Chapter 10
Genomics and Genetics in Cardiovascular Disease

ABSTRACT

This section addresses the origin and relevance of Framingham study to genomic epidemiology of heart disease whereby we explore the economic burden associated with chronic cardiovascular diseases, discuss the gene chromosomes associated with these complex diseases. Besides we accentuate the relevance of the family history approach (FHA) in the identification of intrafamilial risk factors underlying onset of cardiovascular disease and discuss the relevance of the health belief model in sensitizing at-risk groups to participate in primary preventive programs. Finally, we compare the technological and medical diagnostic management of cardiovascular disease in the developed and developing nations, and specify the natural pathways and approaches to heart health.

FRAMINGHAM HEART STUDY: THE LEGACY FOR THE GENOMIC EPIDEMIOLOGY OF CARDIOVASCULAR DISEASES

Introduction

The Framingham Heart Study (FHS) and the associated legacy transcend medical and epidemiologic sciences. The ramification of Framingham Cardiovascular Study, which was initiated in 1948, has implications that link clinical, social, and behavioral sciences. Besides, it is just an inkling of the multifarious, serendipitous benefits which have been reported by medical scientists and journalists. As a Tuft Medical School Faculty in 1990–1991, a visit to Framingham revealed the suitability of this community for a landmark prospective epidemiological investigation. Owing to the dearth of information about the medical, medical engineering, and genomic interventions derived from the Framingham experience, genomic epidemiology of cardiovascular disease (CVD) will be incomplete.

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Nature of Cardiovascular Diseases

The American Heart Association has categorized the six forms of CVDs to include coronary heart disease, hypertension, stroke, congenital heart diseases, rheumatic heart disease, and congestive heart failure. A patient may suffer from one of this disease and encounter a combination of these diseases.

In the 1900s, CVD was not the leading cause of death in the United States; instead pneumonia was the leading cause of death. However, the excessive consumption of food items that was extremely rich in lipids, the habitual use of tobacco and alcohol and exposure to stressful lifestyle created the upsurge of death associated with CVDs. Since 1940, CVD became the leading cause of death not only in the United States, but also in most of the developed nations. Besides, the trend has been an upward swing.

The impetus for the Framingham study, which was initiated in 1948 to investigate the epidemic of coronary disease in the United States and successfully characterize the risk factors associated with this lethal disease. In 1948, the FHS, under the direction of the present National Heart, Lung and Blood Institute (NHLBI), embarked on a very expensive and ambitious epidemiological project which changed our understanding of cardiovascular health problem. Since 1971, this landmark study is now conducted in collaboration with the Boston University. From the outset, the study utilized the prospective epidemiological design, and insights were provided about prevalence, incidence, full clinical spectrum in terms of attrition rates, and the predisposing factors. The recognized risk factors, then which were associated with coronary disease in United States were stroke, peripheral artery diseases, and heart failure. The research team dispelled clinical misconception about isolated systolic hypertension, left ventricular hypertrophy, dyslipidemia, atrial fibrillation, and glucose intolerance. But they emphasized that statistical mean values for blood lipids, blood pressure, body weight, glucose, and fibrinogen were observed to be dangerously suboptimal and had strong association to the onset of CVD (Futherman & Lemburg, 2000).

However, the mean values of blood lipids, blood pressure, body weight, glucose, and fibrinogen in the Legacy cohort were demonstrated to dangerously suboptimal and had a continuous graded association to CVD without critical values quantitatively, the total high-density lipoprotein (HDL) cholesterol ratio was shown to be the most critical lipid profile predicting coronary disease. Besides, low-density lipoprotein (LDL) was shown to be correlated with homocysteine factor, indicating insulin resistance, and small dense LDL was demonstrated to be associated with excess coronary artery disease.

A plethora of studies conducted at Framingham on CVD revealed the following risk factors such as age, stress, obesity, high cholesterol levels, and high levels of LDLs, high blood pressure, high sodium intake, enlarged heart, smoking, diabetes, sedentary lifestyle, or physical inactivity, as well as cytomegalovirus and type A personality.

The documented overarching objective of FHS was to identify the common characteristics that contributed to CVD. As a prospective epidemiological study, subjects who had not previously experienced detectable signs and symptoms of CVD were recruited for the study and followed over a long period of time. This group was described as the Legacy cohort and this group was made up of 5,209 men and women between the ages of 30 and 62 years.

These subjects were provided with a free comprehensive physical examination and a battery of questionnaires was used to elicit their pertinent demographic data, including various anthropometric measurements. Since 1948, the Legacy group and other two cohorts continue to return to the study every two years for their comprehensive medical history taking and physical examination. The involvement of these three groups of participants that have intrafamilial relationships provide the inkling about possible