

Framingham Heart Study: An Enduring Legacy

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The year 2012 marks 65 years since the landmark Framingham Heart Study began. With the dramatic rise in coronary heart disease (CHD) during the first half of the 20th century, the newly formed National Heart Institute realized the significant gap in knowledge about the causes of CHD and embarked in 1947 on planning what was to become the Framingham Heart Study. This study has perhaps brought more to our understanding of the underlying causes of cardiovascular disease than any other study has.

Dr. Thomas Royal Dawber, Framingham's first director, wrote the initial paper in 1950 [1] describing its design, and later in 1957 [2], he described the study's experience after 4 years of follow-up, where age and sex differences in CHD and the frequent occurrence of sudden cardiac death as the first manifestation of CHD were noted. Here, too, the initial observations regarding the significance of elevated blood pressure, cholesterol, and overweight in predicting future CHD were described. Longtime study director Dr. William Kannel's 1961 publication [3], "Factors of Risk in the Development of Coronary Heart Disease," brought the term *risk factors* into the common medical and lay vocabulary and further described how specific levels of cholesterol, blood pressure, and electrocardiographic left ventricular hypertrophy predicted future CHD incidence. Reports by Dr. Kannel and many other investigators over ensuing decades established the following as important predictors of CHD risk: diabetes; hypertension; lipid components, such as low- and high-density lipoproteins; and components of blood pressure, including pulse pressure. Much of what we know about the epidemiology of stroke and heart failure also derives from the Framingham Heart Study. More recently, Framingham has conducted sophisticated studies involving genomics and cardiac biomarkers, as well as subclinical vascular measures (such as coronary artery calcium scores and pulse wave velocity). Beginning in 1971, the second-generation cohort was enrolled, and in 2002, the grandchildren of the original cohort were enrolled in the third-generation cohort. More recent studies across these generations and in collaboration with other observational study cohorts have helped to establish novel predictors of CHD and numerous other diseases and phenotypes. One of the greatest contributions of the Framingham Heart Study is the development of the Framingham Risk Score to define a person's likelihood of future CHD and acute events associated therein, ranging from, initially, 10-year CHD risk scores to total cardiovascular disease algorithms and, currently, the development of lifetime risk scores.

The standardized methods first developed by Framingham, including measurement of risk factors and

adjudicated methods for follow-up of cardiac events served as an important prelude to future National Institutes of Health-sponsored observational studies, including the ARIC (Atherosclerosis Risk in Communities) study, the CARDIA (Coronary Artery Risk Development in Young Adults) study, the CHS (Cardiovascular Health Study), and the MESA (Multiethnic Study of Atherosclerosis). These studies and others continue the legacy that Framingham began more than 60 years ago into the epidemiology of cardiovascular diseases.

The field of preventive cardiology has been the most important contribution of the Framingham Heart Study [4]. The message regarding the importance of cessation of cigarette smoking; pre-hypertension and blood pressure control; hypercholesterolemia and defining the optimal levels of total and high-density lipoprotein cholesterol; and the emerging threat of obesity, metabolic syndrome, and diabetes has led to clinical trials to test the benefits of controlling the modifiable risk factors.

CHD, stroke incidence, and mortality have declined in the United States and many developed countries over the past decades in part because of lessons learned from Framingham. What we have learned from the experience in high-income countries is now being translated into health policies and population-wide efforts to combat CHD and stroke in developing countries. In a recent presidential advisory [5] written by leaders from the World Heart Federation, American Heart Association, American College of Cardiology, European Society of Cardiology, and the European Heart Network, a goal was set to reduce non-communicable disease mortality worldwide by 25% by the year 2025, largely through global targets to reduce cigarette smoking, sodium intake, obesity, and through the promotion of heart-healthy eating and regular physical activity.

This issue of *Global Heart* is dedicated to celebrating the legacy of the Framingham Heart Study. We convened a panel of renowned experts, including key Framingham investigators, to describe the key contributions of the Framingham Heart Study; the design and creation of the study; initial findings regarding CHD incidence; the development of risk assessment methods; the roles of blood pressure, dyslipidemia, diabetes, cigarette smoking, and genetics; and lessons learned regarding stroke and heart failure from this landmark study. Many authors of this special issue of *Global Heart* were also inspired by the work of Framingham's original investigators and have also spent decades of their research and/or medical practice dedicated to preventive cardiology. The authors of this special issue collectively have contributed more than 250 years of dedication and well over 1,000 publications to the field.

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We hope this issue will serve as an inspiration to many more generations of investigators who will continue to examine new hypotheses that may further expand what we have learned so far. What began in the small community of Framingham, Massachusetts, USA, 65 years ago has informed how we prevent and treat cardiovascular diseases and will hopefully continue to have a lasting impact worldwide on reducing CHD, stroke, and other non-communicable diseases. The burden of the effort lies among researchers, healthcare providers, teachers, and governmental policy makers to make the lessons learned from Framingham a priority in their work.

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