

Cardiovascular Disease in Developing Countries

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Epidemiology
Cardiovascular disease (CVD) is the leading cause of death worldwide.¹ The magnitude of the problem is more prominent in the developing countries.^{2,3} When they looked at the prevalence of CVD by regions of the world, they showed that the increasing prevalence of CVD was mainly in the area of developing countries or economies in transition. The prevalence of CVD in developed countries increased to a lesser extent.⁴ The onset of CVD in developing countries became earlier. The prevalence has rapidly increased in Asian women.⁵ The disease is related to the atherosclerotic process. Not only leading to death, but it also causes many morbidities resulting in the decrease in quality of life. It is the major burden of the expense of the health care system not only for the expensive medications, procedures and devices but also the expensive investigation for the diagnosis of the disease. Although most people and doctors know the importance of CVD, it is difficult to control. By the time that a patient develops symptoms, the disease is usually in the advanced disease. The disease may not be diagnosed during the routine physical check up including 12-lead electrocardiogram (ECG).

There is a wide spectrum of CVD. Most patients belong to 3 groups: coronary artery disease (CAD), cerebrovascular disease and peripheral arterial disease (PAD).⁶ Each patient may have disease in more than 1 system since atherosclerosis can be considered a systemic disease.

The World Health Organization (WHO) statistics in 2007 showed that CVD death accounts for 33.7% of all deaths.⁷ Data in 2002 showed that three-fourths of global deaths due to CVD belong to low or middle income countries.⁷ CVD death in low or middle income countries usually occurs at a younger age compared to high income countries. The increase in CVD burden in developing countries is related to the increased prevalence of cardiovascular risk factors and inability to get access to treatment or intervention that would slow disease progression or reduce morbidity and mortality.⁸ East Asia has had a higher rate of stroke death compared to North America or Europe. It is estimated that between 1990 and 2020 there will be an increase in CAD mortality of 120% in women and 137% in men in developing countries which is much higher than data for

developed countries (29% and 48% respectively). Stroke mortality also follows the same trend (124% for men and 107% for women in developing countries versus 78% and 56% in developed countries.⁹

The increase in incidence of CVD in the developing countries may be related to the urbanization and changing life style which is part of the epidemiologic transition.⁹

The epidemiological transition involves 4 stages.¹⁰

1) Pestilence and famine

Life expectancy was 35 years. Dominant forms of cardiovascular disease were infectious and nutritional cardiac disease. The proportion of deaths from cardiovascular disease was 5-10%. Affected regions are South Africa, and parts of almost all developing regions excluding high income areas.¹¹

2) Receding pandemics

Life expectancy was 50 years. There was an improvement in nutrition and public health with an increase in chronic disease and hypertension. Dominant forms of cardiovascular disease were rheumatic heart disease, ischemic heart disease (IHD) and hemorrhagic stroke. The proportion of deaths due to CVD was 15-35%. Affected regions are parts of South Asia.¹²

3) Degenerative and man-made diseases

Life expectancy was 60 years. There was an increase in tobacco use, high fat and caloric intake leading to death due to chronic disease exceeding death from infectious disease. Dominant forms of CVD were IHD, ischemic and hemorrhagic stroke. The proportion of deaths due to CVD was approximately 50%. Affected regions are many parts of South Asia, Latin America and Eastern Europe.^{4,12}

4) Delayed degenerative diseases

Life expectancy was more than 70 years. CVD and cancer are leading cause of death. Onset of CVD was delayed by preventive strategies. There was a decline in age-adjusted mortality from CVD. Dominant forms of CVD were ischemic stroke, IHD and heart failure. Death from CVD accounts for 40-50% of all deaths. Affected regions are high-income countries and parts of Latin America.^{10,12}

Pathogenesis

Atherosclerosis gradually developed beginning at the very early age of life.¹³ The process involved the accumulation of lipid content, inflammatory cells, smooth muscle cells, and fibroblasts into subendothelial layers. The initial part of the process was the penetration of oxidized LDL and inflammatory cells from the blood stream into subendocardial layers by endothelial cells.¹⁴ There are many risk factors that can trigger or facilitate this process mainly by causing endothelial cell dysfunction. The arterial system has a compensatory mechanism to minimize the effect of the atherosclerotic plaque on the compression of the arterial lumen mainly by eccentric dilatation of the artery.¹⁵

Cardiovascular risk factors

The prevalence of many cardiovascular risk factors has increased during the past 10-20 years. The increasing prevalence of CVD and cardiovascular risk factors was predominantly in the developing countries. There are many reasons for this fact. One of the important reasons is the changes in life style.

Data from the INTERHEART study which is a case-control study of 25 countries showed that there are 9 risk factors contributing to acute myocardial infarction.¹⁶ These factors are systemic hypertension, diabetes, smoking, ApoB/ApoA1 ratio, abdominal obesity, psychosocial factors, regular exercise, regular alcoholic consumption and fruit and vegetable intake. CVD involved these risk factors in most parts of the world. Relation between low socioeconomic status and CVD are confounded by the psychosocial and behavioral factors.¹⁷

There may be other risk factors that should be mentioned. Examples of these factors are air pollution,¹⁸ climate changes,¹⁹ HIV infection²⁰ and certain genetic predispositions.²¹

The prevalence of many cardiovascular risk factors has increased in the urban region compared to the rural area, for example, the prevalence of diabetes may be 4 times as much in the urban areas of South Asian countries compared to the rural regions.²² Hypertension and high cholesterol are the main risk factors contributing to CAD. Diabetes, physical inactivity, and tobacco are the remaining risk factors.

Proven risk factors for the causative links are tobacco, increased LDL, low HDL, hypertension, diabetes, obesity, and low physical activity. Other risk factors that showed association with CVD are low socioeconomic status, elevated prothrombotic factors, inflammatory markers, elevated homocysteine, elevated lipoprotein (a), and psychosocial factors. People who live more in the urban areas consume more fat, have less exercise and a more stressful life.⁹ The increase prevalence of CVD may be related to the increased proportion of people living in the urban areas which is estimated to be 12.6% in 1970 and will be approximately 43.5% in 2025 for developing countries.⁹ The increase in urbanization is much less for developed countries. This may result in a change in the dietary patterns of an increase in energy from fat and a decrease in fiber consumption.

Tobacco

Approximately 1.3 billion people use tobacco worldwide based on WHO data in 2003. Eighty percent

of populations with tobacco use live in low or middle income countries. Second-hand smoke is now recognized as a risk factor for CVD with a risk ratio of 1.3.²³ The WHO attempts to combat tobacco use by suggesting 6 key strategies: monitor tobacco use and prevention policy, protect people from smoke, help people to quit tobacco use, warn about the dangers of tobacco, enforce the ban of advertizing and raise tobacco taxes.

Hypertension

In India, the prevalence of hypertension in men and women in urban areas were 25% and 29% whereas the number was 14% and 11% in rural areas. High blood pressure contributes to 62% of strokes and 49% of CAD which accounts for 7 million deaths per year worldwide. One-third of patients with hypertension were unaware of their hypertensive status. Only one-third had a good control of hypertension. Data in 2004 showed that the prevalence of HT was 20-40% in urban areas and 12-17% in rural areas.²⁴

Lipids

High cholesterol contributes approximately 56% of IHD and 18% of stroke worldwide which accounts for 4.4 million deaths per year.⁷ High cholesterol from a western diet is the main component for the increase in CVD rate in China.²⁵

Obesity

The prevalence of obesity has increased especially in the developing countries. Population-based data in 2005 showed that 1.3 billion adults or 20% of adults over 20 years of age were overweight. The increasing rate of an overweight population in developing countries was 2-5 times that of those in western countries.²⁶

Aging population

In 2025, it is estimated that the average life expectancy will be 73 years and more than 20% of the population in developed countries will be over 65 years of age compared to approximately 10% in developing countries. The rate of increase in the elderly population in developing countries is much more than those in developed countries.

Diabetes

Approximately 180 million people have diabetes which will be doubled by the year 2030. More than 80% are type 2 diabetes and more than 70% live in low or middle income countries. Most of type 2 diabetes are related to obesity.²⁷ Currently, there is at least 1 new diagnosis of diabetes every 5 seconds and every 10 seconds someone dies due to diabetic related disease.²⁸

Physical activity

Lack of physical activity has been shown to be an independent risk factor for the development of CVD.^{16,29} Promotion of regular exercise is important for the primary prevention of CVD and secondary prevention of cardiac events.³⁰

Economic burden

There may be 3 aspects of economic burden.³¹ The first aspect is related to the cost of health-care or cost of treatment. The second aspect is related to

household impact since the illness may interfere with the family economic status especially in those who do not have health insurance. The last aspect is the loss in work productivity and growth of economy.

The increase in incidence of CVD is certainly an economic burden including the cost for investigation and treatment. There has been an increasing cost of many types of cardiovascular investigation especially the imaging perspective. The burden for treatment involves expensive medications, percutaneous interventions and surgical procedures.

Prevention of CVD

There is a lack of data on the incidence of CVD and a good predictive model in many countries.³² Although the predictive model in a high income country such as Framingham model in the USA has been applied in many other countries, we believed that regional data is needed for the development of a model for each region.^{33,34} Recent data have indicated that CVD mortality decreased during the past 20 years at least in the United States and European countries.^{35,36} Analysis for the factors contributing to the decrease in CVD mortality during the past 20 years in many regions has shown that risk factor modification accounts for 40-50%.³⁶ Identification of the high risk population is the key for the CVD prevention.³⁷

Funding for healthcare may be 40 fold different between developing and developed countries.⁴ The cost-effectiveness analysis for healthcare expenditure should be implemented. The costs should include personnel cost, hospital stay, clinic visit, diagnostic tests, medications and interventions. Work loss and cost for family assistance should be considered. Calculations for cost effectiveness should be based on costs per quality-adjusted life years (QALY) gained. Data on cost-effectiveness analysis for each treatment should be the basis for the allocation of healthcare budget.

Prevention of CVD can be performed by a community-based or case-based approach.² The community-based approach includes smoking cessation,³⁸ diet salt reduction, weight reduction and promotion of exercise.³⁹ Salt restriction to 5-6 grams per day in the general population has been shown to be cost effective in CVD prevention.⁴⁰ The case-based approach has to target the high risk subsets. Many strategies can be implemented such as lipid lowering agents, appropriate control of diabetes and blood pressure and the use of antiplatelet agents.⁴¹ However, there are many problems in developing countries especially for the price, availability, and affordability of medications. These problems raise concerns for policy makers - how to take good care of CVD especially in public sector⁴² and how to create an effective program for CVD prevention in a primary care setting.⁴³ Secondary prevention of those who already have disease is also important in order to avoid recurrent hospital admission, future intervention and to improve their quality of life.

In conclusion, CVD is increasing in the developing world and poses a major health and economic burden. Health care policies and budgets have to be implemented in order to develop the preventive strategies which will involve a good database system and healthcare resources.

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