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Mini review

Risk assessment tools for type 2 Diabetes Mellitus: Brief Review

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Abstract

T2DM has a long preclinical phase during which significant number of individuals may remain asymptomatic and undiagnosed for many years. Number of T2DM risk assessment tools have been proposed, studied and validated among different populations as screening measures. But identification of high-risk individuals is a major challenge in clinical practice. Accurate estimation of absolute risk is very important because it discriminates individual into clinically relevant risk category.Reliable risk score will help to identify individuals at risk of developing T2DM and for early intervention.

The performance of risk score calculators depends on its accuracy, availability, practicability and cost effectiveness. They should identify the individual who are normoglycemic, but will progress eventually to impaired glucose tolerance and diabetes. To initiate appropriate preventive strategies, individuals should be stratified into high, moderate and lower risk categories by screening at community level. Initial risk assessment with non-invasive measures followed by invasive diagnostic investigations will be the ideal strategy to discriminate person in accurate risk category.

Keywords: Predictor; Risk Score; Type 2 Diabetes Mellitus; Tool

Introduction

Type 2 Diabetes Mellitus (T2DM) is a most prevalent chronic metabolic disorder due to absolute or relative deficiency of insulin. Global epidemic of T2DM is growing at rapid pace with modernization, globalization and economic development. With the drastically changed lifestyle including consumption of energy dense food and minimal physical activity, T2DM and its complications are adding to the health burden worldwide[1].It is predicted that by 2025 around 330 million people in the world will have T2DM.Traditional risk factors for T2DM are age, ethnicity, obesity, high waist circumference, and family history of T2DM in first-degree relatives, sedentary lifestyle, hypertension and history of gestational Diabetes Mellitus among women. Among these, age, ethnicity and positive family history are non-modifiable risk factors, while rest are modifiable [2].

T2DM has a long preclinical phase during which significant number of individuals may remain asymptomatic andundiagnosed for many years[3].Number of T2DM risk assessment tools have been proposed, studied and validated among different populations as screening measures. The term "Risk assessment" implies an individualized approach, which takes into account individual risk factor. It helps to identify high-risk individuals and target them for risk reduction so that progression to the development of overt T2DM will be halted or delayed. But identification of high-risk individuals is a major challenge in clinical practice. Several risk tools or risk scores are available for risk assessment, which involves range of non-invasive and invasive measures in isolation or combination [4].Diabetes risk predicting scores studied to identify the probability of development of T2DM either in cross-sectional or prospective studies.

Multivariate risk score have been studied widely worldwide in different populations. These were developed based on data from various independent cohort studies like FINRISK studies, Japanese American Community Diabetes study, the Atherosclerosis Risk in Communities (ARIC)[5].Predictive ability of such risk scores differs according to ethnicity.Accurate estimation of absolute risk is very important because it discriminates individual into clinically relevant risk category.Reliable risk score will help to identify individuals at risk of developing T2DM and for early intervention. Data from routine medical and demographic data like age, family history of T2DM, body mass index can be used for initial baseline

risk assessment. Individuals with any such risk factor must be targeted for further risk stratification and preventive strategy.

In a systematic review, Pei Lin Hu et al identified 12 studies from Asian population in which researchers developed risk prediction model for incident diabetes. They observed risk scores including laboratory measurements like blood sugar and HbA1C had greatest impact on the risk score. Hence they proposed Asian risk score that would include age, family history of diabetes, gender, smoking status, hypertension, BMI, waist circumference, fasting plasma glucose, HbA1C, High-density Lipoprotein (HDL) cholesterol and triglycerides [6].

American Diabetes Association Risk Tools (ADART): It was constructed as per 2004 criteria for screening pre-diabetes. It included age, ethnicity, BMI, family history of diabetes, level of physical activity, previous history of impaired glucose intolerance, serum HDL and triglycerides and history of vascular disease. In females additionally history of gestational diabetes and polycystic ovary disease were taken into consideration. Its performance is not only best in original population, but also in Taiwan population [7].

Finnish Diabetes Risk Score (FINDRISC)-It was based on FINRISK studies and included age, BMI, waist circumference, history of premedication for hypertension, physical activity, consumption of vegetables, fruits and berries (area under receiver operating curve- 0.85). FINDRISC is a robust predictor of T2DM not only in Europeans but in Iran population also[8]. German Diabetes Risk Score (GDRS) developed as online tool that predicts risk of developing T2DM in next 5 year. It exclusively included non-invasive risk factors like age, anthropometric measures, and history of intervention and lifestyle factors. Then adding family history, smoking status, history of dietary variables, GDRS was updated. German Diabetes Association recommended this score as a primary screening tool for identifying prevalent undiagnosed diabetes cases, apart from its original use as predictor of diabetes. Further GDRS was improved with inclusion of addition laboratory tests of measuring fasting blood glucose, glycated hemoglobin, triglycerides, high-density lipoproteins and liver enzymes. (aROC 0.9)[9,10].

Diabetes Risk Score (DRS): It predicts drug treated diabetes with help of many non-invasive measures. It is easy, fast, reliable, non-invasive, economical and accurate tool to interpret the risk of probability of developing diabetes. Lindstro¨m and Tuomilehto studied the validity of the DRS in an independent population of size 4435, survey performed in 1992 with prospective follow-up for 5 years. They observed the score with sensitivity of 0.78 and 0.81, specificity of 0.77 and 0.76, and positive predictive value of 0.13 and 0.05 in the 1987 and 1992 cohorts, respectively for drug-treated diabetes [11]. Indian Diabetes Risk Score:Prevalence of T2DM is very high in India next to China. It has been estimated that every fifth diabetic subject is Indian. In India, 66% patients remain undiagnosed in comparison to 50% people in Europe and 33% in USA[2].Also T2DM and its complications affect Indians at an earlier age compared to their western counterparts. Mohan V et al developed simple, low cost, feasible Indian Diabetes Risk Score (IDRS), which was further validated by several researchers with 60.1% specificity and 72.5% sensitivity.IDRS discriminates person by taking into consideration the risk factors- age, family history, physical activity and waist circumference [12-14]. Table 1 shows Diabetes risk scores developed in various populations depending on presence of different risk factors.

Study	Country/ Population	Risk factors included	Discrimination AUROC	Calibration
ADART (7) Model I- only ADART Model II ADART plus lifestyle behavior baseline Model III Model II plus biomarkers	Taiwan-Taichung community	Age, BMI, family history of DM, race, physical activity, previous IGT, hypertension, HDL, TG, history of vascular disease. Women- history of GDM, delivery of baby weighing more than 4 kg.	Men- Model I 0.60 Model II 0.62 Model III 0.64 Women- Model I 0.72 Model II 0.74 Model III 0.75	Not mentioned
ARIC (Atherosclerosis Risk in Communities) [15]	Germany	Age, ethnicity, height, waist circumference, systolic blood pressure, family history of DM, fasting plasma glucose, triglyceride, high density lipoprotein cholesterol.	0.8	Not mentioned
AUSDRISK [16]	Australia	Age, sex, ethnicity, parental history of DM, history of high blood glucose, useantihypertensive drugs, smoking, physical inactivity, waist circumference	0.78	Hosmer-Lemeshow p-0.85
Cambridge risk score [17]	UK	Age, sex, current use of corticosteroids, use of antihypertensive drugs, family history of DM< BMI, smoking	0.74	Not mentioned

FINDRISC	Finland	Age, BMI, waist circumference, use of antihypertensive drugs, history of high blood glucose, physical inactivity, daily consumption of vegetables, fruits and berries.	0.84	Not mentioned
Framingham Offspring study[18]	USA	Fasting plasma glucose, BMI, HDL, parental history of DM, triglycerides, blood pressure	0.85	Not mentioned
IDRS	Indian	Age, abdominal obesity, family history of DM, physical activity.	0.69	Not mentioned

Table 1: Diabetes risk scores developed in various populations depending on presence of different risk factors.

T2DM is a major risk factor for numerous diseases. It is considered as a coronary heart disease risk equivalent. Several researchers reported prevention of transition to development of diabetes among high-risk individuals by efficient lifestyle modification. To initiate appropriate preventive strategies, individuals should be stratified into high, moderate and lower risk categories by screening at community level. So screening tools should be simple, easy, safe, simple and cost effective. Risk scores perform differently when they are used in population other than original one in which it was developed and validated. So before using them as screening tools at community level, they should be validated for the targetpopulation. The performance of risk score calculators depends on its accuracy, availability, practicability and cost effectiveness.They should identify the individual who are normoglycemic, but will progress eventually to impaired glucose tolerance and diabetes.Statistical measures like aROC, specificity, sensitivity, and positive predictive value, negative predictive values are used to evaluate the performance of risk models. Precise and accurate identification of low risk individuals is also equally important to avoid unnecessary screening with invasive risk variables[19].

A range of invasive and non-invasive risk assessment tools is available worldwide for general and at risk population depending on ethnicity. Use of risk prediction tools in routine clinical practice by the clinicians will increase the awareness about precautions for modifiable risk factors. Therapeutic lifestyle change is the cornerstone in the prevention of chronic, dreadful disease T2DM. Healthy lifestyle can prevent or postpone the symptomatic phase of diabetes in high-risk individuals also. Randomized controlled trials have reported successful, feasible prevention of developing overt diabetes through improved lifestyle and drugs treatments also. Aguiar EJ et al evaluated efficacy of T2DM Prevention Using Lifestyle Education (PULSE) in Australia. The intervention group received the PULSE Program, comprised of print and video resources on weight loss, diet modification, and exercise for Type 2 diabetes mellitus prevention. The control group received no information until 6 months. After six months, PULSE program improved several risk factors of T2DMincluding weight and glycated haemoglobin [20].Similar findings of beneficial effects of weight loss by improving physical activity and healthy dietary practices are reported in the European Diabees Prevention RCT in adults with impaired glucose tolerance [21].Efficacy of metformin, which is a glucose lowering drug used widely in the treatment of T2DM, has been studied in many RCTs. It was found to be effective in prevention of T2DM especially among individuals with multiple risk factors in addition to lifestyle change [22].

The tools with non-invasive measures are economical for screening in public health sector outside clinics. Numbers of risk assessment tools have been developed, validated in different populations. To evaluate any risk assessment model, its statistical characteristic should fulfill three criteria- discrimination, calibration and reclassification of risk category. Absolute risk estimation for development of T2DM in future is the most important step in preventive strategy. Risk model should be easily acceptable to the participants and easily interpretable for the clinicians. Initial risk assessment with non-invasive measures followed by invasive diagnostic investigations will be the ideal strategy to discriminate person in accurate risk category.

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