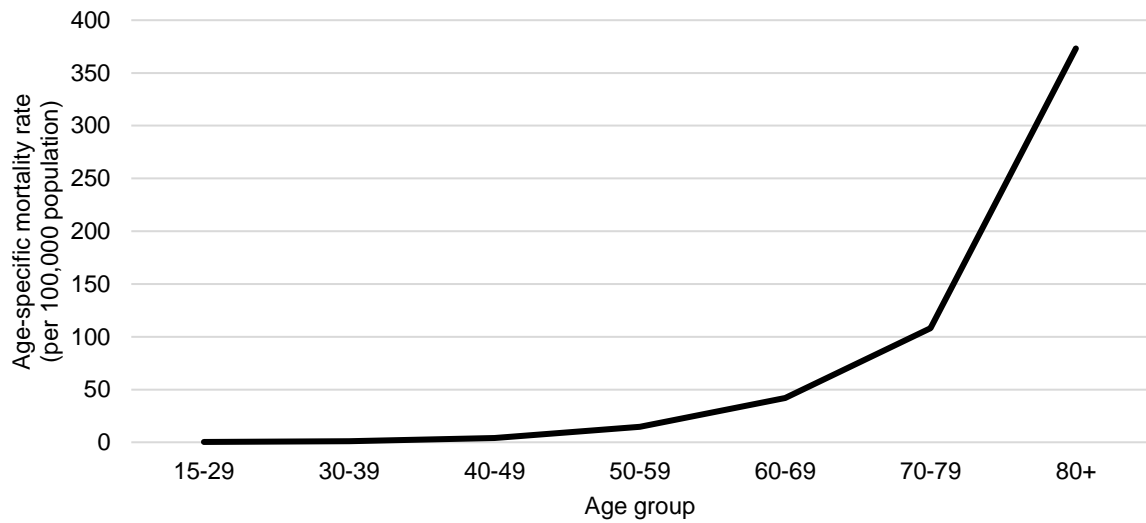
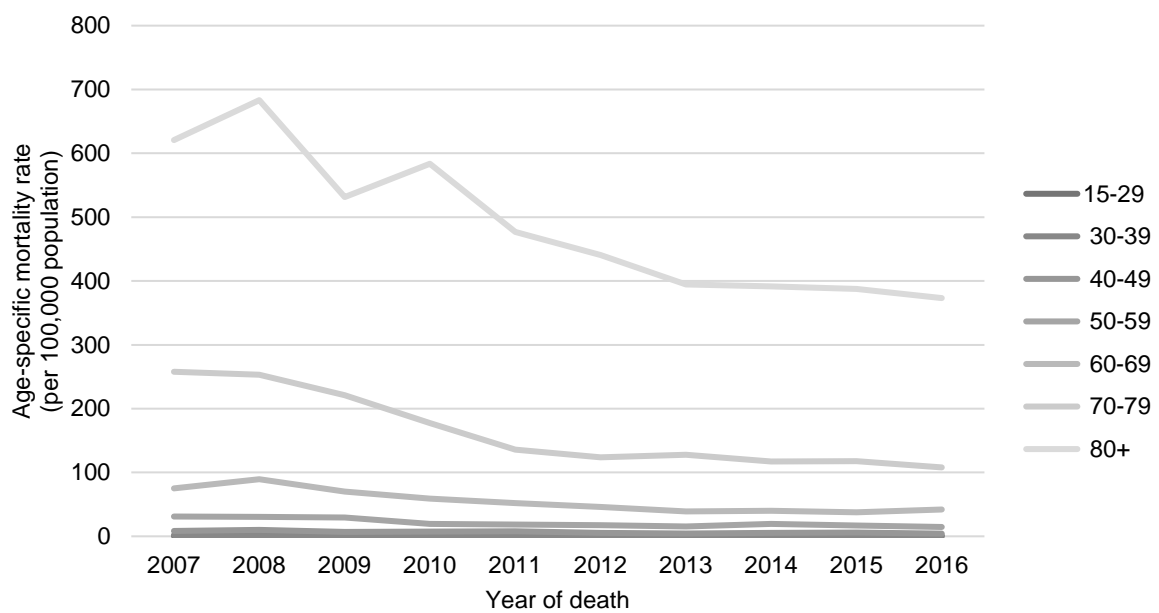


Figure 5.2.3b: Age-specific mortality rate (per 100,000 population) across years

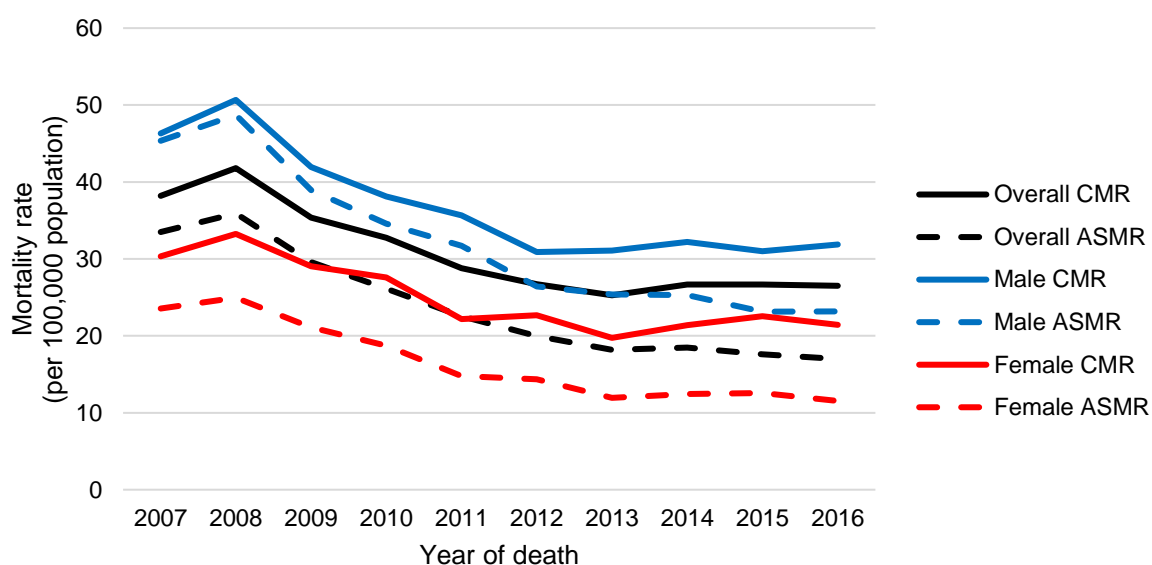


The ASMR declined significantly over the years for both genders ($p < 0.001$ for both) (Table 5.2.4 and Figure 5.2.4). As the ASIR was consistently higher among men than women (Table 5.1.4), it is expected that the ASMR was also consistently higher among men than women across the years. Men had an ASMR of 23.2 per 100,000 population, while women had an ASMR of 11.5 per 100,000 population in 2016.

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 |
| 2007 | 661 | 59.6 | 46.3 | 42.8-49.9 | 45.4 | 41.8-48.9 |
| 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 |
| P for trend | - | - | 0.001 | - | <0.001 | - |
| Female | | | | | | |
| Year of death | Number | % | CMR | 95% CI | ASMR | 95% CI |
| 2007 | 448 | 40.4 | 30.3 | 27.5-33.1 | 23.6 | 21.3-25.8 |
| 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 |
| P for trend | - | - | 0.001 | - | <0.001 | - |

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

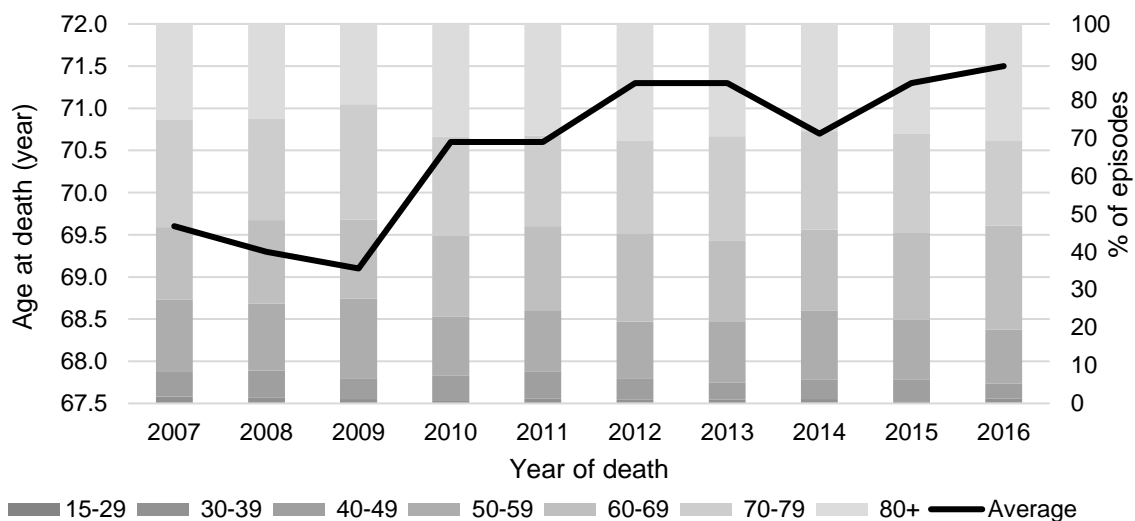


The average age at death ranged from 69 to 72 years among men (Table 5.2.5a and Figure 5.2.5a). The majority of the male patients died at age 80 years or above, with 30.9% in this age group in 2016.

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

| Year of death | Average age | Age 15-29 | | Age 30-39 | | Age 40-49 | | |
|---------------|-------------|-----------|-----------|-----------|-----------|-----------|---------|------|
| | | Number | % | Number | % | Number | % | |
| 2007 | 69.6 | 1 | 0.2 | 11 | 1.7 | 44 | 6.7 | |
| 2008 | 69.3 | 1 | 0.1 | 10 | 1.4 | 53 | 7.2 | |
| 2009 | 69.1 | 1 | 0.2 | 6 | 1.0 | 35 | 5.6 | |
| 2010 | 70.6 | 1 | 0.2 | 3 | 0.5 | 39 | 6.7 | |
| 2011 | 70.6 | 0 | 0.0 | 7 | 1.3 | 39 | 7.1 | |
| 2012 | 71.3 | 1 | 0.2 | 4 | 0.8 | 27 | 5.6 | |
| 2013 | 71.3 | 0 | 0.0 | 5 | 1.0 | 22 | 4.5 | |
| 2014 | 70.7 | 1 | 0.2 | 5 | 1.0 | 26 | 5.1 | |
| 2015 | 71.3 | 0 | 0.0 | 2 | 0.4 | 29 | 5.8 | |
| 2016 | 71.5 | 1 | 0.2 | 6 | 1.2 | 20 | 3.9 | |
| Year of death | Age 50-59 | | Age 60-69 | | Age 70-79 | | Age 80+ | |
| | Number | % | Number | % | Number | % | Number | % |
| 2007 | 125 | 18.9 | 126 | 19.1 | 187 | 28.3 | 167 | 25.3 |
| 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 |

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

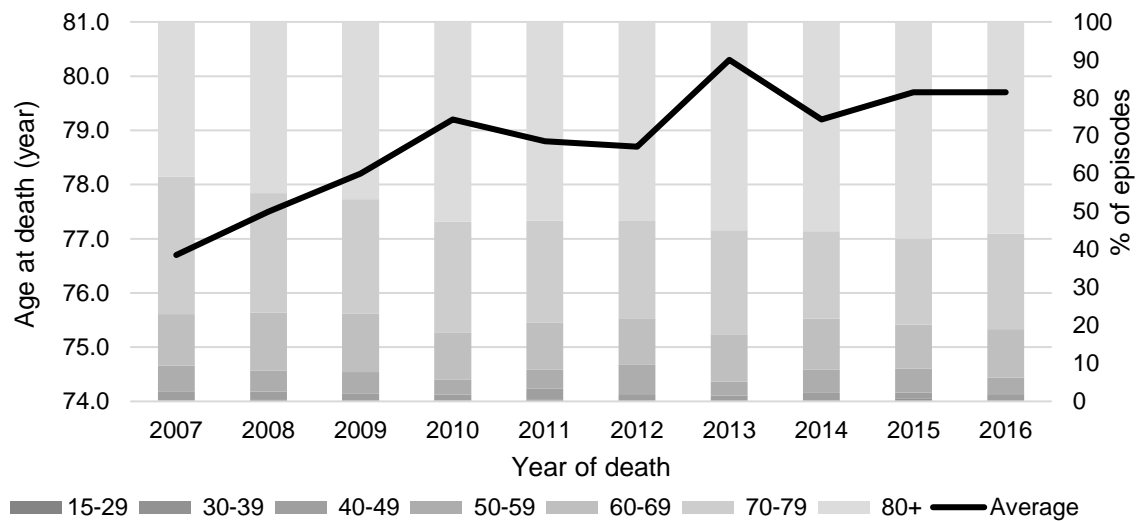


The average age at death ranged from 76 to 81 years among women, a few years older than the average age at death among men (Table 5.2.5b and Figure 5.2.5b). The majority of the female patients died at age 80 years or above, with 55.9% in this age group in 2016.

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

| Year of death | Average age | | Age 15-29 | | Age 30-39 | | Age 40-49 | |
|---------------|-------------|-----|-----------|------|-----------|------|-----------|------|
| | | | Number | % | Number | % | Number | % |
| 2007 | 76.7 | | 0 | 0.0 | 1 | 0.2 | 11 | 2.5 |
| 2008 | 77.5 | | 0 | 0.0 | 2 | 0.4 | 11 | 2.2 |
| 2009 | 78.2 | | 0 | 0.0 | 0 | 0.0 | 9 | 2.0 |
| 2010 | 79.2 | | 1 | 0.2 | 0 | 0.0 | 7 | 1.6 |
| 2011 | 78.8 | | 0 | 0.0 | 2 | 0.6 | 10 | 2.8 |
| 2012 | 78.7 | | 0 | 0.0 | 1 | 0.3 | 6 | 1.6 |
| 2013 | 80.3 | | 0 | 0.0 | 0 | 0.0 | 5 | 1.5 |
| 2014 | 79.2 | | 0 | 0.0 | 1 | 0.3 | 7 | 2.0 |
| 2015 | 79.7 | | 0 | 0.0 | 3 | 0.8 | 6 | 1.6 |
| 2016 | 79.7 | | 1 | 0.3 | 0 | 0.0 | 6 | 1.6 |
| Year of death | Age 50-59 | | Age 60-69 | | Age 70-79 | | Age 80+ | |
| | Number | % | Number | % | Number | % | Number | % |
| 2007 | 30 | 6.7 | 61 | 13.6 | 162 | 36.2 | 183 | 40.8 |
| 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 |

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

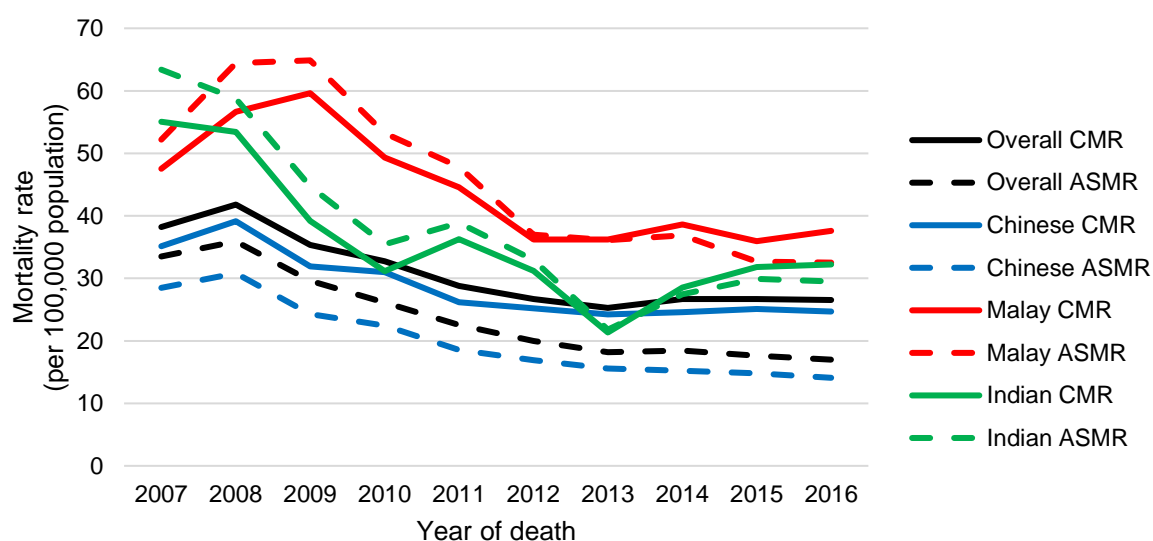


The ASMR showed a significant downward trend over the years for all the three main ethnic groups ($p < 0.001$ for Chinese and Malays; $p = 0.002$ for Indians) (Table 5.2.6 and Figure 5.2.6). As the Chinese consistently had the lowest ASIR (Table 5.1.6), they also generally had the lowest ASMR across the years. In 2016, the ASMR of 14.1 per 100,000 population among the Chinese was significantly lower than the Malays (32.5 per 100,000 population) and Indians (29.5 per 100,000 population).

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 |
| 2007 | 782 | 70.5 | 35.2 | 32.7-37.6 | 28.5 | 26.5-30.5 |
| 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 |
| P for trend | - | - | 0.001 | - | <0.001 | - |
| Malay | | | | | | |
| Year of death | Number | % | CMR | 95% CI | ASMR | 95% CI |
| 2007 | 175 | 15.8 | 47.6 | 40.5-54.6 | 52.2 | 44.2-60.2 |
| 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 |
| P for trend | - | - | 0.004 | - | <0.001 | - |
| Indian | | | | | | |
| Year of death | Number | % | CMR | 95% CI | ASMR | 95% CI |
| 2007 | 133 | 12.0 | 55.0 | 45.7-64.4 | 63.4 | 52.2-74.6 |
| 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 |
| P for trend | - | - | 0.016 | - | 0.002 | - |

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

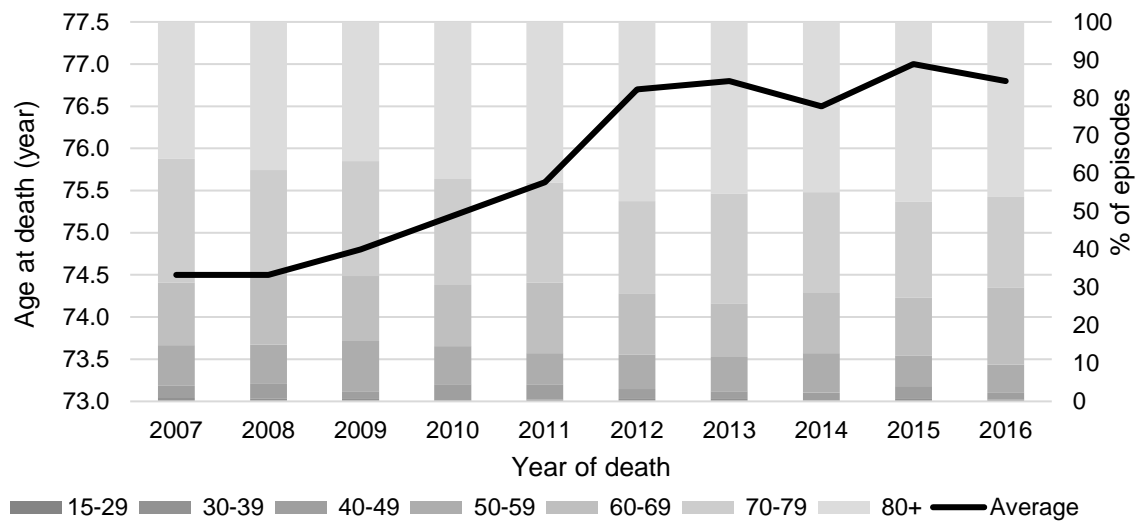


The average age at death ranged from 74 to 77 years among the Chinese (Table 5.2.7a and Figure 5.2.7a). The majority of the Chinese patients died at age 80 years or above, with 46.1% in this age group in 2016.

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

| Year of death | Average age | Age 15-29 | | Age 30-39 | | Age 40-49 | | |
|---------------|-------------|-----------|-----------|-----------|-----------|-----------|---------|------|
| | | Number | % | Number | % | Number | % | |
| 2007 | 74.5 | 0 | 0.0 | 7 | 0.9 | 25 | 3.2 | |
| 2008 | 74.5 | 1 | 0.1 | 6 | 0.7 | 34 | 3.8 | |
| 2009 | 74.8 | 1 | 0.1 | 4 | 0.5 | 15 | 2.0 | |
| 2010 | 75.2 | 0 | 0.0 | 2 | 0.3 | 31 | 4.2 | |
| 2011 | 75.6 | 0 | 0.0 | 3 | 0.5 | 24 | 3.9 | |
| 2012 | 76.7 | 1 | 0.2 | 3 | 0.5 | 16 | 2.6 | |
| 2013 | 76.8 | 0 | 0.0 | 4 | 0.7 | 12 | 2.0 | |
| 2014 | 76.5 | 1 | 0.2 | 1 | 0.2 | 12 | 2.0 | |
| 2015 | 77.0 | 0 | 0.0 | 4 | 0.6 | 21 | 3.4 | |
| 2016 | 76.8 | 0 | 0.0 | 3 | 0.5 | 11 | 1.8 | |
| Year of death | Age 50-59 | | Age 60-69 | | Age 70-79 | | Age 80+ | |
| | Number | % | Number | % | Number | % | Number | % |
| 2007 | 84 | 10.7 | 129 | 16.5 | 255 | 32.6 | 282 | 36.1 |
| 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 |

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



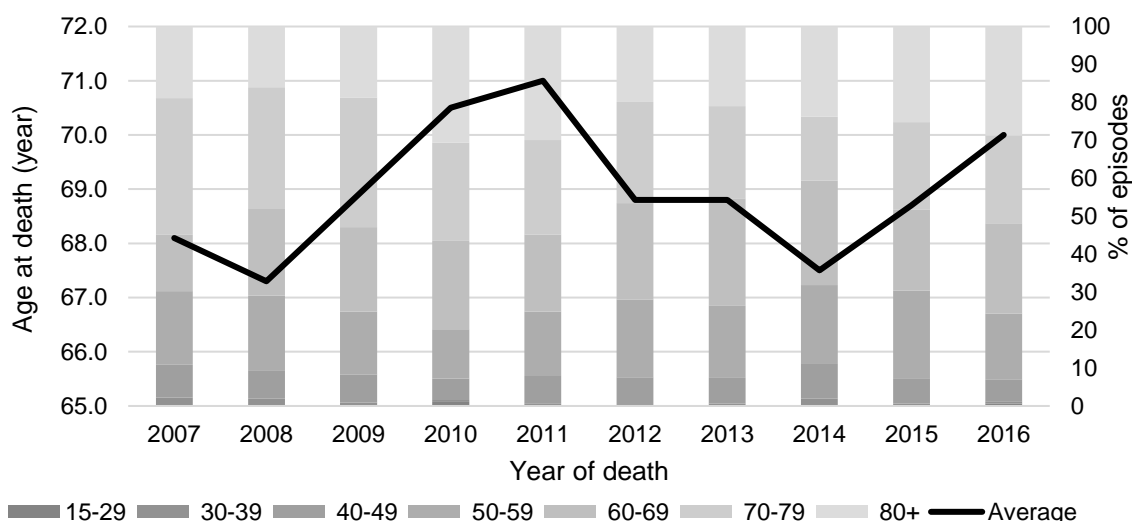
The average age at death ranged from 67 to 71 years among the Malays, a few years younger than the average age at death among the Chinese (Table 5.2.7b and Figure 5.2.7b). The majority of the Malay patients died at age 60 years or above (23.8%, 23.1% and 28.8% in the 60-69, 70-79 and 80+ age groups respectively in 2016).

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

| Year of death | Average age | Age 15-29 | | Age 30-39 | | Age 40-49 | |
|---------------|-------------|-----------|-----|-----------|-----|-----------|-----|
| | | Number | % | Number | % | Number | % |
| 2007 | 68.1 | 0 | 0.0 | 4 | 2.3 | 15 | 8.6 |
| 2008 | 67.3 | 0 | 0.0 | 4 | 1.9 | 16 | 7.5 |
| 2009 | 68.9 | 0 | 0.0 | 2 | 0.9 | 17 | 7.4 |
| 2010 | 70.5 | 2 | 1.0 | 1 | 0.5 | 11 | 5.7 |
| 2011 | 71.0 | 0 | 0.0 | 1 | 0.6 | 13 | 7.3 |
| 2012 | 68.8 | 0 | 0.0 | 0 | 0.0 | 11 | 7.5 |
| 2013 | 68.8 | 0 | 0.0 | 1 | 0.7 | 10 | 6.8 |
| 2014 | 67.5 | 0 | 0.0 | 3 | 1.9 | 15 | 9.4 |
| 2015 | 68.7 | 0 | 0.0 | 1 | 0.7 | 10 | 6.6 |
| 2016 | 70.0 | 1 | 0.6 | 1 | 0.6 | 9 | 5.6 |

| Year of death | Age 50-59 | | Age 60-69 | | Age 70-79 | | Age 80+ | |
|---------------|-----------|------|-----------|------|-----------|------|---------|------|
| | Number | % | Number | % | Number | % | Number | % |
| 2007 | 34 | 19.4 | 26 | 14.9 | 63 | 36.0 | 33 | 18.9 |
| 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 |

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

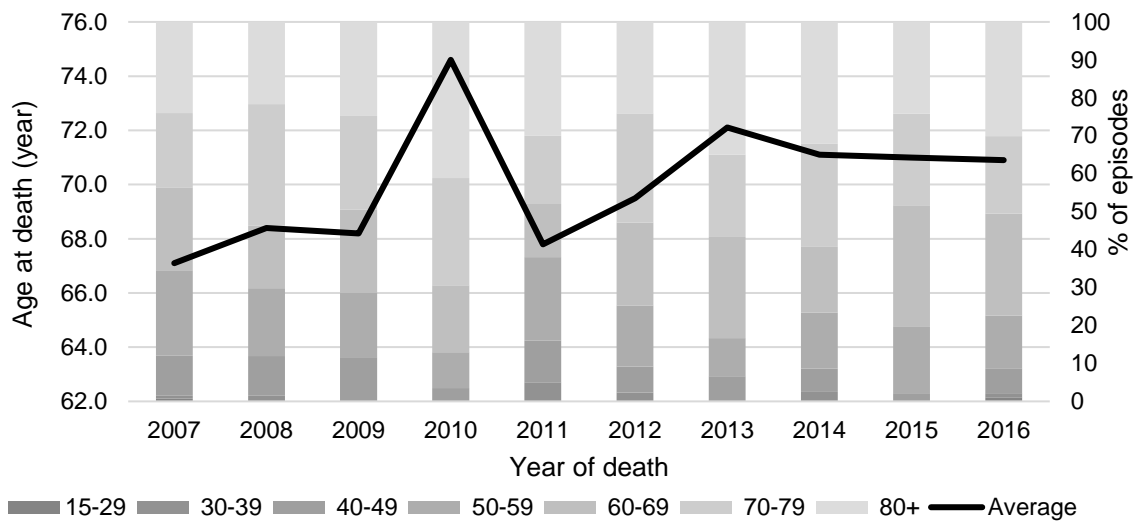


The average age at death ranged from 67 to 75 years among the Indians, close to average age at death among the Malays and a few years younger than the average age at death among the Chinese (Table 5.2.7c and Figure 5.2.7c). Similar to the Malays, the majority of the Indian patients died at age 60 years or above (26.9%, 20.4% and 30.1% in the 60-69, 70-79 and 80+ age groups respectively in 2016).

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

| Year of death | Average age | Age 15-29 | | Age 30-39 | | Age 40-49 | | |
|---------------|-------------|-----------|-----------|-----------|-----------|-----------|---------|------|
| | | Number | % | Number | % | Number | % | |
| 2007 | 67.1 | 1 | 0.8 | 1 | 0.8 | 14 | 10.5 | |
| 2008 | 68.4 | 0 | 0.0 | 2 | 1.5 | 14 | 10.4 | |
| 2009 | 68.2 | 0 | 0.0 | 0 | 0.0 | 12 | 11.4 | |
| 2010 | 74.6 | 0 | 0.0 | 0 | 0.0 | 3 | 3.5 | |
| 2011 | 67.8 | 0 | 0.0 | 5 | 5.0 | 11 | 11.0 | |
| 2012 | 69.5 | 0 | 0.0 | 2 | 2.3 | 6 | 6.9 | |
| 2013 | 72.1 | 0 | 0.0 | 0 | 0.0 | 4 | 6.7 | |
| 2014 | 71.1 | 0 | 0.0 | 2 | 2.5 | 5 | 6.2 | |
| 2015 | 71.0 | 0 | 0.0 | 0 | 0.0 | 2 | 2.2 | |
| 2016 | 70.9 | 1 | 1.1 | 1 | 1.1 | 6 | 6.5 | |
| Year of death | Age 50-59 | | Age 60-69 | | Age 70-79 | | Age 80+ | |
| | Number | % | Number | % | Number | % | Number | % |
| 2007 | 30 | 22.6 | 29 | 21.8 | 26 | 19.5 | 32 | 24.1 |
| 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 |

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

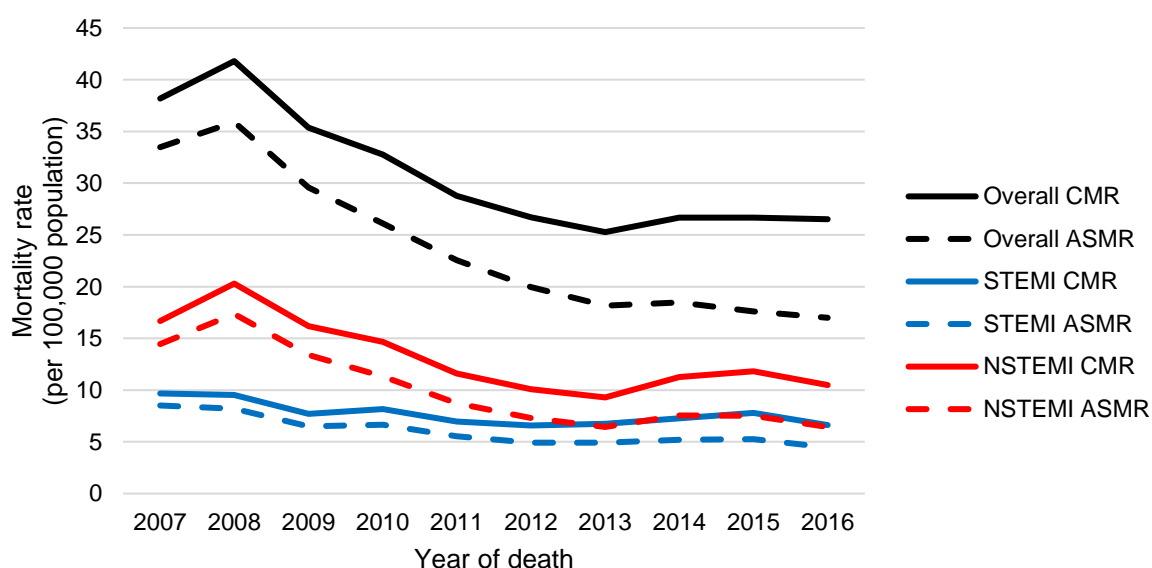


The ASMR among patients with STEMI declined significantly from 8.5 per 100,000 population in 2007 to 4.5 per 100,000 population in 2016 ($p < 0.001$) (Table 5.2.8 and Figure 5.2.8). Similarly, the ASMR among patients with NSTEMI declined significantly from 14.5 per 100,000 population in 2007 to 6.4 per 100,000 population in 2016 ($p < 0.001$). As the ASIR was consistently higher among the NSTEMI patients (Table 5.1.8), the ASMR of patients with NSTEMI was also consistently higher than that of their STEMI counterparts across the years.

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 |
| 2007 | 281 | 25.3 | 9.7 | 8.5-10.8 | 8.5 | 7.5-9.5 |
| 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 |
| P for trend | - | - | 0.014 | - | <0.001 | - |
| NSTEMI | | | | | | |
| Year of death | Number | % | CMR | 95% CI | ASMR | 95% CI |
| 2007 | 484 | 43.6 | 16.7 | 15.2-18.2 | 14.5 | 13.1-15.8 |
| 2008 | 603 | 48.6 | 20.3 | 18.7-21.9 | 17.4 | 15.9-18.8 |
| 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 |
| P for trend | - | - | 0.004 | - | <0.001 | - |

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

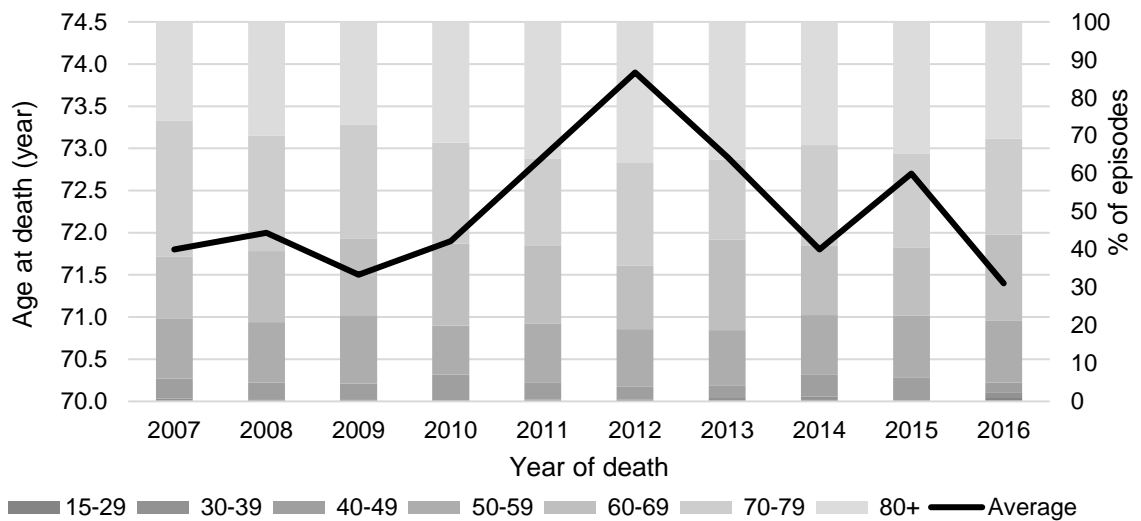


The average age at death ranged from 71 to 74 years among the STEMI patients (Table 5.2.9a and Figure 5.2.9a). The majority of the STEMI patients died at age 70 years or above (25.3% and 30.8% in the 70-79 and 80+ age groups respectively in 2016).

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

| Year of death | Average age | Age 15-29 | | Age 30-39 | | Age 40-49 | | |
|---------------|-------------|-----------|-----------|-----------|-----------|-----------|---------|------|
| | | Number | % | Number | % | Number | % | |
| 2007 | 71.8 | 0 | 0.0 | 2 | 0.7 | 15 | 5.3 | |
| 2008 | 72.0 | 0 | 0.0 | 1 | 0.4 | 13 | 4.6 | |
| 2009 | 71.5 | 0 | 0.0 | 1 | 0.4 | 10 | 4.2 | |
| 2010 | 71.9 | 0 | 0.0 | 0 | 0.0 | 18 | 7.1 | |
| 2011 | 72.9 | 0 | 0.0 | 1 | 0.5 | 10 | 4.6 | |
| 2012 | 73.9 | 1 | 0.5 | 0 | 0.0 | 7 | 3.3 | |
| 2013 | 72.9 | 0 | 0.0 | 2 | 0.9 | 7 | 3.2 | |
| 2014 | 71.8 | 1 | 0.4 | 2 | 0.8 | 14 | 5.9 | |
| 2015 | 72.7 | 0 | 0.0 | 0 | 0.0 | 16 | 6.2 | |
| 2016 | 71.4 | 2 | 0.9 | 3 | 1.4 | 6 | 2.7 | |
| Year of death | Age 50-59 | | Age 60-69 | | Age 70-79 | | Age 80+ | |
| | Number | % | Number | % | Number | % | Number | % |
| 2007 | 44 | 15.7 | 46 | 16.4 | 101 | 35.9 | 73 | 26.0 |
| 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 |

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

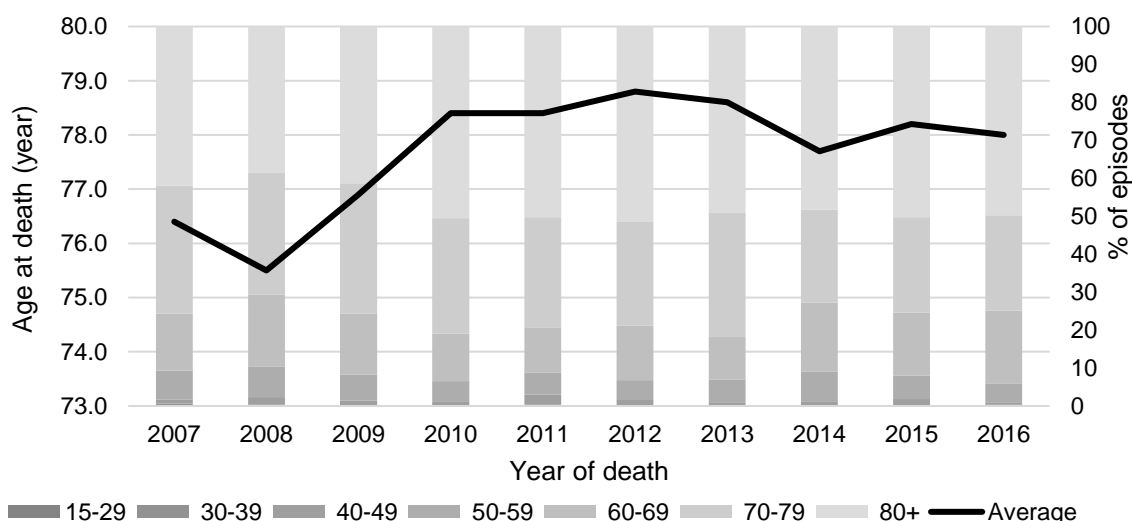


The average age at death ranged from 75 to 79 years among the NSTEMI patients, a few years older than the average age at death among the STEMI patients (Table 5.2.9b and Figure 5.2.9b). The majority of the NSTEMI patients died at age 80 years or above, with 49.7% in this age group in 2016.

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

| Year of death | Average age | Age 15-29 | | Age 30-39 | | Age 40-49 | | |
|---------------|-------------|-----------|-----------|-----------|-----------|-----------|---------|------|
| | | Number | % | Number | % | Number | % | |
| 2007 | 76.4 | 0 | 0.0 | 3 | 0.6 | 5 | 1.0 | |
| 2008 | 75.5 | 0 | 0.0 | 2 | 0.3 | 12 | 2.0 | |
| 2009 | 76.9 | 0 | 0.0 | 1 | 0.2 | 6 | 1.2 | |
| 2010 | 78.4 | 0 | 0.0 | 0 | 0.0 | 5 | 1.1 | |
| 2011 | 78.4 | 0 | 0.0 | 1 | 0.3 | 10 | 2.7 | |
| 2012 | 78.8 | 0 | 0.0 | 0 | 0.0 | 5 | 1.6 | |
| 2013 | 78.6 | 0 | 0.0 | 0 | 0.0 | 3 | 1.0 | |
| 2014 | 77.7 | 0 | 0.0 | 0 | 0.0 | 4 | 1.1 | |
| 2015 | 78.2 | 0 | 0.0 | 1 | 0.3 | 6 | 1.5 | |
| 2016 | 78.0 | 0 | 0.0 | 1 | 0.3 | 2 | 0.6 | |
| Year of death | Age 50-59 | | Age 60-69 | | Age 70-79 | | Age 80+ | |
| | Number | % | Number | % | Number | % | Number | % |
| 2007 | 37 | 7.6 | 73 | 15.1 | 163 | 33.7 | 203 | 41.9 |
| 2008 | 49 | 8.1 | 114 | 18.9 | 194 | 32.2 | 231 | 38.3 |
| 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 |

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



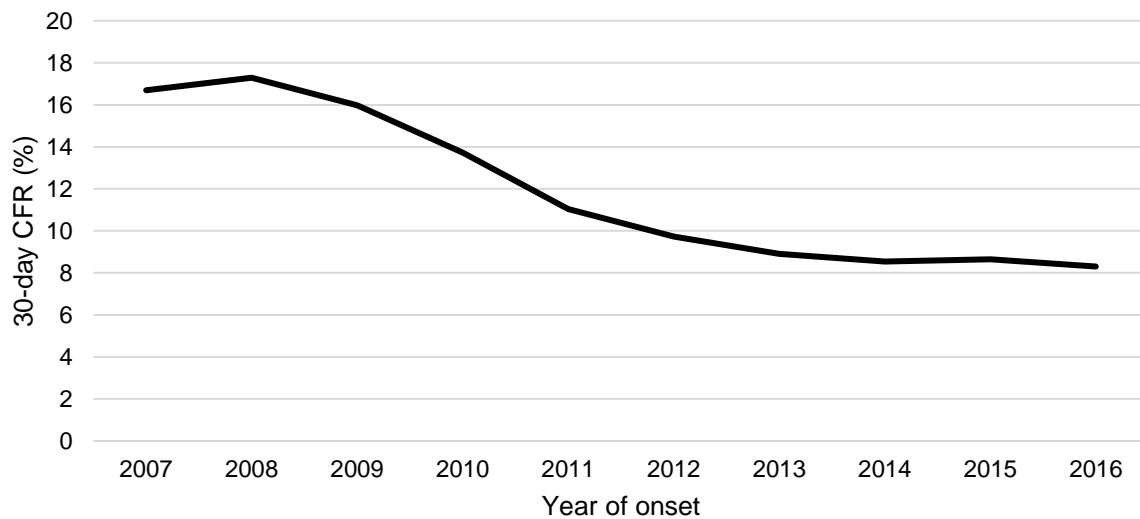
5.3 30-Day Case Fatality

The number of AMI deaths within 30 days from onset fell from 1,076 in 2007 to 832 in 2016 (Table 5.3.1 and Figure 5.3.1). Similarly, the CFR decreased significantly from 16.7% in 2007 to 8.3% in 2016 ($p < 0.001$). Advancement in medical technology and skills of the healthcare professionals 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 |
|---------------|--------|--------|-----------|
| 2007 | 1076 | 16.7 | 15.7-17.7 |
| 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 | 830 | 11.0 | 10.3-11.8 |
| 2012 | 824 | 9.7 | 9.1-10.4 |
| 2013 | 785 | 8.9 | 8.3-9.5 |
| 2014 | 783 | 8.5 | 7.9-9.1 |
| 2015 | 820 | 8.7 | 8.1-9.2 |
| 2016 | 832 | 8.3 | 7.7-8.9 |
| P for trend | - | <0.001 | - |

Figure 5.3.1: Case fatality rate (%)



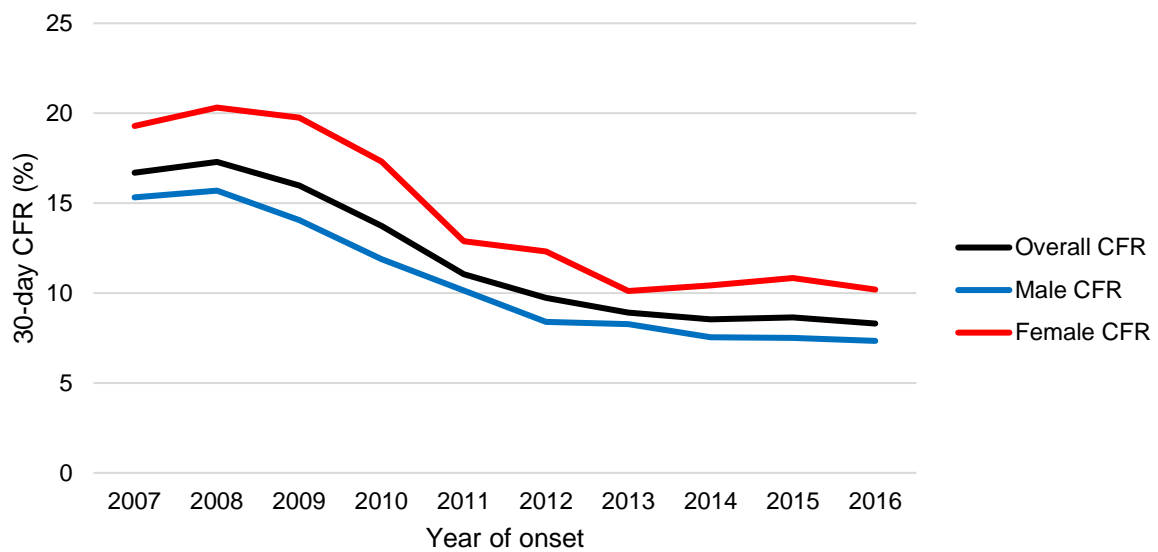
The CFR fell significantly over the years for both genders ($p < 0.001$ for both) (Table 5.3.2 and Figure 5.3.2). Although the ASMR for men was consistently higher than that for women (Table 5.2.4), the CFR for men was consistently lower than that for women across the years. In 2016, the CFR was 7.3% for men and 10.2% for women. As women tend to have AMI at an older age than men (Tables 5.1.5a and 5.1.5b), they are likely to have more co-morbidities when AMI happened, making them more susceptible to the contraindications of revascularization or decline revascularization. Without revascularization of the blocked arteries, this may lead to higher CFR among women¹⁵.

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

| Male | | | | |
|----------------------|---------------|----------|------------|---------------|
| Year of onset | Number | % | CFR | 95% CI |
| 2007 | 646 | 60.0 | 15.3 | 14.1-16.5 |
| 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 | 473 | 60.3 | 8.3 | 7.5-9.0 |
| 2014 | 454 | 58.0 | 7.5 | 6.9-8.2 |
| 2015 | 464 | 56.6 | 7.5 | 6.8-8.2 |
| 2016 | 486 | 58.4 | 7.3 | 6.7-8.0 |
| P for trend | - | - | <0.001 | - |
| Female | | | | |
| Year of onset | Number | % | CFR | 95% CI |
| 2007 | 430 | 40.0 | 19.3 | 17.5-21.1 |
| 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 | 321 | 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 | 41.6 | 10.2 | 9.1-11.3 |
| P for trend | - | - | <0.001 | - |

¹⁵ 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

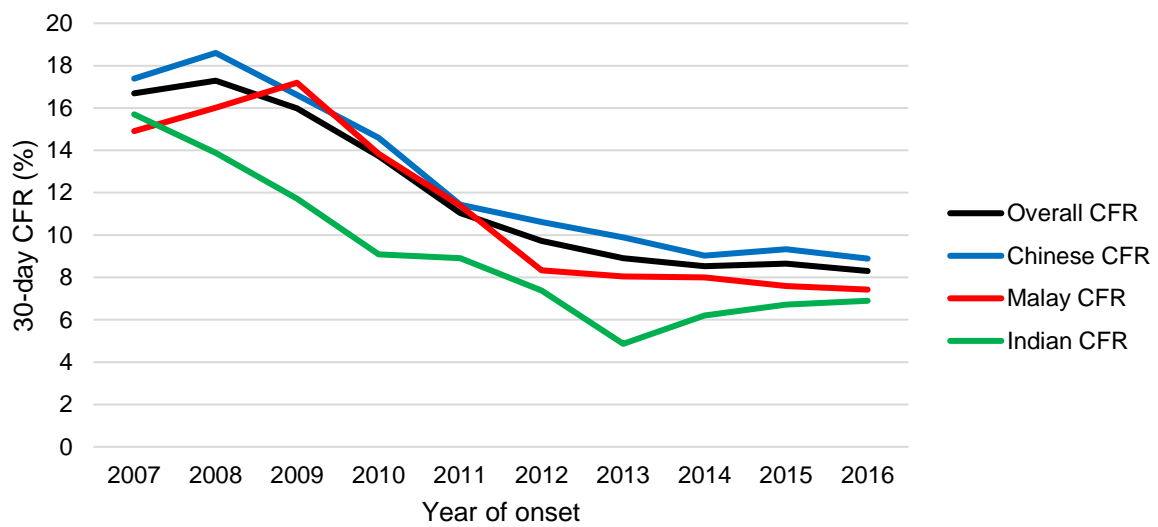


The CFR fell significantly over the years for all the three main ethnic groups ($p < 0.001$ for Chinese and Malays; $p = 0.001$ for Indians) (Table 5.3.3 and Figure 5.3.3). Although the Chinese consistently had the lowest ASMR among the three main ethnic groups (Table 5.2.6), they generally had the highest CFR across the years. In 2016, the CFR for the Chinese, Malays and Indians was 8.9%, 7.4% and 6.9% respectively. 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), and hence more likely to have more co-morbidities when AMI happened.

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

| Chinese | | | | |
|----------------------|---------------|----------|------------|---------------|
| Year of onset | Number | % | CFR | 95% CI |
| 2007 | 762 | 70.8 | 17.4 | 16.2-18.6 |
| 2008 | 848 | 71.7 | 18.6 | 17.3-19.9 |
| 2009 | 698 | 68.4 | 16.6 | 15.4-17.8 |
| 2010 | 675 | 71.1 | 14.6 | 13.5-15.7 |
| 2011 | 569 | 68.6 | 11.4 | 10.5-12.4 |
| 2012 | 592 | 71.8 | 10.6 | 9.8-11.5 |
| 2013 | 577 | 73.5 | 9.9 | 9.1-10.7 |
| 2014 | 549 | 70.1 | 9.0 | 8.3-9.8 |
| 2015 | 593 | 72.3 | 9.3 | 8.6-10.1 |
| 2016 | 587 | 70.6 | 8.9 | 8.2-9.6 |
| P for trend | - | - | <0.001 | - |
| Malay | | | | |
| Year of onset | Number | % | CFR | 95% CI |
| 2007 | 165 | 15.3 | 14.9 | 12.6-17.2 |
| 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 | 9.7-13.1 |
| 2012 | 140 | 17.0 | 8.3 | 6.9-9.7 |
| 2013 | 139 | 17.7 | 8.1 | 6.7-9.4 |
| 2014 | 139 | 17.8 | 8.0 | 6.7-9.3 |
| 2015 | 140 | 17.1 | 7.6 | 6.3-8.9 |
| 2016 | 148 | 17.8 | 7.4 | 6.2-8.6 |
| P for trend | - | - | <0.001 | - |
| Indian | | | | |
| Year of onset | Number | % | CFR | 95% CI |
| 2007 | 130 | 12.1 | 15.7 | 13.0-18.4 |
| 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 | 6.9 | 5.5-8.3 |
| P for trend | - | - | 0.001 | - |

Figure 5.3.3: Case fatality rate (%) by ethnicity

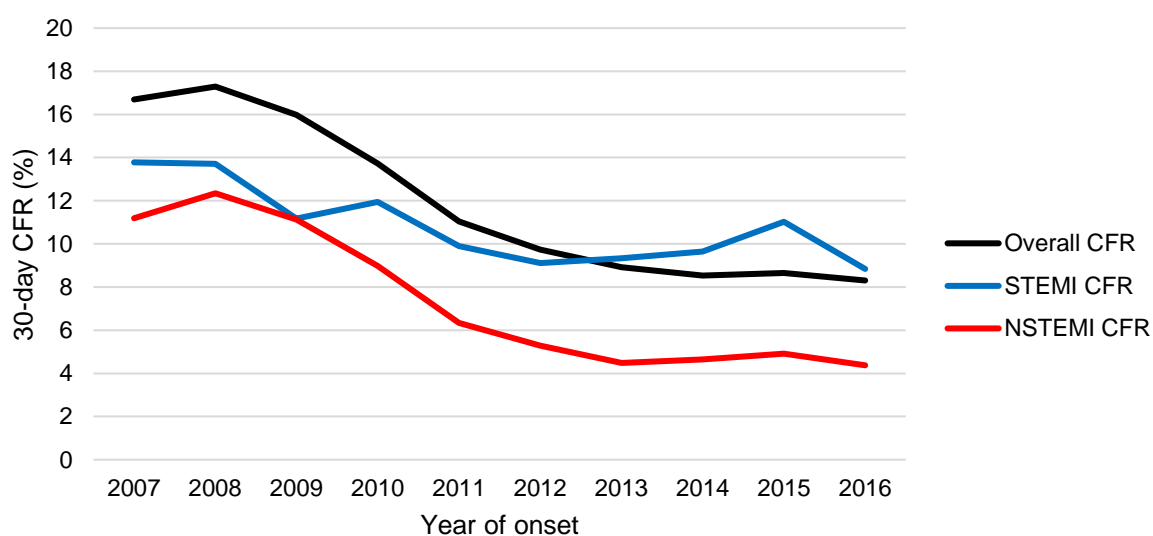


The CFR fell significantly over the years for both STEMI and NSTEMI patients ($p=0.005$ for STEMI; $p<0.001$ for NSTEMI) (Table 5.3.4 and Figure 5.3.4). Although patients with STEMI consistently had lower ASMR than patients with NSTEMI (Table 5.2.8), the CFR among patients with STEMI was consistently higher than that among patients with NSTEMI. The CFR for STEMI and NSTEMI patients in 2016 was 8.8% and 4.4% respectively. 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 |
| 2007 | 279 | 25.9 | 13.8 | 12.2-15.4 |
| 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 | 28.0 | 9.6 | 8.4-10.9 |
| 2015 | 249 | 30.4 | 11.0 | 9.7-12.4 |
| 2016 | 207 | 24.9 | 8.8 | 7.6-10.0 |
| P for trend | - | - | 0.005 | - |
| NSTEMI | | | | |
| Year of onset | Number | % | CFR | 95% CI |
| 2007 | 453 | 42.1 | 11.2 | 10.2-12.2 |
| 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 | 36.9 | 6.3 | 5.6-7.0 |
| 2012 | 306 | 37.1 | 5.3 | 4.7-5.9 |
| 2013 | 273 | 34.8 | 4.5 | 4.0-5.0 |
| 2014 | 303 | 38.7 | 4.6 | 4.1-5.2 |
| 2015 | 338 | 41.2 | 4.9 | 4.4-5.4 |
| 2016 | 316 | 38.0 | 4.4 | 3.9-4.9 |
| P for trend | - | - | <0.001 | - |

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

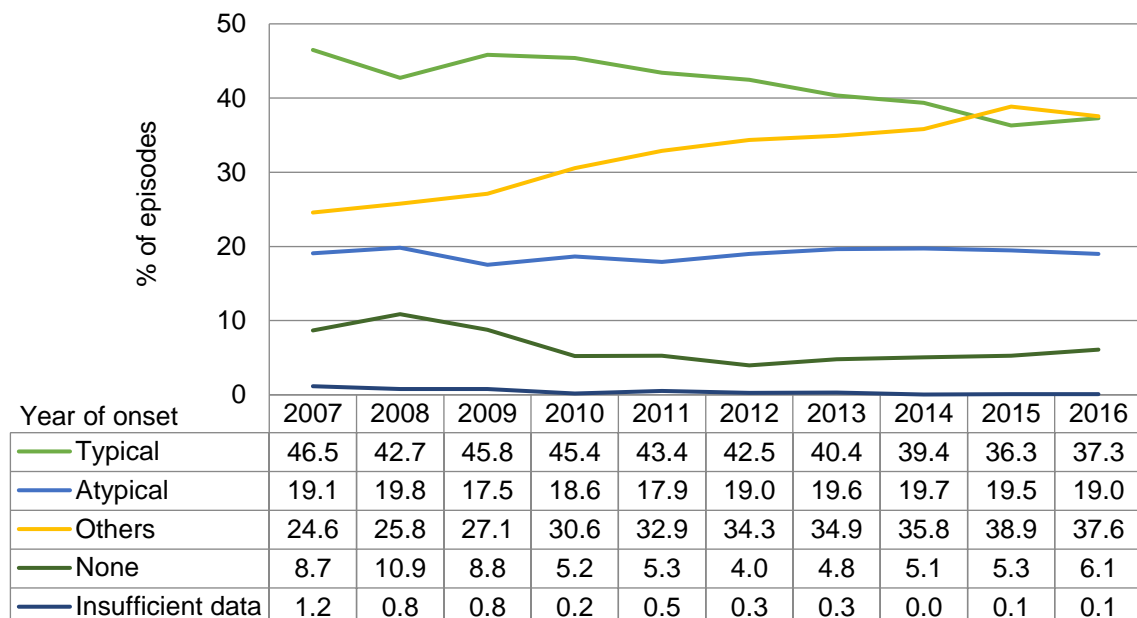


5.4 Symptoms

Clinical presentation has consequences on triage categorization at the Emergency Department, prescription of diagnostic tests and disease management. Symptoms of AMI are considered to be typical when chest pain was present or if the pain was described as feeling of tightness, pressure or protracted, and characterized by a duration of at least 20 minutes. Atypical symptoms are defined as presence of chest pain of short duration, 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 such as 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 46.5% in 2007 to 37.3% in 2016. The proportion of patients with other symptoms that were neither typical nor atypical, rose from 24.6% in 2007 to 37.6% in 2016. STEMI patients are likely to have typical symptoms, whereas NSTEMI patients tend to have non-typical symptoms¹⁶. Hence, the drop in proportion of patients with typical symptoms is largely attributed to the drop in proportion of STEMI patients over the years (Table 5.1.8).

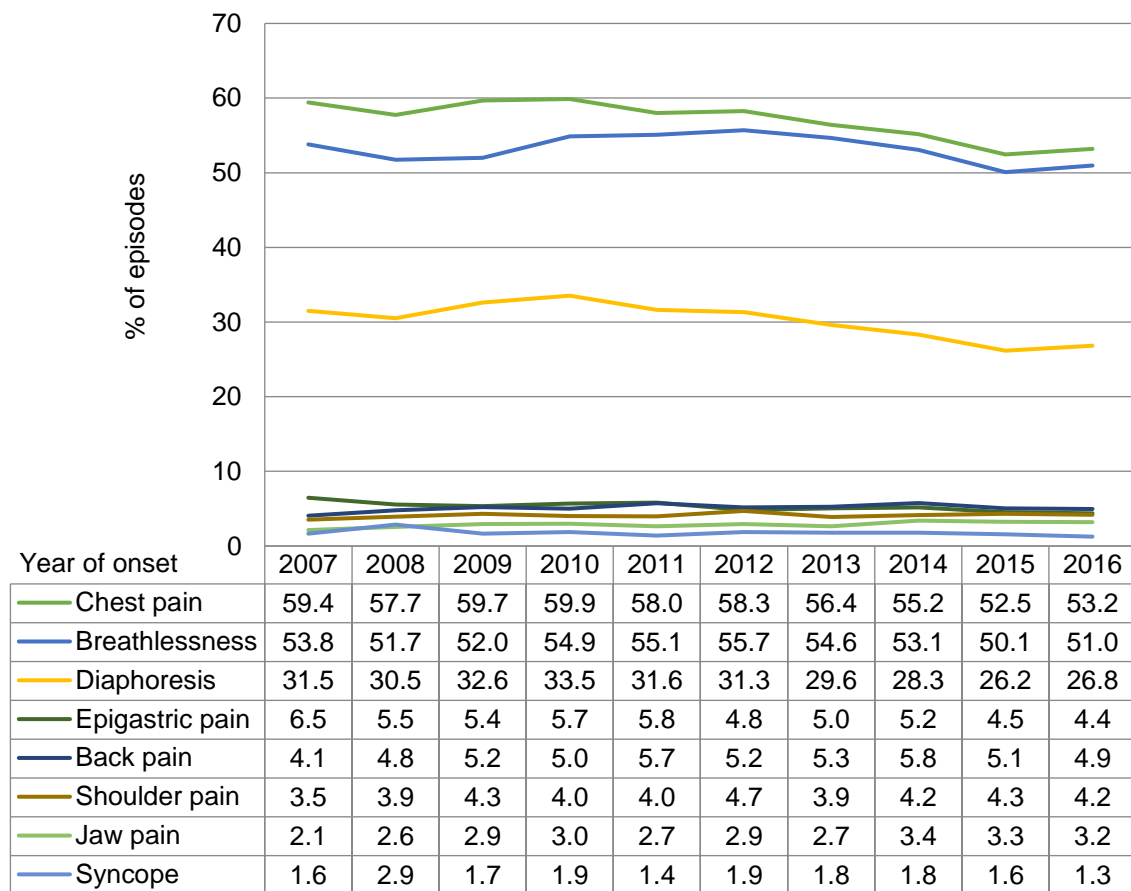
Figure 5.4.1: Types of symptoms (%)



¹⁶ 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 over the years, the common presenting symptoms of AMI were chest pain, breathlessness and diaphoresis. While about half of the patients had chest pain (53.2%) and breathlessness (51.0%) accompanying the onset of AMI in 2016, about a quarter of them (26.8%) had diaphoresis (Figure 5.4.2). The proportions of patients who showed these symptoms dropped slightly every year from 2012 onwards. Since STEMI patients are likely to experience typical symptoms such as chest pain compared to NSTEMI patients, the drop in proportion of STEMI patients had led to a drop in proportions of patients who encountered chest pain, breathlessness and diaphoresis in recent 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 AMI¹⁷. Hypertension, hyperlipidemia and diabetes are defined as positive if there was a past medical history of the condition or if it was newly diagnosed during 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 such BMI¹⁸. Smoking includes former and current smoker on admission. Past AMI or revascularization includes history of AMI and history of coronary artery bypass graft or percutaneous coronary intervention (PCI) done for any heart disease.

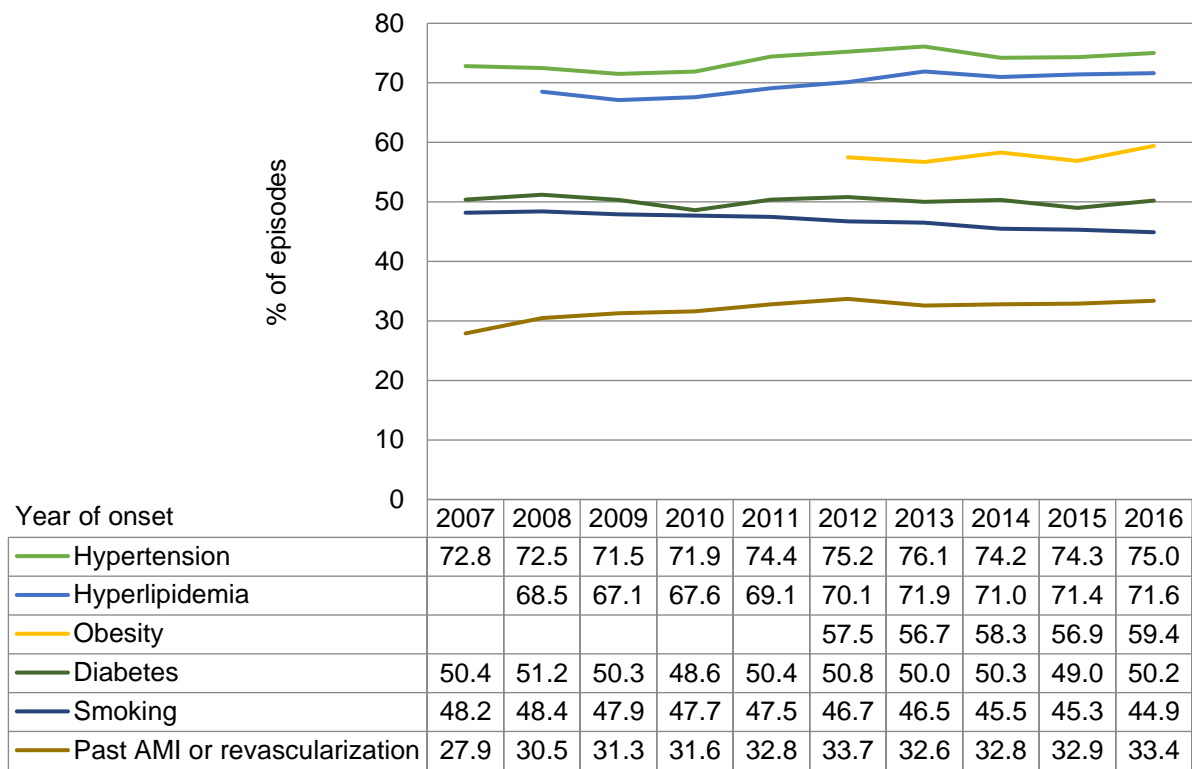
Hypertension and hyperlipidemia were consistently the two most common risk factors among the AMI patients across the years (Figure 5.5.1). In 2016, 75.0% of the patients had hypertension and 71.6% of them had hyperlipidemia. Since 2009, the proportions of patients with hypertension and hyperlipidemia increased slightly. The proportion of patients who smoked decreased slightly since 2009, while those with diabetes, obesity and history of AMI or revascularization fluctuated slightly over time.

Due to a change in the Registry's definition of hyperlipidemia in 2008, the proportion of patients with hyperlipidemia in 2007 is not shown in Figure 5.5.1. As BMI had relatively more unknown values than the other risk factors due to unknown weight, unknown height, or both, obesity is also not shown in Figure 5.5.1 for earlier years, where the completeness of BMI was less than 80%. As a patient could have multiple risk factors, the percentages in Figure 5.5.1 will not add up to 100% for each year.

¹⁷ 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.

¹⁸ 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 (%)



5.6 Door-to-balloon Time

Door-to-balloon (DTB) time refers to the time from the first medical contact to the first device of primary PCI. 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 first device time by the hospitals will affect the accuracy of DTB time. The targeted DTB time recommended by the American Heart Association is within 90 minutes¹⁹.

Patients that were admitted for a non-AMI condition but developed AMI during hospitalization, patients that were transferred to another hospital, and patients that experienced non-system delays²⁰, 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 and hence the inclusion of them would skew the numbers.

The median DTB time improved from 95 (interquartile range, IQR 72 – 124) minutes in 2007 to 55 (IQR 44 – 68) minutes in 2016 (Figure 5.6.1). The proportion of STEMI with DTB time of 90 minutes or less improved from 45.5% in 2007 to 94.3% in 2016. This improvement was largely driven by the efficiency in the healthcare delivery system comprising of the early response teams and the hospitals.

¹⁹ 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.

²⁰ The SMIR only started collecting this variable from 2012 onwards.

Non-system delay refers to delay in doing 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 doing 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, uptriaged case, missed diagnosis, unknown reason.

Figure 5.6.1: DTB time by mode of arrival among STEMI

