Research Highlight

Ending the epidemics of cardiovascular diseases: time is now to integrate both population and individual strategies for prevention

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Cardiovascular disease (CVD) has been the leading cause of death for well over a century [1]. To date, CVD remains the number one cause of death globally, and approximately one fourth of the world’s CVD occur in China where CVD accounts for over 40% of the deaths, and together with diabetes consume approximately 80% health care resources annually [2]. Set against this unfortunate global epidemic is the consistent decline in both incidence and prevalence of CVD in the United States since its peak in the 1950s. It has been well documented that changes in lifestyles such as decreases in the prevalence of major risk factors including high blood pressure, dyslipidemia, adiposity, smoking, physical inactivity, and unhealthy diet, have since reduced CVD incidence and prevalence in the U.S. [3]. These risk factors are also targeted by the American Heart Association’s “Life’s Simple 7” approach to achieve even better cardiovascular health, which includes being active, keeping a healthy weight, learning about cholesterol, no smoking or using smokeless tobacco, eating a heart-healthy diet, keeping a healthy blood pressure, and learning about blood sugar and diabetes mellitus [4]. Many of these risk factors are commonly used in developing risk prediction equations, which serve as a valuable risk evaluation tool for individuals for CVD prevention in populations of North America and European nations. For instance, in the U.S. the Framingham Risk Score (FRS) has been an integral part of the primary prevention strategies outlined in the Third Report of the National Cholesterol Education Program Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults since 2001 [5]. More recently, guidelines released by the American College of Cardiology and American Heart Association in 2013 provided the risk equation obtained through the pooling of multiple cohorts (PCEs) in predicting the risk of atherosclerotic cardiovascular disease (ASCVD) that combined stroke and coronary heart disease as one clinical outcome [6,7]. The main purpose of using these risk assessment tools in primary prevention is to identify individuals at high risk as precisely as possible, so as to direct intensive prevention efforts towards these individuals within the constraint of limited resources in the health care system.

The above-mentioned risk prediction equations, however, often do not perform well in racial/ethnic groups other than the original populations in which the equations were developed and calibrated [8–11]. In light of the substantial public health and economic burden caused by CVD in China, the China-PAR project (Prediction for ASCVD Risk in China) developed and validated the first sex-specific 10-year risk prediction equations for ASCVD in 2016, which were based on data from four contemporary Chinese cohorts [11].

In this issue of Science Bulletin, Liu and colleagues took another step forward reporting the most recent data from the China-PAR project, which derived and validated sex-specific risk prediction equations for lifetime risk of ASCVD in Chinese [12]. For the first time, the lifetime ASCVD risk equations in Chinese were developed using data in two large prospective cohorts using standard survival analysis methodology to account for competing risk from non-ASCVD death. The authors demonstrated good discrimination and calibration properties for their ASCVD equations that were further validated in two additional cohorts of Chinese. The risk factors in the lifetime risk equations were consistent with those in the previously published 10-year risk equations, which included age (as underlying time function), systolic blood pressure, total cholesterol, high-density-lipoprotein cholesterol, waist circumference, smoking status, diabetes status, and geographical region (northern or southern China), while the equation for men additionally included urbanization (urban or rural) and family history of ASCVD. The authors also demonstrated that individuals with high lifetime risk and high 10-year risk, individuals with high lifetime risk alone, and individuals with high 10-year risk alone developed ASCVD earlier than those with low lifetime risk and low 10-year risk [12]. These findings will facilitate in raising awareness of long-term ASCVD risk especially in young adults with low or medium 10-year risk, and enable early intervention on risk factors with suboptimal levels.

Both the lifetime risk equations and the 10-year risk equations for ASCVD integrate information from multiple risk factors into much simpler metrics. In clinical practice, such metrics can be very useful in conveying individually estimated risk of developing ASCVD to the general public, as well as the potential benefit of interventions targeted at risk factors that are not at optimal levels, whether through lifestyle changes and/or therapeutic approaches. For such risk assessment tools to be easily and readily implemented in clinical or primary care settings, they should pose minimum burden to both the physicians and the individuals seeking care, especially given the large population size in China and
generally very limited time for physicians to meet patients. In this regard, the two sets of ASCVD risk prediction equations of the China-PAR project were able to strike a balance between achieving good prediction accuracy and using a parsimonious model with predictors that can be easily measured by questionnaire and routine laboratory tests. In addition, the web-based calculator (http://www.cvdrisk.com.cn) accompanying Lin and colleagues’ article is a practical example of how we could implement these risk prediction tools in real-world settings.

Waist circumference (WC), geographical region, urbanization, and family history of ASCVD were unique features that have not been used in previous risk prediction models such as the FRS or PCEs. As a measure of central obesity, WC has gained much research attention in relation to cardiometabolic health in Chinese populations [13,14]. CVD mortality in rural areas of China has exceeded that of urban areas since 2009, while the difference has become more substantial in 2013 and 2014 [3]. Geographical region and urbanization may reflect different levels of health care services and environmental factors, while family history may reflect different genetic background, which are all potential risk factors for ASCVD. Incorporation of these markers beyond those traditionally used in risk prediction significantly improved the discrimination ability and is a novel and practical approach in developing population-specific risk prediction models. Future investigations of similar nature may also consider other predictors such as inflammatory markers, genetic data, or even data from electronic health records [15], in order to further improve personalized prediction performance. However, one must keep in mind that incorporation of additional predictors increases the complexity of the models and difficulty of implementation in general settings. The cross-validation technique used in deriving the risk prediction equations and the validation procedure in external cohorts in the China-PAR project represent approaches commonly used in statistical learning that improve prediction accuracy while mitigating the issue of overfitting. While cross-validation techniques are already widely used in prediction modeling, the use of validation populations should be promoted so that the external validity and accuracy of the risk prediction equations can be evaluated.

Primary prevention of cardiometabolic diseases and related risk factors remains a major challenge to our increasingly Westernized world. As globalization continues to accelerate rapid social-economic transformation and urbanization of societies everywhere, it is imperative to provide evidence-based systematic and comprehensive effort directed at both populations and individuals to curb the prevalence of unhealthy dietary practice, physical inactivity, high blood pressure, smoking, obesity, dyslipidemia, and diabetes [3]. The challenge is particularly acute now in China given the sheer size of its population. In 2012, for example, less than half of hypertensive adults were aware of their high blood pressure, and only 13.8% had blood pressure under control [1], which highlights the need for health promotion and education at the national level to safeguard and promote a healthy living environment. Doubling the effort in education of ASCVD-related prevention strategies should improve accessibility and equality of health care, and raise awareness of the importance of maintaining healthy lifestyle choices [1]. To this end, the risk stratification work by professor Gu’s team will guide individual’s best practice to improve cardiometabolic health while informing population allocation of health care resources to achieve optimal population health [1]. To curb the global epidemic of CVD it is critical to develop risk assessment equations tailored to different populations that are calibrated and validated under different settings.

At the individual level, being informed of one’s predicted 10-year and lifetime risk of developing ASCVD can also facilitate in planning individualized intervention strategies for optimal cardiovascular health. Combining the lifetime risk equation and the 10-year risk equation will further advance the utility of these equations in the primary prevention of ASCVD in China. And as China’s CVD burden goes, so will the world’s.

Conflict of interest

The authors declare that they have no conflict of interest.

References


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