

# Acute myocardial infarction in young Asian women: a comparative study on Chinese, Malay and Indian ethnic groups

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## ABSTRACT

**Introduction:** There is a paucity of data on acute myocardial infarction (AMI) in young Asian women and of comparative data among various ethnic groups with respect to risk factor profile and clinical outcomes. We present a comprehensive overview of the clinical characteristics of young Asian women with AMI and a comparative analysis among Chinese, Malay and Indian women in a multi-ethnic Asian country.

**Methods:** We studied 45 Asian female patients aged 50 years and below who were admitted to our hospital with a diagnosis of ST-segment elevation myocardial infarction (STEMI) or non-ST-segment elevation myocardial infarction (NSTEMI).

**Results:** Overall, diabetes mellitus, hypertension and hyperlipidaemia were prevalent in the study population. Hyperlipidaemia was more prevalent among Indian patients, while diabetes mellitus was more common among Malay patients. Only a minority of the study patients were current smokers. Among the 20 patients admitted with STEMI, 17 (85 percent) received urgent reperfusion therapy. The mean symptom-to-balloon time and door-to-balloon time for the Malay patients were longer compared to those for other ethnic groups. Among the 25 patients admitted with NSTEMI, 12 (48 percent) underwent coronary revascularisation therapy. The average duration of hospital stay was 4 +/- 4.1 days, with no significant difference observed among the various ethnic groups.

**Conclusion:** Many young Asian women with AMI have identifiable risk factors that are different from those found in the Western population. There seems to be an ethnic effect

on the prevalence of these risk factors and door-to-balloon time.

**Keywords:** ethnicity, myocardial infarction, women, young

*Singapore Med J 2011; 52(11): 835-839*

## INTRODUCTION

Acute myocardial infarction (AMI) in young women before menopause is a rare occurrence. Epidemiological data suggests that approximately 4%–10% of patients with AMI were below the age of 50, of which only a very small proportion constituted women.<sup>(1)</sup> Diagnosis and management of AMI in young women present a unique challenge for cardiologists. Apart from its rarity, previous studies on AMI in Western populations have shown that women have a different risk factor profile, more atypical presentations and a different pathophysiology compared to men.<sup>(2)</sup> Moreover, women with AMI have been found to have worse in-hospital prognosis compared to men. The existing suboptimal management could thus have stemmed from the lack of public awareness about the disease on the part of patients as well as clinicians.

Although Asia hosts 60% of the world's current human population, there is a paucity of data on AMI in young Asian women. Moreover, comparative data among various ethnic groups with respect to risk factor profile and clinical outcomes following AMI in young Asian women is equally lacking. In this study, we present a comprehensive overview of the clinical characteristics of young Asian women who were admitted with AMI and a comparative analysis among Chinese, Malay and Indian women in a multi-ethnic Asian country.

## METHODS

Apart from ethnicity, the patient variables included age and traditional risk factors of coronary artery disease, such as hyperlipidaemia, hypertension, diabetes mellitus, current smoker status and family history of premature coronary artery disease. Important medical histories, including previous percutaneous coronary intervention and coronary artery bypass grafting, were also collected.

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**Table I. Baseline characteristics of the young women with acute myocardial infarction.**

| Characteristic                    | No. of patients (%) |                  |                |                 |                | p-value |
|-----------------------------------|---------------------|------------------|----------------|-----------------|----------------|---------|
|                                   | Total (n = 45)      | Chinese (n = 17) | Malay (n = 12) | Indian (n = 11) | Others (n = 5) |         |
| Mean age $\pm$ SD (yrs)           | 43.9 $\pm$ 5.4      | 42.8 $\pm$ 6.4   | 44.8 $\pm$ 5.4 | 44.2 $\pm$ 4.7  | 45.0 $\pm$ 3.3 | 0.732   |
| Hyperlipidaemia                   | 24 (53.3)           | 7 (41.2)         | 6 (50.0)       | 9 (81.8)        | 2 (40.0)       | 0.171   |
| Hypertension                      | 27 (60.0)           | 11 (64.7)        | 6 (50.0)       | 7 (63.6)        | 3 (60.0)       | 0.895   |
| Diabetes mellitus                 | 26 (57.8)           | 7 (41.2)         | 10 (83.3)      | 7 (63.6)        | 2 (40.0)       | 0.105   |
| Current smoker                    | 3 (6.7)             | 0                | 1 (8.3)        | 1 (9.1)         | 1 (20.0)       | 0.192   |
| BMI $\pm$ SD (kg/m <sup>2</sup> ) | 27.6 $\pm$ 6.0      | 26.6 $\pm$ 6.2   | 28.1 $\pm$ 6.5 | 25.7 $\pm$ 6.1  | 23.4 $\pm$ 1.5 | 0.232   |
| Family history of premature CAD   | 5 (11.1)            | 2 (11.8)         | 1 (8.3)        | 1 (9.1)         | 1 (20.0)       | 0.919   |
| Previous PCI                      | 1 (2.2)             | 0                | 0              | 1 (9.1)         | 0              | 0.356   |
| Previous CABG                     | 0                   | 0                | 0              | 0               | 0              | -       |
| History of PVD                    | 1 (2.2)             | 1 (5.9)          | 0              | 0               | 0              | 0.984   |
| History of stroke                 | 3 (6.7)             | 1 (5.9)          | 2 (16.7)       | 0               | 0              | 0.763   |
| History of CRF                    | 4 (8.9)             | 1 (5.9)          | 3 (25.0)       | 0               | 0              | 0.619   |

SD: standard deviation; BMI: body mass index; CAD: coronary artery disease; PCI: percutaneous coronary intervention; CABG: coronary artery bypass grafting; PVD: peripheral vascular disease; CRF: chronic renal failure

**Table II. Baseline characteristics of the young women with acute myocardial infarction.**

| Mean lipid $\pm$ SD (mmol/L) | Total (n = 45) | Chinese (n = 17) | Malay (n = 12) | Indian (n = 11) | Others (n = 5) | p-value |
|------------------------------|----------------|------------------|----------------|-----------------|----------------|---------|
| Total cholesterol            | 5.0 $\pm$ 1.3  | 4.6 $\pm$ 1.1    | 5.5 $\pm$ 1.5  | 5.3 $\pm$ 1.3   | 4.7 $\pm$ 1.4  | 0.324   |
| LDL- cholesterol             | 3.1 $\pm$ 1.1  | 2.8 $\pm$ 1.1    | 3.4 $\pm$ 1.2  | 3.3 $\pm$ 1.1   | 2.6 $\pm$ 1.0  | 0.532   |
| HDL- cholesterol             | 1.2 $\pm$ 0.6  | 1.1 $\pm$ 0.4    | 1.0 $\pm$ 0.3  | 1.0 $\pm$ 0.3   | 1.0 $\pm$ 0.3  | 0.291   |
| Triglycerides                | 2.2 $\pm$ 2.6  | 1.4 $\pm$ 0.7    | 3.2 $\pm$ 5.1  | 2.0 $\pm$ 0.6   | 2.1 $\pm$ 1.6  | 0.221   |

SD: standard deviation; LDL: low-density lipoprotein; HDL: high-density lipoprotein

The presence of comorbidities such as peripheral vascular disease, stroke and chronic renal failure was also determined. In addition, the laboratory values of total cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol and triglycerides measured during lipid monitoring on admission of all patients were retrieved from the Computerised Patient Support System (CPSS<sup>®</sup>), where obtainable. Both body height and weight measured during the same admission were extracted from the 4D System<sup>®</sup>.

Cardiac catheterisation data was retrieved from the 4D System<sup>®</sup>, and the number of patients who had undergone coronary angiogram was determined. The number of diseased vessels was assessed based on the number of vessels with significant stenosis (i.e.  $\geq$  75% occlusion) of the right coronary artery, left anterior descending coronary artery, left circumflex coronary artery or left main coronary artery. The patients were classified as having single-, double- or triple-vessel disease. Data on short-term outcome based on in-hospital mortality rate, average duration of hospital stay, left ventricular ejection fraction and number of patients with post-infarction complications were obtained. All categorical variables were expressed as proportions, and chi-square

test was used to determine the statistical differences of demographics and cardiovascular risk factors among the ethnic groups. All continuous variables were expressed as mean  $\pm$  standard deviation, and analysed using one-way analysis of variance.

## RESULTS

During the three-year study period, a total of 45 young (aged  $\leq$  50 years) Asian women were admitted to our hospital with a diagnosis of ST segment elevated myocardial infarction (STEMI) (n = 20) or non-STEMI (NSTEMI) (n = 25). Table I summarises the baseline demographics and clinical characteristics of the study cohort. Among the 45 patients, 17 (37.8%) were Chinese, 12 (26.7%) were Malay, 11 (24.4%) were Indian and five (11.1%) belonged to other Asian races (three Indonesian and two Bangladeshi). Singapore's population comprises 77% Chinese, 14% Malays and 8% Indians among women in the age group of 15–64 years.<sup>(2)</sup> This leads to an overrepresentation ratio of 22% in Indians, 14% in Malays and 4% in Chinese in our study.

The mean age of the patients at presentation was 43.9  $\pm$  5.4 years, and there was no significant difference among the various ethnic groups. Overall, diabetes

**Table III. Angiographic findings of the study population.**

| Characteristic            | No. of patients (%) |                  |                |                 |                | p-value |
|---------------------------|---------------------|------------------|----------------|-----------------|----------------|---------|
|                           | Total (n = 45)      | Chinese (n = 17) | Malay (n = 12) | Indian (n = 11) | Others (n = 5) |         |
| Coronary angiography      | 39 (86.7)           | 16 (94.1)        | 8 (66.7)       | 10 (90.9)       | 5 (100)        | 0.773   |
| No. of diseased vessels   |                     |                  |                |                 |                | 0.362   |
| 0                         | 2 (5.1)             | 2 (12.5)         | 0              | 0               | 0              |         |
| 1                         | 28 (71.8)           | 11 (68.8)        | 5 (62.5)       | 9 (90.0)        | 3 (60.0)       |         |
| 2                         | 5 (12.8)            | 2 (12.5)         | 2 (25.0)       | 1 (10.0)        | 0              |         |
| 3                         | 4 (10.3)            | 1 (6.3)          | 1 (12.5)       | 0               | 2 (40.0)       |         |
| Infarct-related vessel    |                     |                  |                |                 |                | 0.339   |
| LAD                       | 28 (71.8)           | 9 (56.3)         | 7 (87.5)       | 8 (80.0)        | 4 (80.0)       |         |
| LCx                       | 5 (12.8)            | 4 (25.0)         | 1 (12.5)       | 0               | 0              |         |
| RCA                       | 5 (12.8)            | 2 (12.5)         | 0              | 2 (20.0)        | 1 (20.0)       |         |
| Lm                        | 0                   | 0                | 0              | 0               | 0              |         |
| Baseline TIMI flow        |                     |                  |                |                 |                | 0.839   |
| Grade 0*                  | 13 (46.4)           | 4 (44.4)         | 4 (80)         | 3 (30)          | 2 (50)         |         |
| Final TIMI grade $\geq$ 2 | 28 (100)            | 9 (100)          | 5 (100)        | 10 (100)        | 4 (100)        |         |
| Final TIMI grade 3        | 27 (96.4)           | 9 (100)          | 4 (80)         | 10 (100)        | 4 (100)        |         |

Data is expressed as relative frequency (%).

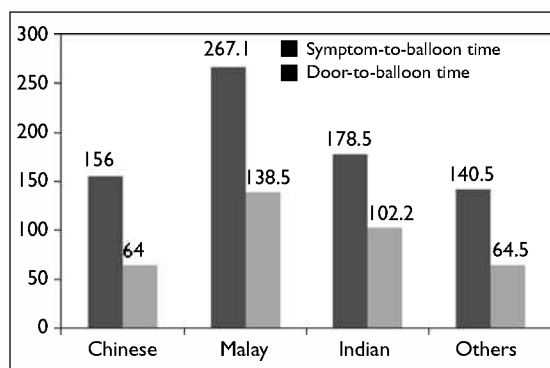
\*All data on TIMI flow grades were only obtainable for patients who had undergone percutaneous coronary intervention.

LAD: left anterior descending artery; LCx: left circumflex artery; RCA: right coronary artery; Lm: left main coronary artery; TIMI: thrombolysis in myocardial infarction

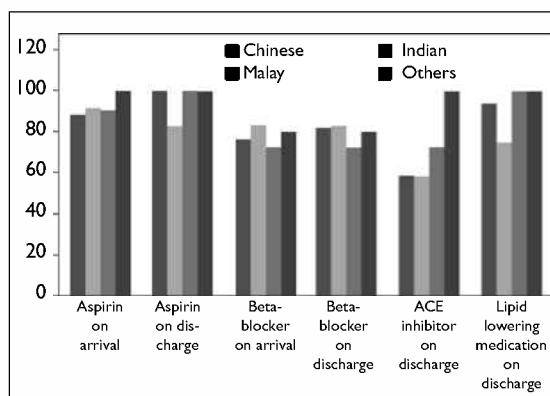
mellitus, hypertension and hyperlipidaemia were prevalent in the study population. Only a minority of the study patients were current smokers. The serum lipid levels measured during the index admission are shown in Table II. Indian patients had the greatest average number of risk factors ( $2.9 \pm 0.9$ ), followed by Malay ( $2.3 \pm 1.5$ ) and Chinese ( $1.9 \pm 0.7$ ) patients. One Chinese patient had known systemic lupus erythematosus on presentation.

A total of 39 (86.7%) patients underwent coronary angiography during the index admission. The angiographic characteristics of the study population are shown in Table III. Most of the patients (n = 28, 71.8%) had single-vessel disease. Normal coronary artery without significant stenosis was found in two (5.1%) patients. Among the various study groups, Malay patients had the greatest predilection for multi-vessel disease. None of the patients had significant left main coronary artery stenosis. Among the 20 patients admitted with STEMI, 17 (85%) received urgent reperfusion therapy (16 primary percutaneous coronary intervention; 1 fibrinolytic therapy). One STEMI patient declined urgent reperfusion therapy on admission, but subsequently agreed to an elective percutaneous coronary intervention two days after admission. The remaining two patients declined treatment, apparently due to financial reasons.

The mean symptom-to-balloon time and door-to-balloon time for the 16 patients who underwent primary percutaneous coronary intervention were  $187.3 \pm 117.5$  minutes and  $99 \pm 55.4$  minutes, respectively. Fig. 1 summarises the results of the different ethnic groups. The mean symptom-to-balloon time and door-to-



**Fig. 1** Graph shows symptom-to-balloon and door-to-balloon times among the different ethnic groups.



**Fig. 2** Graph shows the usage of evidence-based medications for myocardial infarction.

balloon time were longer for Malay patients compared to those for other ethnic groups. The use of evidence-based medications among the various ethnic groups is shown in Fig. 2. All except two patients were on dual

antiplatelet therapy on discharge; two Malay patients were not discharged with aspirin, as one was found to have aspirin allergy on Day 2 of admission and the other refused antiplatelet therapy due to menorrhagia.

Among the 25 patients admitted with NSTEMI, 12 (48%) underwent coronary revascularisation therapy. 11 of these patients underwent percutaneous coronary intervention, mostly (nine out of 11) within 48 hours of admission, and one patient underwent coronary artery bypass surgery. The average left ventricular ejection fraction, determined by two-dimensional echocardiography performed during the hospitalisation period, was  $51\% \pm 12.1\%$ . As part of the complications of AMI, acute renal failure developed in four (8.9%) patients, acute pulmonary oedema in three (6.7%), cardiogenic shock in two (4.4%) and ischaemic stroke in one (2.2%) patient. None of the study patients died during the index admission. The average duration of hospital stay was  $4 \pm 4.1$  days, with no significant difference observed among the various ethnic groups.

## DISCUSSION

This study focused on the characteristics of a cohort of young Asian women admitted with AMI in Singapore. In addition, we evaluated the impact of ethnicity on risk factor profile and treatment received. A number of important findings deserve to be highlighted. Unlike in the Western population, smoking was not an important risk factor among young Asian women who developed AMI. Instead, diabetes mellitus, hypertension and hyperlipidaemia were prevalent, especially among Malay and Indian women. Single-vessel coronary artery disease was more common than multi-vessel disease. The clinical outcomes of the patients were good, and none of the patients died during the index admission. The door-to-balloon time for patients undergoing primary percutaneous coronary intervention for STEMI appeared to be longer among Malay women.

We found that diabetes mellitus, hypertension and hyperlipidaemia were important risk factors in our study population. The prevalence of each of these risk factors was  $> 50\%$ . This is in contrast to a study conducted at two centres in the United States and Canada,<sup>(3)</sup> in which smoking and a family history of premature coronary artery disease were the most prevalent risk factors. In the cohort of Western patients, only 4% of the patients had diabetes mellitus and 13% had hyperlipidaemia. This probably reflects the difference in the influence of culture and diet between Western and Asian populations. In our study, diabetes mellitus was found to be more common among Malay women, which was in line with the higher

average body mass index in this ethnic group. It was previously reported that Malays developed diabetes mellitus at an earlier age, especially young Malay females, in which a high prevalence of obesity was also observed.<sup>(4)</sup> Early onset of diabetes mellitus corresponds to a longer duration of the disease, which in turn augments the risk of AMI. Consistent with previous findings, the incidence of AMI was disproportionately higher among the Indians compared to other races in Singapore.<sup>(5)</sup> Our study also demonstrated that Indian patients had the highest number of coronary risk factors among the three ethnic groups. The INTERHEART study also reported a gradual increase in the number of traditional risk factors of coronary artery disease in the Indian subcontinent in recent years.<sup>(6)</sup>

Prompt reperfusion of the occluded artery is crucial in the management of STEMI. A door-to-balloon time  $> 90$  minutes is associated with suboptimal microvascular perfusion after primary percutaneous coronary intervention.<sup>(7)</sup> Among our group of young Asian women, most received primary percutaneous coronary intervention, which is the state-of-the-art therapy. However, the door-to-balloon time in this study ( $99 \pm 55.4$  min) was longer than the average door-to-balloon time during the same period (72 min).<sup>(8)</sup> This was possibly due to the delay in diagnosis owing to the rarity of AMI in young women. Interestingly, the delay was most pronounced among the Malay and Indian women, compared to the Chinese. The underlying reason is not immediately obvious. This could be due to prolonged decision-making to undergo an invasive reperfusion procedure, which reflects the impact of culture and socioeconomic conditions on treatment choice.

A decade ago, the National Registry of Myocardial Infarction 2 data, which included 384,878 patients, found that among younger patients ( $< 50$  years of age), the adjusted mortality for women was more than twice that of men.<sup>(9)</sup> The absence of in-hospital mortality in our cohort of young Asian women suggests that there has been an improvement in the care of patients with AMI. This is reflected by the high usage of prompt reperfusion therapy, as well as the adherence to evidence-based medicine.

The main limitation of our study is its small sample size. However, given the low incidence of AMI among young women, we believe that our results represent a good approximation of the real-world situation. Another limitation pertains to selection bias, in which only cases admitted to the coronary care unit alive were included. These patients may have a survival advantage due to their more favourable clinical characteristics, compared to those who died before reaching the hospital. However, the

number of such cases is at best small; thus, we still believe that our sample population is largely representative of the overall AMI cases among young Asian women in Singapore. Although data on the menopausal state of the patients was not available, it has been reported that the average age of menopause for women in Singapore was 49.0 years, with no difference among the various ethnic groups.<sup>(10)</sup> Therefore, the authors believe that most patients in this cohort were pre-menopausal at the time of admission for AMI.

In conclusion, many young Asian women with AMI have identifiable risk factors that are different from those found in the Western population. There seems to be an ethnic effect on the prevalence of these risk factors, with diabetes mellitus being more common in Malay patients and hyperlipidaemia, in Indian patients. Although most patients with STEMI underwent primary percutaneous coronary intervention, the door-to-balloon time seemed to be long, especially among Malay patients. With contemporary medical therapy and prompt revascularisation treatment, the in-hospital outcomes of these patients are likely to be good.

#### REFERENCES

1. Shaw LJ, Bugiardini R, Merz CN. Women and ischemic heart disease: evolving knowledge. *J Am Coll Cardiol* 2009; 54:1561-75.
2. Foo S. Singapore: Statistical Profile. Available at: [www.bc.edu/agingandwork](http://www.bc.edu/agingandwork). Accessed November 4, 2011.
3. Hoit BD, Gilpin EA, Henning H, et al. Myocardial infarction in young patients: an analysis by age subsets. *Circulation* 1986; 74:712-21.
4. Hong CY, Chia KS, Hughes K, Ling SL. Ethnic differences among Chinese, Malay and Indian patients with type 2 diabetes mellitus in Singapore. *Singapore Med J* 2004; 45:154-60.
5. Mak KH, Chia KS, Kark JD, et al. Ethnic differences in acute myocardial infarction in Singapore. *Eur Heart J* 2003; 24:151-60.
6. McQueen MJ, Hawken S, Wang X, et al. Lipids, lipoproteins, and apolipoproteins as risk markers of myocardial infarction in 52 countries (the INTERHEART study): a case-control study. *Lancet* 2008; 372:224-33.
7. Lee CH, Tai BC, Lau C, et al. Relation between door-to-balloon time and microvascular perfusion as evaluated by myocardial blush grade, corrected TIMI frame count, and ST-segment resolution in treatment of acute myocardial infarction. *J Interv Cardiol* 2009; 22:437-43.
8. Lee CH, Ooi SB, Tay EL, et al. Shortening of median door-to-balloon time in primary percutaneous coronary intervention in Singapore by simple and inexpensive operational measures: clinical practice improvement program. *J Interv Cardiol* 2008; 21:414-23.
9. Vaccarino V, Parsons L, Every NR, Barron HV, Krumholz HM. Sex-based differences in early mortality after myocardial infarction. National Registry of Myocardial Infarction 2 Participants. *N Engl J Med* 1999; 341:217-25.
10. Loh FH, Khin LW, Saw SM, Lee JJ, Gu K. The age of menopause and the menopause transition in a multiracial population: a nation-wide Singapore study. *Maturitas* 2005; 52:169-80.

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