Chapter 2

Epidemiology of Myocardial Infarction

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Additional information is available at the end of the chapter

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Abstract

Coronary heart disease (CHD) is the leading cause of morbidity and mortality throughout the world. The most common form of CHD is the myocardial infarction. It is responsible for over 15% of mortality each year, among the vast majority of people suffering from non-ST-segment elevation myocardial infarction (NSTEMI) than ST-segment elevation myocardial infarction (STEMI). The prevalence of myocardial infarction (MI) is higher in men in all age-specific groups than women. Although the incidence of MI is decreased in the industrialized nations partly because of improved health systems and implementation of effective public health strategies, nevertheless the rates are surging in the developing countries such as South Asia, parts of Latin America, and Eastern Europe. The modifiable risk factors represent over 90% of the risk for acute MI. The risk factors such as dyslipidemia, smoking, psychosocial stressors, diabetes mellitus, hypertension, obesity, alcohol consumption, physical inactivity, and a diet low in fruits and vegetables were strongly associated with acute MI.

Keywords: myocardial infarction, epidemiology, prevalence, incidence, risk factors

1. Introduction

The widely accepted definition of epidemiology is "the study of the distribution and determinants of health-related states or events in specified populations, and the application of this study to the control of health problems" [1]. The overarching aim of epidemiology is to improve the control of disease through both prevention and treatment that will decrease morbidity and mortality due to the disease and will increase the quality of life of those who have a severe illness like coronary artery diseases, e.g., myocardial infarction.

1.1. Coronary heart disease

The most common cause of coronary heart disease (CHD) is atherosclerosis of coronary arteries [2]. Atherosclerosis causes an inadequate supply of oxygen for a given a myocardial demand leading to myocardial hypoxia.

1.2. Atherosclerosis

The sequence of endothelial dysfunction, plaque formation consisting of lipids and smooth muscles, and associated inflammation causes atherosclerotic plaque [3]. Over these plaques rupture and thrombosis causing further narrowing of arteries and occlusion of blood flow can occur.

Although beyond the scope of this chapter, atherosclerosis implies disturbances in the coronary circulation as well as the microcirculation dysfunction.

1.3. Burden of coronary heart disease

Globally, cardiovascular diseases (CVDs) are the number one cause of mortality. According to the World Health Organization (WHO), it is estimated that 7.4 million deaths were due to coronary heart disease in 2015. Eighty-two percent of deaths in low- and middle-income countries are accountable for CVD. **Figure 1** shows the age-standardized estimate of mortality by cardiovascular diseases and diabetes per 100,000 people. It is estimated that 23.6 million people will die from CVDs by 2030. These are projected to remain the leading cause of mortality.

1.4. Geographic variations in coronary heart disease

Worldwide the prevalence of CHD is increasing albeit there are regional variations due to the influence of economies, industrialization, and advancement in healthcare systems [5]. Data from the USA suggest about 25% of deaths in the USA are associated with heart disease each year [6]. An American dies due to myocardial infarction (MI) every 60 seconds [6]. The incidence of CHD in the western world is decreasing even though the risk factors for CHD such as hypertension, diabetes mellitus, and obesity are increasing. The decline is due to strengthening healthcare systems due to relative advancement in therapeutic and invasive interventions. As a result, CHD costs the USA about $200 billion each year [7]. The total cost includes not only the cost of healthcare services or medications, but it also includes the loss of productivity [7].

As Asia comprises over one-third of the world population, its experience on the prevalence of CHD is significant. In India, CHD may not be explained due to the traditional risk factors [8], whereas in China, CHD remains the second most cause of the deaths. Chinese cardiovascular medicine focusses centrally on prevention by shifting its focus from symptom-based therapy to lifestyle-guided improvement [9]. Trends in mortality from CHD were favorable in European Union countries, whereas in Eastern European countries, mortality from CHD

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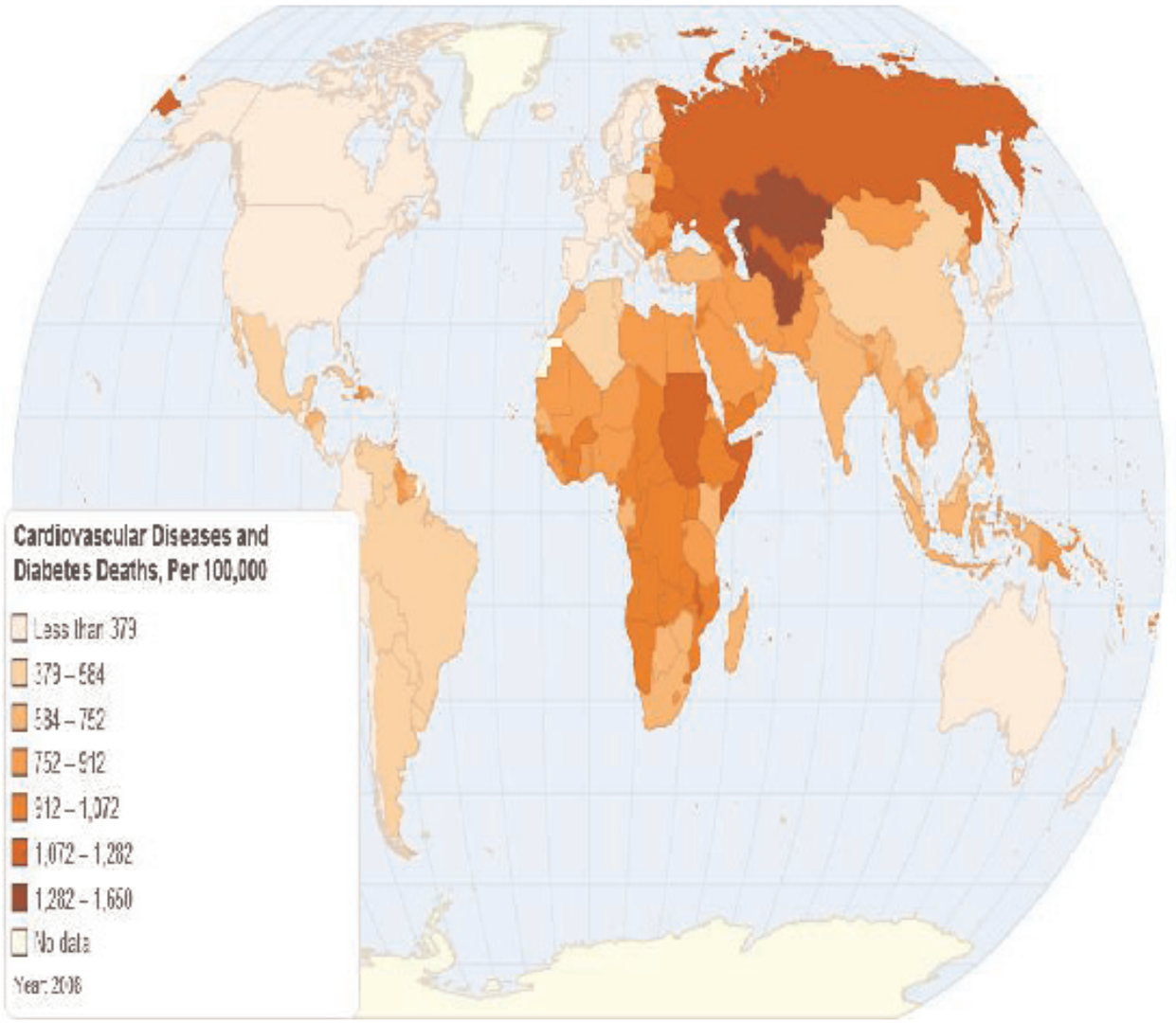

Figure 1. Cardiovascular diseases and diabetes, deaths per 100,000 people. Source: Global Health Observatory data repository and World Health Organization [4].

remains exceptionally high [10]. CVD death rates have been significantly decreasing in most of the countries of Latin America despite the disparities in current trends [11].

The WHO has identified very cost-effective interventions that are feasible to be implemented even in low resource settings for averting the global epidemic of CVDs.

2. Myocardial infarction

2.1. Defining myocardial infarction

The most common form of CHD is the myocardial infarction (MI) [12]. MI occurs when a coronary artery is occluded or almost occluded, which creates a severe reduction in the blood flow, causing some of the heart muscle being supplied by that artery to become infarcted [13].

There are two clinical settings of MI—ST-segment elevation myocardial infarction (STEMI) and non-ST-segment elevation myocardial infarction (NSTEMI). STEMI is recognized by characteristic changes on the electrocardiography (ECG) [14]. One of those ECG changes is the typical elevation in the "ST segment" which is called as STEMI. On the contrary the absence of ST-segment elevation and the presence of positive cardiac biomarker such as troponin are called NSTEMI [15].

In the following sections, prevalence and incidence of myocardial infarction are elaborated. Prevalence is defined as the number of diseased individuals present in the population at a specific time. The incidence rate is determined as the number of new cases of a disease that occur during a specific time. The estimates are reported from various data sources such as general practice registries and self-reported by the patient through the national survey. The reliability of the data is based on the data source.

2.2. Prevalence of myocardial infarction

According to 2014, based on the self-reported national survey of the UK, the prevalence of MI was reported as 640,000 in men and 275,000 in women; this represents about 915,000 people that have suffered an MI in the UK. In 2013, the prevalence of MI in men was about three times higher than for women in the UK [16]. As shown in **Figure 2**, the prevalence of age-specific MI extends from 0.06% of men <45 years of age to 2.46% of those ≥75 years old.

In contrast to these developed countries, South Asian countries (India, Pakistan, Sri Lanka, Bangladesh, and Nepal) have the highest prevalence of MI seen in younger than 45 years of age compared to those older than 60 years.

2.3. Incidence of myocardial infarction

Prevalence reflects first (acute) MI and MI in patients who had a previous MI. The incidence of MI only reflects the former. The incidence of MI has been declining in developed countries, including the USA and the UK.

The recent estimates of the incidence of MI in the USA are about 525,000 based on AHA data [18]. The Mozaffarian Study reported data comparing and contrasting the incidence of myocardial infarction in white men and women versus and black men and women. The study concludes that the incidence of myocardial infarction was more significant among black men (12.9/100,000 males) who are in the age group 75–84 years of age than whites for both men (9.1/100,000 males) and women (7.8/100,000 females). Similar trends exist in other age groups and their counterparts (**Figure 3**) [19]. It is essential to assess the effectiveness of public health strategies to fight MI.

Regarding the clinical type of MI, it has been estimated that incidence rates (per 100,000) of STEMI decreased appreciably (121 to 77), whereas those incidence rates of NSTEMI declined slightly (126 to 132) [20]. In a landmark study, no variation was seen in all-cause mortality for both STEMI and NSTEMI between 6 months and 4 years of follow-up. But, STEMI patients

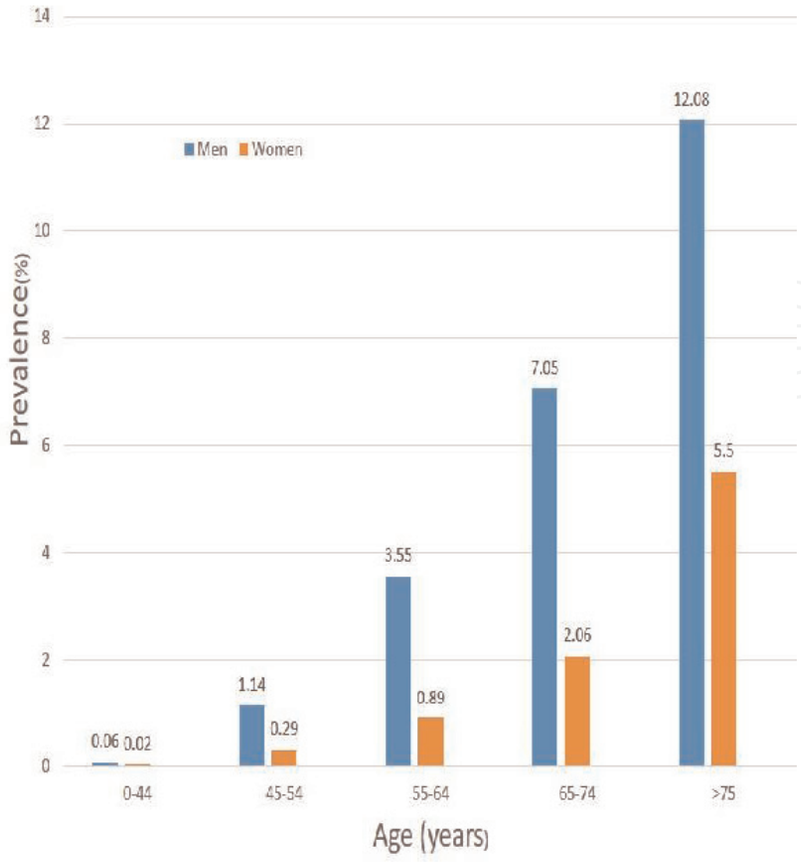

Figure 2. Age-specific prevalence of MI in the UK, 2014 [17]. Adapted from Clinical Practice Research Datalink (CPRD), 2014. Evaluations are based on records from a sample of general practices in each of the constituent nations of the UK.

have a worse long-term prognosis matched to NSTEMI patients [21]. Other studies have shown a worse 7-year mortality rate for NSTEMI patients than STEMI patients [22].

2.4. Risk factors

The INTERHEART study evaluated the prevalence of nine potentially modifiable risk factors in more than 15,000 cases with the first acute MI and matched with about 15,000 asymptomatic age- and sex-matched controls [23]. Nine risk factors were strongly associated with acute MI in the 52 countries included in the trial. The modifiable risk factors represent over 90% of the risk for acute MI. Diabetes mellitus is a significant predictor of adverse cardiac outcomes, especially in women. It is considered to be a coronary heart disease equivalent (**Tables 1**–**4**) [24, 25].

2.5. Summary

It is evident that MI is the leading cause of morbidity and mortality worldwide. It is responsible for over 15% of mortality each year, among the vast majority of people suffering from NSTEMI than STEMI. The prevalence of MI is higher among men in all age-specific groups than women. Although the incidence of MI is decreased in the industrialized nations partly

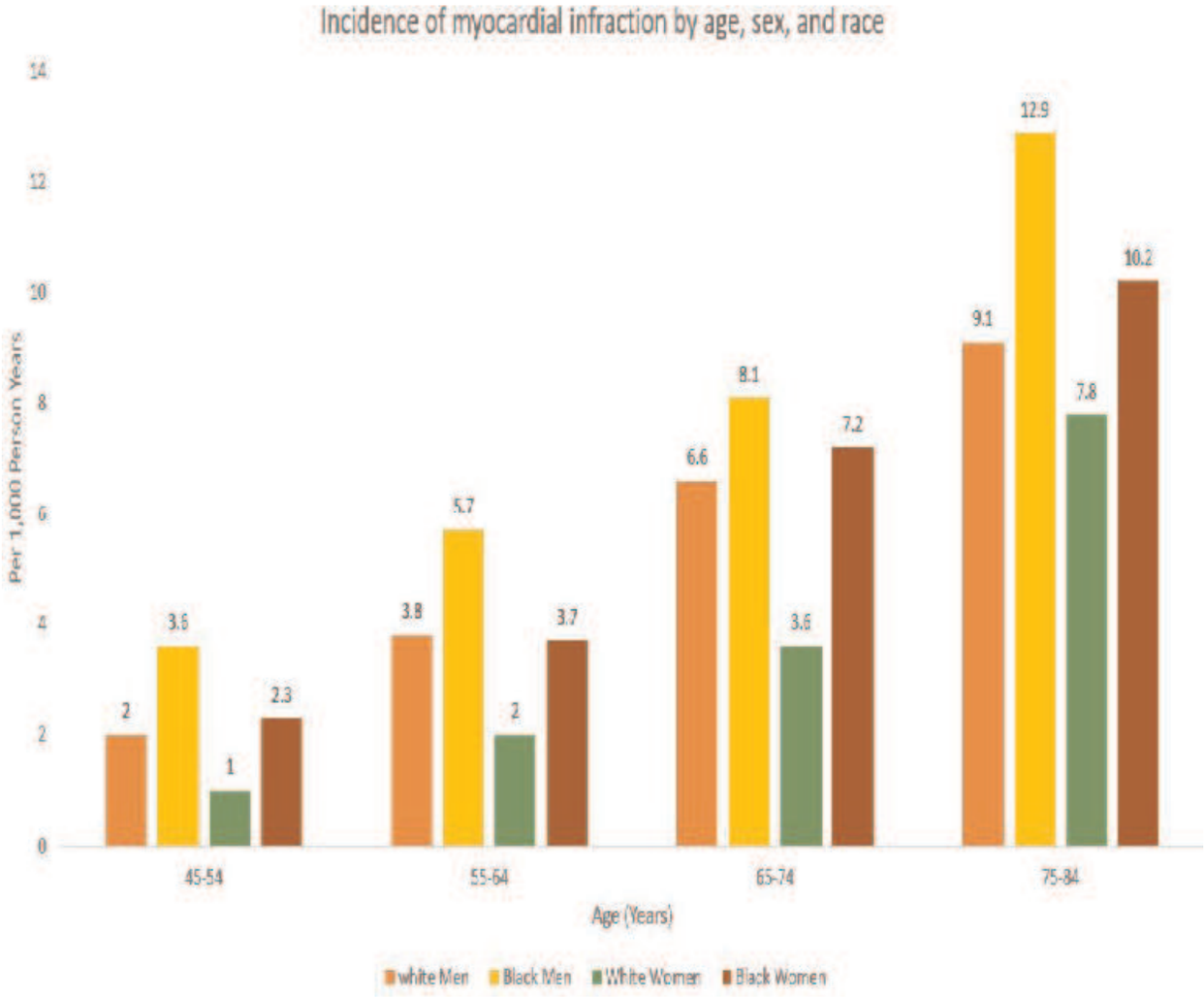

Figure 3. Incidence of myocardial infarction by age, sex, and race in the USA, 2015 [19]. Adapted from Heart Disease and Stroke Statistics—2015 update: A report from the American Heart Association.

CHD risk equivalents	• Noncoronary atherosclerotic disease (e.g., carotid, peripheral, abdominal aortic aneurysm) • Diabetes mellitus • Chronic kidney disease
CHD-established risk factors	• Dyslipidemia, smoking, psychosocial stressors, diabetes mellitus, hypertension, obesity, alcohol consumption, physical inactivity, and diet low in fruits and vegetables • Age (especially >50 in men and postmenopausal women) • Family history of CHD in first-degree relative age < 50 (men) and age < 60 (women)

Table 1. Risk factors for coronary heart disease (CHD).

because of improved health systems and implementation of effective public health strategies, nevertheless the rates are surging in the developing countries such as South Asia, parts of Latin America, and Eastern Europe. The modifiable risk factors account for more than 90% of the risk for acute MI. Nine risk factors such as dyslipidemia, smoking, psychosocial stressors,

Involved myocardium	Occluded vessel	ECG leads involved
Anterior MI	LAD	Some or all of leads V1–V6
Inferior MI	RCA or LCX	ST elevation in leads II, III, and aVF
Right ventricular MI (occurs in ½ of inferior MI)	RCA	ST elevation in leads V4–V6R
Posterior MI	LCX or RCA	ST depression in leads V1–V3 ST elevation in leads I and aVL (LCX) ST depression in leads I and aVL (RCA)
Lateral MI	LCX, diagonal	ST elevation in leads I, aVL, V5, and V6 ST depression in leads II, III, and aVF

Table 2. Myocardial infarction location based on coronary artery involvement.

Test	Onset of abnormality	Duration of abnormality
ECG	Immediately at onset of chest pain	ST elevation progresses to Q-waves over several days to weeks
Myoglobin	1–4 hours	1–2 days
CK-MB	4–6 hours	1–2 days
Troponin	4–6 hours	1–2 weeks

Table 3. Diagnostic tests.

Mechanical complication of acute MI	Coronary artery typically involved	Time course	Clinical findings	Echocardiography
RV failure	RCA	Acute	• Hypotension and clear lungs • Kussmaul sign	• Hypokinetic RV
Papillary muscle rupture	RCA	Acute and within 3–5 days	• Acute severe pulmonary edema • New holosystolic murmur	• Severe mitral regurtitation with fail leaflet
Interventricular septal rupture/defect	LAD: Apical septal rupture RCA: Basal septal rupture	Acute and within 3–5 days	• Shock and chest pain • New holosystolic murmur • Biventricular failure	• Left-to-right shunt at the level of rupture • Step-up oxygen level between the right atrium and ventricle
Free wall rupture	LAD	Within first 5 days to 2 weeks	• Shock and chest pain • Jugular venous distention • Distant heart sounds	• Pericardial effusion with tamponade

Table 4 Evaluation of chest pain in the acute setting.

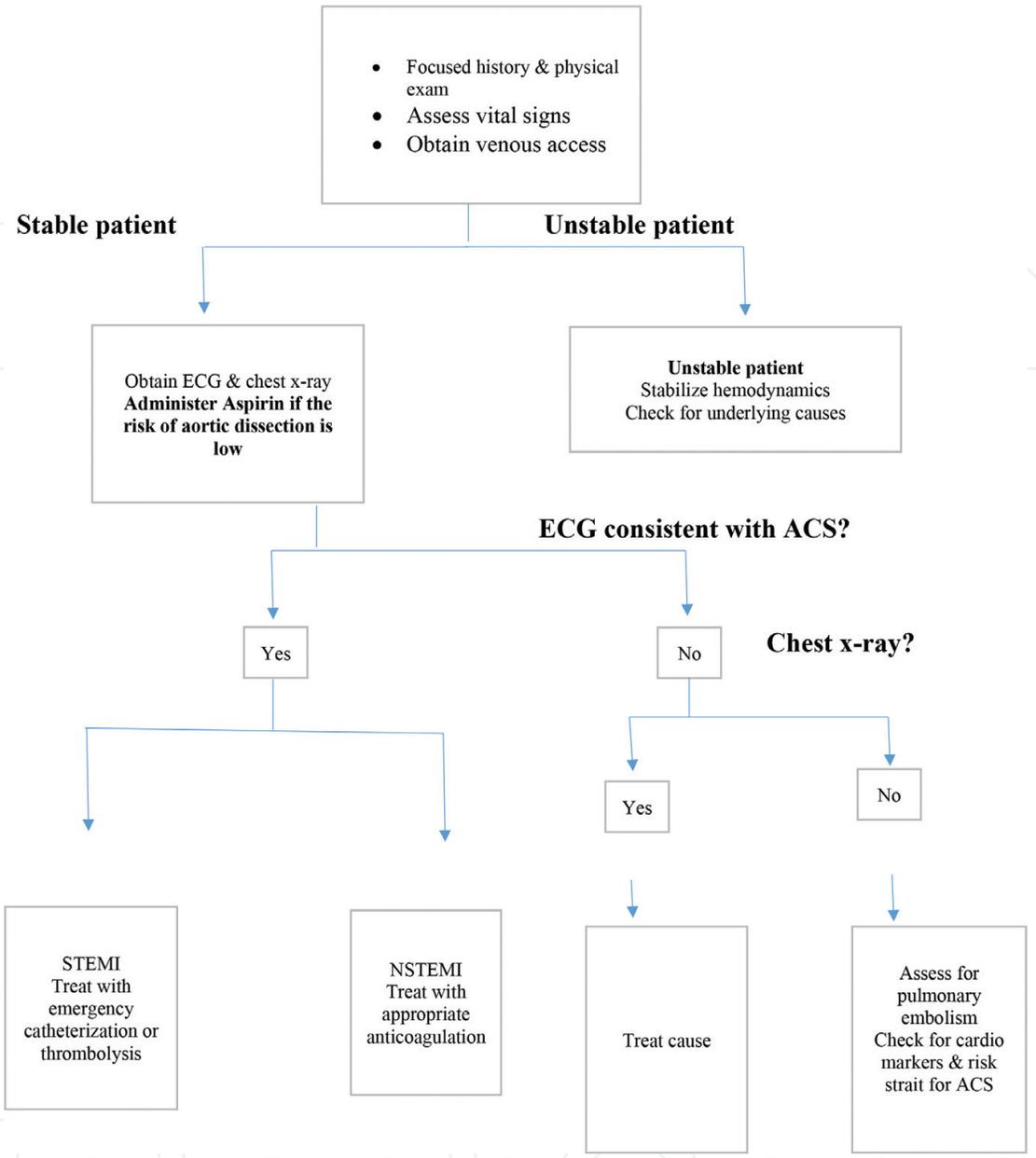

Chart 1 Evaluation of chest pain in the acute setting.

diabetes mellitus, hypertension, obesity, alcohol consumption, physical inactivity, and a diet low in fruits and vegetables were strongly associated with acute MI in the 52 countries (**Chart 1**).

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Conflict of interest

No conflict of interest.

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