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Development of a clinical risk score in predicting undiagnosed diabetes in urban Asian Indian adults: a population-based study

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Summary
Objectives: India has the largest burden of diabetes in the world, much of which remains undiagnosed. This study aimed to develop a risk score to predict the likelihood of having undetected diabetes in individuals, based on identification of non-invasive risk factors for Type 2 diabetes.
Methodology: The risk score was developed in urban and rural participants, aged 35—64 years, from a representative cross-sectional population survey conducted in Delhi in 1991—1994. Multivariable logistic regression model coefficients were used to assign each categorical risk factor a score value with undiagnosed diabetes as the dependent variable. The validity of the composite risk score was tested in an independent multicentre cross-sectional survey conducted in 2001—2003 in a different population.
Results: Complete baseline data were available for 4044 men and women in the first population, of whom, 440 had diabetes (199 cases undiagnosed). Age, waist circumference, blood pressure and family history of diabetes were significant ($p < 0.01$) non-invasive predictors of diabetes status in the multivariable model. The risk of having diabetes increased progressively as the risk score rose from 0 to 29. When tested in the independent population ($n = 10566$, of whom 1066 had diabetes and 375 were undiagnosed), a score value >16 predicted diabetes status with a sensitivity of 0.79 (95% CI:0.77—0.82), specificity of 0.56 (95% CI:0.55—0.57), and a positive likelihood ratio of 1.8 (95% CI:1.7—1.9) for all cases with diabetes, and a sensitivity

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of 73%, specificity of 56% and a positive likelihood ratio of 1.6 (95% CI: 1.5—1.7) for undiagnosed diabetes cases.
Conclusion: Application of this risk score identified a substantial proportion of individuals with undiagnosed diabetes, using tools easily available in low-resource settings.

Introduction

India has the largest number of persons with diabetes among all countries and will triple its burden between 1995 and 2025 [1]. This will be characterized by a rapid increase in the prevalence of diabetes, especially in urban areas, and widening urban—rural gaps in diabetes related disease burdens. This is already evident in many parts of India [2,3], and has important implications for the future burden of cardiovascular disease (CVD), as Type 2 diabetes is a major risk factor for vascular disease and death.

Much of this burden is undiagnosed; a half to two-thirds of individuals with hyperglycemia are undiagnosed [4—6] in India due to lack of awareness, lack of resources, and a healthcare infrastructure which is not geared to deal with chronic diseases. While identification of individuals with undiagnosed hyperglycemia is essential, mass screening for its detection cannot be recommended because it would be invasive, costly and unsustainable. As Type 2 diabetes is associated with many clinical risk factors, identification of individuals having a clinical profile, which is associated with a high probability of Type 2 diabetes is likely to be a cost-effective alternative [7]. Only individuals with a high probability of Type 2 diabetes will then require undergoing targeted blood testing. Such a strategy has additional advantages, in that the presence of many of these risk factors increases the risk for CVD as well, hence their detection will provide an opportunity for targeted primary prevention.

We developed a clinical risk score, based on a combination of several non-invasive risk factors easily measured at a primary healthcare level, to estimate the likelihood of an individual having hyperglycemia. The aim of our study was to develop a simple and practical model for primary healthcare providers to identify individuals likely to be at a high risk of having Type 2 diabetes, and to validate the model in an independent population.

While such risk scores have been developed extensively in western countries, predominantly for the Caucasian population, risk prediction rules are few and recent in South Asian countries, where Type 2 prevalence of diabetes is high [4].

Methods

For development of the risk score, we used data from a study (ICMR Task Force Project on Collaborative Study of Coronary Heart Disease — Delhi Center), conducted by three of the investigators (KSR, PS, BS) on behalf of the Indian Council of Medical Research, in urban and rural North India (urban Delhi and rural Haryana, respectively) in 1991—1994, henceforth referred to as Population A. The sampling methodology has been described elsewhere [8]. Briefly, the design was that of a cross-sectional study and sampling methodology involved stratification of geographical zone and type of residential locality followed by multi-stage random cluster sampling in each stratum in the urban areas. In rural areas random stratified sampling was done based on the village size. All individuals of both sexes, aged 35—64 years were eligible to participate. The response rate was 94% for the urban component and 50% for the rural areas for the biochemical component of the study. After obtaining consent, 5537 individuals (52.2% women) were surveyed by questionnaire, clinical examination, blood sampling and an electrocardiogram for presence of vascular disease and its risk factors. The profile of respondents and non-respondents for blood sampling was similar for age, sex, locality and socio-economic status in the rural areas. The interviewer administered questionnaire was designed to elicit information regarding demographic variables, risk behaviours, past and current medical history, and family history as relevant to the study of CVD risk. Clinical examination included: measurement of seated blood pressure, prior to blood sampling, using standard methodology [9], by a regularly calibrated random zero sphygmomanometer with an average of two readings, taken 5 min apart; weight was measured to the nearest kilogram, using a single bathroom scale, which was calibrated on a daily basis with known weights; height, measured using a stadiometer, to the nearest centimeter; waist circumference, measured to the nearest 5 mm in the mid-axillary line at the center of two points defined by the subcostal margin and the highest point of the iliac crest. Measurements were done with a fibre glass tape after