PRIMARY PREVENTION OF CORONARY HEART DISEASE (CHD) IN SAUDI ARABIA: MEETING THE CHALLENGE

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ABSTRACT

Coronary heart disease (CHD) represents the third most common cause of hospital-based mortality. Many studies have identified that diabetes, dyslipidemia, hypertension, obesity, smoking, lack of physical activity, unhealthy diet, and excessive alcohol consumption are the main risk factors associated with myocardial infarction. Primary prevention of CHD includes delaying or limiting the first changes in individuals who have not yet been diagnosed with a heart disease or being aware of potential heart illness, while secondary prevention aims to prevent, postpone, or limit the progression or the recurrence of the clinical manifestations of CHD in patients who have already been diagnosed with CHD. Identifying individuals with cardiovascular risk factors through screening allows for additional evaluation, diagnosis, and treatment. Several studies have compared the outcomes of when care is given to high-risk individuals with poor lifestyle to the care given to the entire population, addressing the environmental and behavioral characteristics of the population in general. However, if the recent increase in the incidence of obesity, diabetes, and smoking continues, Saudi Arabia will face major challenges to lowering cardiovascular risk factors in the population, and the end of this epidemic will not be in sight. This review draws attention to possible prevention modalities to address this important public health problem.

KEYWORDS : Coronary Heart Disease, Prevention, Saudi Arabia.

INTRODUCTION

Coronary heart disease (CHD) is now among the leading causes of death and disability globally **(1)**. The World Health Organization (WHO) estimated that 42.2% of global deaths are due to cardiovascular diseases (CVD) (1). In Saudi Arabia, the estimated proportion of deaths due to CVD in 2014 was 46% **(2)**. In the same WHO report, the main risk factors associated with CVD deaths were tobacco smoking in 22% (males, 38%; females, 1%), raised blood pressure in 24.2% (males, 26%; females, 1.5%), and obesity in 33% (males, 28.6%; females, 39.1%) of patients with CVD. Other studies identified that diabetes, dyslipidaemia, hypertension, obesity, smoking, lack of physical activity, unhealthy diet,

and excessive alcohol consumption are the main risk factors associated with myocardial infarction **(3, 4)**. Next to the rapid economic and social growth in Saudi Arabia, there has been a significant change in the people's standard of living and lifestyle, including an increased consumption of fatty and poor quality foods, the adoption of an inactive lifestyle with a marked decrease in physical activity, increased use of tobacco, and obesity. As a consequence of these lifestyle changes, the rates of CVD and associated risk factors among the Saudi population have also increased **(5)**.

A study in 2011 assessed the burden of ischemic heart disease in a major cardiac center in Saudi Arabia and estimated that the average cost of a coronary artery disease patient is 40,164 Saudi Riyals (SAR)/patient (US $10,710), while the pharmacological medications contributed the lowest portion in this cost (3.2%). It was also reported that the lowest average length of stay in the hospital was 6.5 days, and the average length of stay increased with the number of co-morbidities from 5.67 days (no co-morbidity) to 11.25 days (6 co-morbidities) **(6)**. It is estimated that, in the next few decades and without any change in prevention or treatment practices, the prevalence of CVD will increase, and the costs attributable to CVD will increase accordingly **(7)**. Although the death rate from CHD has fallen, the prevalence of risk factors, especially obesity and diabetes, has continued to increase at an alarming level over the past few decades. Throughout the country, the prevalence of overweight and obese individuals has increased dramatically among both males and females of different age groups and occupations. Saudi Arabia is now among the nations with the highest prevalence of overweight and obese individuals due to factors related to recent social and economic changes such as eating habits, genetic factors, marital status, and lack of physical activity **(8)**. Generally, the risk factors that predispose to cardiovascular disease have genetic, physiologic, lifestyle, and environmental elements. The non-modifiable risk factors include advancing age, genetic predisposition, and male gender. The modifiable risk factors comprise smoking, dyslipidemia, hypertension, diabetes, obesity, and metabolic syndrome. There are other new or non-traditional risk factors that include C-reactive protein, lipoprotein-associated phospholipase A2, 14 LDL particle number, fibrinogen, lipoprotein (a), small dense LDL, triglycerides, plasminogen activator inhibitor (PAI-1), interleukin-6 (IL-6), and others **(4)**. Some pharmacological agents are now prescribed for risk reduction of CHD for both primary and secondary prevention as well as for treatment. A recent perspective highlighted the role of rosuvastatin in primary prevention **(9)**.

Additionally, in a recent study to estimate the prevalence of prediabetes and diabetes in a Saudi community, it was reported that the prevalence of prediabetes was 9.0% (9.4% in men and 8.6% in women), and the prevalence of diabetes was 12.1% (12.9% in men and 11.4% in women). It was also reported that the prevalence of diabetes and prediabetes increased with age to reach 46% of men and 44% of women for people aged ≥50 years. Diabetes was also found to be associated with dyslipidemia in women and cardiovascular disease in men **(10)**. Although some reviews of the prevalence of CVD and its risk factors in the Gulf region, including Saudi Arabia, have been published **(11)**, this review draws attention to the possible prevention strategy to address this important public health problem. CHD represents the third most common cause of hospital-based mortality. Unfortunately, by the time CHD is detected, the underlying causes, such as atherosclerosis, are usually advanced and have been progressing in severity. Vascular changes usually accumulate from a young age and adolescence, making it necessary that primary and primordial preventive measures are taken early in life. Therefore, there is increasing emphasis on prevention strategies of CHD by modifying risk factors rather than on diagnosis and treatment **(12).**

PRIMARY PREVENTION

Primary prevention of CHD includes delaying or limiting the first changes in individuals who have not yet been diagnosed with a heart disease or are aware of a heart illness, while secondary prevention aims to prevent, postpone, or limit the progression or the recurrence of clinical manifestations in patients who have already been diagnosed with CHD **(13)**. Lowering the level of cardiac risk factors among the population would lead to a significant reduction in the prevalence of CHD **(14)**. In Saudi Arabia, there is a widespread consensus among professionals and health decision makers that preventive measures are fundamental; however, these measures remain unsatisfactory, and even with the widespread consensus, prevention services remain low and are likewise undervalued by the public. The American Heart Association (AHA) uses the principle of

primordial and primary prevention in defining "ideal cardiovascular health" as a goal to reduce cardiovascular disease mortality by 20% by the year 2020 **(15)**. Ideal cardiovascular health is defined as an absence of cardiovascular disease, a healthy lifestyle including sufficient exercise and an adequate diet, absence of smoking, appropriate BMI, and normal values of blood pressure, cholesterol, and fasting glucose (Table 1).

Studies also demonstrated that the degree of protection against CHD by using primordial and primary preventive measures is much higher than the reversal of existing risk factors **(16)**. It is well known that atherosclerosis begins at an early age and progresses throughout life; therefore, primary prevention is exceptionally effective in defeating CHD. Preventing atherosclerosis also protects against other degenerative diseases and reduces all-cause mortality. It is also known that healthy dietary habits may cause cardiac lesion regression in humans **(17)**. A number of recent prospective studies suggested that population-based primordial prevention is able to reduce CHD deaths by approximately 10% of the current expected rate **(18)**. Weight loss of 15% or more accompanied by other dietary and lifestyle changes, especially exercise, will considerably reduce cardiovascular risk up to 45%. Lowering the risk factor burden in the general population through lifestyle, environmental, and social changes would be expected to produce greater reductions in CHD risk **(19)**. However, methods used to positively influence individual behaviors have been unsuccessful in many countries around the globe.

INDIVIDUAL VERSUS POPULATION-BASED PREVENTION

Identifying individuals with cardiovascular risk factors through screening aims to target them for additional evaluation, diagnosis, and treatment. This approach has led to a large decrease in cardiovascular mortality. It has also been observed during the past few decades that a fall in the prevalence of risk factors within the population is responsible for a decrease in the death rate of CHD by approximately half **(20,21)**. It has been also observed that population-based interventions to control risk factors

resulted in smaller individual benefit and required a larger political commitment and higher economic expenditure **(22, 23)**. However, a recent study estimated that 90% or more of cardiovascular events occur in individuals with one or more risk factors; however, those individuals would not qualify for intensive diagnosis or treatment through the individual screening process. Therefore, the study concluded that lowering the burden of risk factors in the general population through lifestyle, environmental, and social measures would be expected to produce a greater decrease in CHD risk **(24)**.

FUTURE TRENDS

During the last two decades, adherence to a healthy lifestyle has deteriorated significantly worldwide and in Saudi Arabia. Moreover, studies demonstrate that the rising prevalence of overweight individuals, obesity, and diabetes not only reflect the rapid rise, but the absolute levels are higher than ever before **(8, 25)**. Most of these results are based on self-reported data; therefore, the actual numbers are likely to be higher. Additionally, the overall prevalence of current smoking in Saudi Arabia has been estimated in a recent review to range from 2.4-52.3% (median = 17.5%) **(26)**. Among school students, the prevalence of current smoking ranges from 12-29.8% (median = 16.5%), among university students from 2.4-37% (median = 13.5%), and among adults from 11.6-52.3% (median = 22.6%). The prevalence of smoking in males ranges from 13-38% (median = 26.5%), while in females, it ranges from 1-16% (median = 9%). Generally, smoking prevalence in Saudi Arabia is higher than ever before in different age groups and is also higher in males than in females of different ages. If the recent increase in the incidence of obesity, diabetes, and smoking continues, Saudi Arabia will be facing major challenges of lowering cardiovascular risk factors in the population, and the end of these epidemics will not be in sight. Although the information about cardiovascular health is available and accumulating, there are no comprehensive, evidence-based, population-wide strategies to combat this health crisis **(8, 25, 26)**.

TABLE 1:

Ideal cardiovascular health, defined by the American heart association, now known as "life's simple 7TM" composed of four behaviors and three factors*

Not smoking or quitting over 1 year ago

A body mass index, 25 kg/m2.

Exercising at a moderate intensity ≥150 minutes (or 75 minutes at vigorous intensity) each week

Eating a "healthy diet": adhering to four to five important dietary Components

sodium intake,1.5 g/day;

Sugar-sweetened beverage intake, 36 oz† weekly;

≥4.5 cups of fruits and vegetables/day;

≥three 1 oz servings of fiber-rich whole grains/day;

≥two 3.5 oz servings of oily fish/week.

Maintaining total cholesterol, 200 mg/dL.

Keeping blood pressure, 120/80 mmHg.

Keeping fasting blood glucose, 100 mg

*Other recommendations include ≥ four servings of nuts, legumes and seeds/week; ≤ less servings of processed meats/week; less than 7% total energy intake as saturated fat.
†1 ounce "oz" = 28.3495 gram

CORONARY HEART DISEASES BEGIN IN CHILDHOOD

Risk factors for CHD, particularly atherosclerosis, begin in infancy, childhood and progress throughout a lifetime **(27)**. Additionally, there is increasing evidence that obesity begins during the prenatal period **(28)**. The longer the duration of exposure and the greater the intensity of the risk factors, the higher the burden of atherosclerosis in the future **(29)**. Observations from recent studies show that the major etiologies of heart disease and atherosclerosis in adults are hypertension, dyslipidemia, and obesity. These events begin in childhood, tracking into adulthood, with anatomic changes evident early in life by 5–8 years of age. The greater the number of risk factors, the higher the probability of CHD in adulthood. The speed of progression depends not only on the time of appearance of these risk factors but also strongly depends on the number of risk factors present **(30)**. The period from the appearance of these risk factors in children to the CHD incidence in adults is usually asymptomatic. Therefore, health education and preventive measures should be emphasized at the earlier time of childhood **(31)**. Several studies on children and adolescents agree that up to 90% of heart disease can be effectively prevented by the promotion of healthy lifestyles, nutrition, and adequate exercise early in childhood **(32)**.

FACING THE CHALLENGE

The concept of risk factors was first introduced by the early Framingham researchers in 1961, who established the notion of preventive cardiology. Now, the concept of risk factors is universally accepted as antecedents of atherosclerosis. The level of atherosclerosis in individuals can predict subsequent cardiovascular events; therefore, reducing the level of atherosclerosis becomes the target for prevention and therapy of cardiovascular events. Individual- and community-based screening for cardiovascular events is thoroughly summarized by Berger and associates in their state-of-the-art study published in 2010 **(24)**. Reducing the risk factors of CHD in the general population is of paramount importance. However, there is no ideal or "gold-standard" method for risk assessment nor a drug-response equation for treatment. Currently, researchers are focusing on the following issues in primary prevention of CHD: the long incubation period, methods to evaluate the risk in the general population, population-based vs. individual risk-based approaches, cutoff values of the traditional risk factors, treatment targets, particularly the LDL, imaging techniques for evaluation and monitoring of therapy, advanced lipid testing, and use of statins in primary prevention.

Primordial prevention is an efficient method for risk reduction and more efficient than pharmacological intervention. The evidence supporting the effectiveness of lifestyle modifications for preventing

cardiovascular events is summarized in many research studies **(15, 18)**. While primordial prevention is recommended, the social and political barriers are substantial, and the individual resistance to behavioral modification is complex and not well understood. It is therefore justifiable that the enforcement of public education is fundamental for any progress in CHD prevention. At the same time, Wilson & Lloyd have suggested that attempts to reduce cardiovascular risk without population-wide prevention is destined to fail **(33)**. Moreover, data now indicate that examining and monitoring non-HDL-C can be a better predictor of cardiovascular incidents than the use of LDL-C **(34)**. However, all lipid monitoring should ideally be done to minimize cardiovascular events. Currently, there is considerable progress in understanding HDL metabolism accompanied by interest in raising HDL-C levels for reducing risk of CHD. However, there is scarce evidence that raising HDL-C using pharmacological interventions will improve CHD risk reduction by more than what is achieved by lifestyle modification alone. The European **(35)** as well as the Canadian **(36)** guidelines for dyslipidemia management highlight that trial data do not show that pharmacological treatment of HDL-C will reduce cardiovascular risk. Moreover, Wald and Law proposed the use of a Polypill to lower LDL-C, blood pressure, and serum homocysteine levels and inhibit platelets regardless of pretreatment levels **(37)**. In their study, one-third of people taking this pill age 55 and above benefitted, with an average of 11 years added to life, free from a CHD event or stroke. This recommended intervention is assumed to produce fewer side effects, with minimal cost if used for the population over the age of 55. If the safety of this intervention rises and the cost falls, risk stratification will be considered less valuable.

CONCLUSIONS

Improving cardiovascular prevention has changed remarkably based on new data in recent years. Traditional risk factors among the general population do not predict the risk of CHD well enough and do not discriminate sufficiently between those who will have cardiovascular events and those who will not.

Therefore, choosing the best mix of approaches for primary prevention of CHD should be based on an evidence-based synthesis of new accumulating data. For effective improvements in cardiovascular risk, primordial prevention is necessary as an addition to the high-risk individual strategy. Moreover, population-wide pharmacological reduction of risk is being reevaluated as a cost-effective intervention. In high-risk patients, aggressive treatment to reduce risk factors should be instituted early and maintained for years, and greater demand for pharmacological and invasive therapies is needed. Psychosocial aspects of individual behaviors for accepting primordial and primary prevention are receiving greater attention, especially when the disease is asymptomatic. Attention should also be given to pediatric patients who are in a time when habits are formed. Monitoring of adolescents and young adults must also increase. Additionally, the global risk scoring should be reaffirmed to assess risk in all adults. Similarly, taking the family history for all patients is recommended. Women deserve special attention because lowering the threshold for risk level appears to bring more benefit. Cardiovascular health and its importance have not been fully appreciated by the public, the media, or health policy authorities. Therefore, success in CHD prevention will not be in sight except through a combination of public adherence to lifestyle modifications, compliance with guidelines, new evidence-based pharmacological interventions, applications of primordial prevention strategies, and cooperation between all Saudi populations, patients, physicians, researchers, policy makers, and public health officials. Although there are many obstacles, recent advances in medicine and technology offer greater opportunities to meet this challenge.

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