

Comparative evaluation of Indian Diabetes Risk Score and Finnish Diabetes Risk Score for predicting risk of diabetes mellitus type II: A teaching hospital-based survey in Maharashtra

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ABSTRACT

Context: India is currently becoming capital for diabetes mellitus. This significantly increasing incidence of diabetes putting an additional burden on health care in India. Unfortunately, half of diabetic individuals are unknown about their diabetic status. Hence, there is an emergent need of effective screening instrument to identify “diabetes risk” individuals. **Aims:** The aim is to evaluate and compare the diagnostic accuracy and clinical utility of Indian Diabetes Risk Score (IDRS) and Finnish Diabetes Risk Score (FINDRISC). **Settings and Design:** This is retrospective, record-based study of diabetes detection camp organized by a teaching hospital. Out of 780 people attended this camp voluntarily only 763 fulfilled inclusion criteria of the study. **Subjects and Methods:** In this camp, pro forma included the World Health Organization STEP guidelines for surveillance of noncommunicable diseases. Included primary sociodemographic characters, physical measurements, and clinical examination. After that followed the random blood glucose estimation of each individual. **Statistical Analysis Used:** Diagnostic accuracy of IDRS and FINDRISC compared by using receiver operative characteristic curve (ROC). Sensitivity, specificity, likelihood ratio, positive predictive and negative predictive values were compared. Clinical utility index (CUI) of each score also compared. SPSS version 22, Stata 13, R3.2.9 used. **Results:** Out of 763 individuals, 38 were new diabetics. By IDRS 347 and by FINDRISC 96 people were included in high-risk category for diabetes. Odds ratio for high-risk people in FINDRISC for getting affected by diabetes was 10.70. Similarly, it was 4.79 for IDRS. Area under curves of ROCs of both scores were indifferent ($P = 0.98$). Sensitivity and specificity of IDRS was 78.95% and 56.14%; whereas for FINDRISC it was 55.26% and 89.66%, respectively. CUI was excellent (0.86) for FINDRISC while IDRS it was “satisfactory” (0.54). Bland-Altman plot and Cohen’s Kappa suggested fair agreement between these score in measuring diabetes risk. **Conclusions:** Diagnostic accuracy and clinical utility of FINDRISC is fairly good than IDRS.

Keywords: Clinical utility index, Finnish Diabetes Risk Score, Indian Diabetes Risk Score

Introduction

In 2016, World Health Organization (WHO) reports that 422 million adults are suffering from diabetes, indicating one in every 11 adults is affected by diabetes.^[1] Country-wise WHO report 2016 shows an

overall prevalence of diabetes in India is 7.8%.^[2] Indian population is increasingly susceptible to diabetes. There are now an estimated 70 million patients with diabetes in India.^[3,4] Changing the pattern of epidemiology of diabetes and meeting of rural-urban difference of incidence of the explosive growth of diabetes put the health-care system at stake. Disease Sufferers and the country at large also carry high economic burden due to diabetes.

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Primary health-care practitioners in low-income countries do not have access to the basic technologies needed to diagnose diabetes at primary level and to help people with diabetes properly to manage their disease. Only one in three low- and middle-income countries report that the most basic technologies for diabetes diagnosis and management are generally available in primary health-care facilities.^[1] Many cases of diabetes can be prevented at primary care level by effectively applying lifestyle modification after identification of under risk population. Hence, to intervene, one requires a cost-effective reasonably handy tool to assess the risk of people, pertaining to diabetes; so that the health promotional measures can be applied to high-risk individuals at the earliest to reduce the burden.

Due to lack of clear etiological agent in diabetes, it's imperative to identify the high-risk individuals to tackle effectively the on-going diabetes epidemic. Many health professional organizations in the world have prepared risk assessing tools for predicting the risk of diabetes. Preventive strategies cannot be planned unless the population "under the risk of diabetes" is correctly identified. In this study, commonly used cost-effective "risk scores" such as "Indian Diabetes Risk Score" (IDRS) and "Finnish Diabetes Risk Score" (FINDRISC) are compared for identifying their effectiveness in diabetes risk measurement.^[5] Both IDRS and FINDRISC are validated scores for estimating diabetes.^[5]

Subjects and Methods

Study design and study setting

It is a retrospective, record-based study on secondary data of a survey conducted during hospital-based camp, which was conducted in a teaching hospital - Government Medical College at Miraj, Maharashtra; in 2015 on world health day. This cross-sectional survey was completed in 2 days.

Participants

Diabetes awareness campaign was held in town at different places for 1 week. Two dates were announced during the campaign. Those who had visited outpatient department (OPD) voluntarily on particular dates were considered for the survey. Out of all participants of the health camp/survey, the records of those participants who fulfilled following inclusion and exclusion criteria were included in the study.

Inclusion criteria

Those above 20 years of age group.

Exclusion criteria

- Those suffering from diabetes mellitus Type I and diabetes mellitus Type II (already known diabetics of any kind)
- Pregnant women.

Sample size

Totally 780 people had voluntarily visited OPD on announced dates. Out of 780 people, 763 people as they were full filling the

inclusion criteria were enrolled in the study. This sample size is well above the required minimum sample size ($n = 489$) for the present study which was calculated by considering 4% precision of 75% of sensitivity and specificity each for IDRS score with 7.8% (rounded 8%) prevalence of diabetes.^[2]

Tools used in the study to ascertain the variables

During the survey, WHO stepwise approach to surveillance (STEPS) was followed for noncommunicable disease risks measurements^[6] which includes baseline sociodemographic variables and other variables which are part of IDRS and FINDRISC such as body mass index, waist circumference, and physical activity status. Clinical examination of each individual was done by physicians with noting signs and symptoms (includes three classical symptoms of diabetes polyuria, polydipsia, polyphagia) which followed by checking of randomized blood glucose estimation (random blood sugar [RBS]) of each individual using standardized digital glucometer (Accu-Check, Roche Diagnostics, Germany).

Data analysis

- Data were processed and analyzed using Microsoft Excel 2010 (Microsoft Corp, Redmond, WA, USA), SPSS version 22 (IBM Corp, Armonk, NY, USA), R version 3.2.4 (R foundation for statistical computing, Vienna, Austria), Stata version 13 (StataCorp, College station, TX, USA)
- IDRS and FINDRISC were compared using receiver operative characteristic (ROC) curve. Area under curve's (AUC) for each score method was compared. ROC curves were interpreted as the probability that the particular score (IDRS or FINDRISC) can correctly discriminate diabetic individuals from those without diabetes, where 0.5 is the chance discrimination and 1.0 is perfect discrimination. Optimal cutoff point for each score (for discrimination) on the ROC curve is determined by calculating maximum Youden's index ($\text{sensitivity} + [1 - \text{specificity}]$) and point with shortest distance value from the top of y-axis ($[1 - \text{sensitivity}]^2 + (1 - \text{specificity})^2$)²
- Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), positive likelihood ratio, negative likelihood ratio, Mitchell's clinical utility indices (CUIs),^[7] number needed to adopt lifestyle risk modification to prevent one case of diabetes was also calculated for each scale. Binary logistic regression method was used to assess chance of getting diabetes by a unit increase in a score point of each tool
- Agreement between IDRS and Finnish scores in predicting risk of DM was analyzed by using Bland-Altman approach (B-A plot). By the standard procedure, after calculating differences of between scores we checked normality of differences (Kolmogorov-Smirnov and Shapiro-Wilk test $P = 0.03$). Neither simple differences nor the log transformed differences were following normality. Hence, here we used nonparametric approach for B-A plot^[8]
- Agreement between scores is also assessed using Kappa statistics.

Operational definition of a case of diabetes

According to the American Diabetes Association, 2011 guidelines, we defined a patient as newly diagnosed diabetic when the patient has three classical symptoms (polyuria, polyphagia, polydipsia) with RBS 200 mg/dl or above than this.^[9]

For assessing clinical symptoms, clinical consensus of physicians followed.

Results

Table 1 denotes the baseline information of the surveyed people. Out of total 763 people surveyed, only 38 people were found to be newly detected diabetics. Their sociodemographic information was compared along with their diabetic status using Chi-square test. Only age group above 40 years was significantly associated

Table 1: Baseline characteristics of surveyed population (n=763)

Baseline characteristics	Diabetes mellitus Type II status		Total	χ^2	df	P
	Present	Absent				
	Sex					
Female	18	292	280	0.75	1	0.38
Male	20	433	453			
Age* (years)						
<30	2	156	158	17.25	1	0.00
30-40	5	228	233			
>40	31	341	372			
Religion						
Hindu	33	641	674	1	0.92 [#]	
Muslim	4	72	76			
Christian	0	5	5			
Bauddh	0	7	7			
Others	1	0	1			
Locality						
Urban	23	389	412	0.68	1	0.41
Rural	15	336	351			
Diet						
Vegetarian	11	230	241	0.12	1	0.72
Mix diet	27	495	522			
Exercise						
Doing exercise	17	439	456	3.75	1	0.05
Not doing exercise	21	286	307			
Obesity by WHO grading						
<25	16	212	228	3.09	1	0.07
25-29.99	4	54	58			
30-34.99	0	12	12			
>35	18	447	465			
Habits						
Smoking	0	21	21	0.01	1	0.94
Tobacco	9	157	166			
Alcohol	1	23	24			
Others	3	13	16			
No any habit	25	511	536			

*Significant; [#]Fisher's exact test P value. WHO: World Health Organization

with their diabetic status ($P = 0.00$). All other characteristics such as sex, religion, locality, diet, exercise status, obesity status, and habits were not significant in relation with diabetic status of the study group ($P > 0.05$).

Relevant clinical symptoms were assessed in comparison of diabetic status of the individuals in Table 2. Except, the nonhealing ulcers, all other clinical characteristics such as polyuria, polydipsia, polyphagia, tingling, and numbness in extremities and blurred vision were statistically significantly associated with the diabetic status of individuals ($P < 0.05$).

Risk pertaining to diabetes of each individual was assessed by using IDRS and FINDRISC. Tables 3a and b show the distribution of studied individuals with their diabetes risk status. In Table 3a, according to FINDRISC only 12.6% people were having score >15, that is, were in above high-risk category. While Table 3b shows 45% of the study population was in the high-risk category according to IDRS, that is, having score >60.

All individual were classified in high- and low-risk category according to each score method. Odds of being affected by diabetes were calculated. In Table 4 with respect to high-risk categories of people with their diabetic status, individuals with high risk by FINDRISC (>15) were at 10.7 times higher odds (95% confidence interval [CI] 5.41–21.19) of being affected by diabetes than individuals without high risk and similarly, individuals with high risk by IDRS (>60) had 4.79 times higher odds (95% CI 2.17–10.61) of diabetes than low to moderate risk group individuals.

Table 2: Association diabetic status to the symptoms of patients

Clinical symptoms	Newly diagnosed DM		χ^2	P
	Yes	No		
Polyurea*				
Yes	12	130	4.44	0.03
No	26	595		
Polydypsia*				
Yes	11	74	12.81	0.00
No	27	651		
Polyphagia*				
Yes	9	27	31.99	0.00
No	29	698		
Nonhealing ulcers				
Yes	0	4		0.99 [#]
No	38	721		
Tingling and numbness*				
Yes	11	102	6.33	0.01
No	27	623		
Blurred vision*				
Yes	33	48		0.00 [#]
No	5	677		

*Significant; [#]Fishers exact test used. DM: Diabetes mellitus

Table 3a: Classifying individuals according Finnish Diabetes Risk Score

FINDRISC	Frequency	Percentage
Low risk (0-6)	356	46.7
Slightly elevated (7-11)	222	29.1
Moderate (12-14)	89	11.7
High (15-20)	80	10.5
Very high (>20)	16	2.1
Total	763	100.0

FINDRISC: Finnish Diabetes Risk Score

Table 3b: Classifying individuals according Indian Diabetes Risk Score

IDRS	Frequency	Percentage
Low risk (0-29)	82	10.7
Moderate risk (30-59)	334	43.8
High risk (>60)	347	45.5
Total	763	100.0

IDRS: Indian Diabetes Risk Score

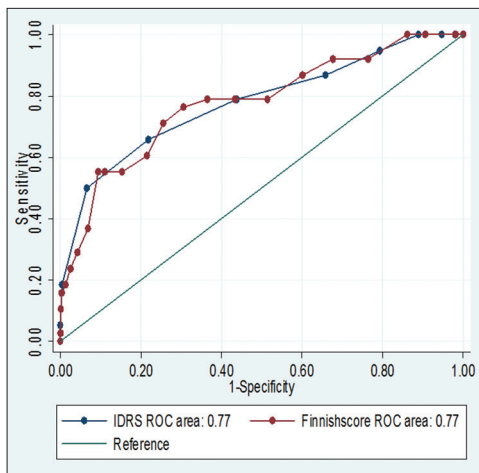


Figure 1: Comparison of receiver operative characteristic curves of Indian Diabetes Risk Score and Finnish Diabetes Risk Score

Both IDRS and FINDRISC scores of each individual were compared using ROC curve using AUC of each score. Figure 1 and Table 5 show the ROC curve comparison of both the scores. There was the nonsignificant difference between AUC's of both scores ($P = 0.98$).

With respect to optimum cutoff points criterias of each score mentioned in methodology, Table 6 shows the scores >60 of IDRS (optimum cutoff point) had sensitivity 78.95% and specificity of 56.14% whereas FINDRISC had optimum cutoff point of score value >14 with sensitivity 55.26% and specificity 90.66% [Table 6].

Diagnostic accuracy of IDRS and FINDRISC was assessed. In Table 7, the comparison of screening utility for each score was done using IDRS cutoff value >60 and FINDRISC cutoff value >15 (FINDRISC cutoff which is routinely in practice). Sensitivity (78.95%) of IDRS was more than

Table 4: Association of high risk status of individuals by each tools with their diabetic status

Scores	Newly diagnosed diabetics		OR	95% CI of OR	P
	Yes	No			
Finnish score					
>15	21	75	10.70	5.41-21.19	<0.00001
<15	17	650			
Total	38	725			
IDRS score					
>60	30	318	4.79	2.17-10.61	0.00
<60	8	407			
Total	38	725			

OR: Odds ratio; CI: Confidence interval; IDRS: Indian Diabetes Risk Score

Table 5: Comparison of area under curve under receiver operative characteristic curve of each score tool

Comparison of AUC's of Indian Diabetes Risk Score and Finnish Risk Score	
ROC comparison characters	Values
Difference between areas	0.00
SE	0.03
95% CI	-0.06-0.06
Z statistic	0.01
P	0.98

SE: Standard error; CI: Confidence interval; AUC's: Area under curve's

FINDRISC (55.26%); while specificity of FINDRISC (89.66%) was more than that of IDRS (56.14%) score. AUC was 0.77 for both the scores. Positive likelihood ratio was more for FINDRISC, that is, 5.34 than for IDRS (1.80). Hence, those who were in high-risk category according to Finnish score were 5.34 times more likely to be diabetic than nondiabetics. The probability of having diabetes when FINDRISC detects high risk was 21.88% (PPV), while it was less (PPV 8.62%) for high-risk people by IDRS. FINDRISC had more correctly classified the diabetic and nondiabetic individuals (accuracy 87.94%) than IDRS (accuracy 57.27%). Number needed to adopt risk modification strategies to prevent one diabetes case was calculated using number needed to treat/harm concept. The number was six for FINDRISC and 15 for IDRS. On binary logistic regression, we found that for every one-point increase in IDRS core point, raises 8% chance of developing diabetes; similarly, in FINDRISC each one point increase raises 25% chance of developing diabetes (not shown in tables due to constraint of space).

CUI of both scores for case finding was very poor [Table 8], while Finnish score's clinical utility for screening (ruling out diabetes) was "excellent" when compared same with IDRS (CUI – for FINDRISC was 0.86, and for IDRS it was 0.54, i.e., satisfactory).

By using B-A plot, we measured the level of agreement between the two scores for stratifying risk of diabetes. Figure 2 shows B-A plot, where differences were increasing as mean was increasing. There was no perfect agreement in these two tools. There was

Table 6: Optimum cutoff points for each score tool

Scores	Youden index	Optimum cutoff point	95% CI of optimum cutoff pints (%)	Sensitivity (%)	Specificity (%)
IDRS	0.44	>60	>50->70	78.95	56.14
Finnish score	0.46	>14	>10->14	55.26	90.66

CI: Confidence interval; IDRS: Indian Diabetes Risk Score

Table 7: Comparison of screening test evaluation of both the score tools

Screening test characteristics	IDRS (>60)		Finnish risk score (>15)	
	Value	95% CI	Value	95% CI
Sensitivity (%)	78.95	62.68-90.45	55.26	38.30-71.38
Specificity (%)	56.14	52.44-59.79	89.66	87.21-91.78
AUC	0.77	0.69-0.87	0.77	0.69-0.86
Positive likelihood ratio	1.8	1.50-2.16	5.34	3.74-7.64
Negative likelihood ratio	0.38	0.20-0.70	0.5	0.35-0.71
Positive predictive value (%)	8.62	5.89-12.08	21.88	14.08-31.47
Negative predictive value (%)	98.07	96.24-99.16	97.45	95.95-98.51
Accuracy (%)	57.27		87.94	
Number needed to adopt risk reducing strategies to prevent one diabetic case	15	10-29	6.00	3-9

IDRS: Indian Diabetes Risk Score; CI: Confidence interval; AUC: Area under curve

Table 8: Comparison clinical utility indices of both the score tools

Score name	CUI	Value	Qualitative grades
FINDRISC	CUI ⁺	0.11	Poor
	CUI ⁻	0.86	Excellent
IDRS	CUI ⁺	0.06	Poor
	CUI ⁻	0.54	Satisfactory

CUI: Clinical utility index; FINDRISC: Finnish Diabetes Risk Score; IDRS: Indian Diabetes Risk Score

a proportionality bias as the majority of observations were lying well above the 0 (y-axis). Differences can be regressed on mean but as these values were not following normal curve, it was not plotted. Except few, majority of values in the graph lies in CIs (within 5th-95th percentiles); signifying an agreement. According to Kappa statistics for agreement, Kappa value was 0.21 suggesting a fair degree of agreement in risk stratification between these two scores.

Discussion

In the present study, the prevalence of diabetes was 4.98%, in contrary to our finding; the study conducted by Indian Council of Medical Research-India DIABetes shown the prevalence of diabetes in Maharashtra in 2011 was 8.4% while the WHO 2016 report shows 7.8%.^[2,3] Reasons for low prevalence in our study might be sampling procedure and not using fasting blood glucose for diabetes detection.

There was significant association between diabetes status of individuals with their age (>40 years). Age has a significant impact on diabetes prevalence and incidence. A study done by Mohan *et al.* shown there is significantly increase in diabetes prevalence as advances above 40 years of age.^[4]

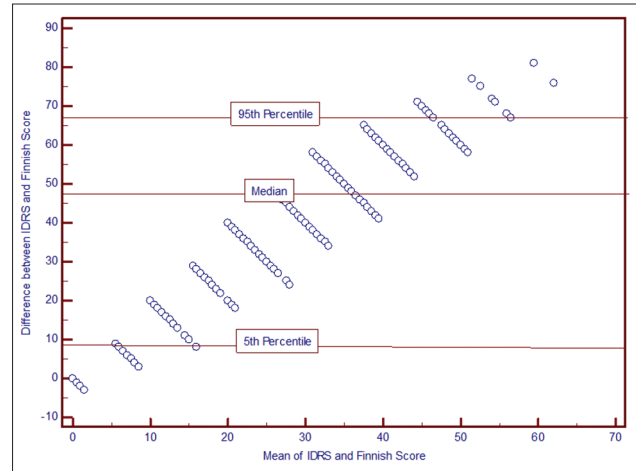


Figure 2: Bland-Altman plot for assessing the agreement between two scores

For IDRS, our study found sensitivity of 78.95%, specificity 56.14% at optimal cutoff point of 60, while Mohan *et al.* found sensitivity 72.5% and specificity of 60.1%. High true positives and low false negatives by IDRS had influenced its sensitivity in our study; high false positives might have reduced its specificity. Similarly, for FINDRISC at 15 score we found sensitivity of 55.26% and specificity of 89.66%, however, study conducted by Vandersmissen GJ *et al.* found sensitivity of 67.7% and specificity of 67.2%.^[10] Low sensitivity of FINDRISC in our study might be because of high false negatives, and because of low false positives and higher true negatives its specificity was pretty high.

Youden’s index gives equal weightage to sensitivity and specificity, and by ignores relative importance of false positives and false negatives; signifies that Youden index used in ROC curve has only limited clinical value. CUI overcomes this limitation (CUI⁺ = sensitivity × PPV; CUI⁻ = specificity × NPV); because in IDRS false positives were more, it made IDRS CUI⁺ very less. Similarly, high true negatives in FINDRISC made FINDRISC CUI⁻ “excellent.” According to CUI⁺ both the scores had limited utility (very poor) in case-findings, but FINDRISC had “excellent” utility in ruling out diabetes. Means, false negatives were rare in those who screen negative; suggesting a potentially useful screening test.

Our study suggests that FIDRISC is better at “ruling out” than “ruling in” of diabetes diagnosis on screening. FINDRISC is appealing as a useful instrument in primary care settings to screen population effectively for diabetes than IDRS; Because it includes more number of modifiable risk factors in its set than IDRS.

IDRS and FINDRISC carries limitations like with all risk assessment tools. In some studies, Finnish score cutoff point

chosen was 12 which may be too insensitive for efficiently identifying individuals who may unnoticingly land up in diabetes; while IDRS cutoff point used everywhere is 60; carrying high sensitivity. This means larger number of individuals (false positives) may have to send (considering a referral) to their physician than is actually necessary, which will lose its cost-effectiveness.

By considering fair agreement between these screening tools and above facts, it is recommended to use FINDRISC than IDRS in the Indian scenario.

Limitations

The sampling procedure was nonrandomized.

Conclusions

FINDRISC shows fairly good diagnostic accuracy and clinical utility for detecting diabetes. In resource-poor settings of the developing countries like India, where there is increasing the incidence of diabetes requires a most useful and most cost-effective tool to screen out the population. Here, when compared with IDRS; FINDRISC has excellent screening utility over IDRS.

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Conflicts of interest

There are no conflicts of interest.

References

1. World Health Organization. Global Report on Diabetes. Geneva: World Health Organization; 2016. Available from: http://www.who.int/diabetes/global-report/WHD2016_Diabetes_Infographic_v2.pdf?ua=1. [Last cited on 2016 Jun 17].
2. World Health Organization. Country-wise Report on Diabetes 2016. Geneva: World Health Organization; 2016. Available from: http://www.who.int/diabetes/country-profiles/ind_en.pdf?ua=1. [Last cited on 2016 Jun 17].
3. Bhansali A, Joshi SR, Joshi PP, Yajnik CS, Dhandhanika VK. Prevalence of diabetes and prediabetes (impaired fasting glucose and/or impaired glucose tolerance) in urban and rural India: Phase I results of the Indian Council of Medical Research-India Diabetes (ICMR-INDIAB) Study. *Diabetologia* 2011;54:3022-7.
4. Mohan V, Deepa M, Deepa R, Shanthirani CS, Farooq S, Ganesan A, *et al.* Secular trends in the prevalence of diabetes and impaired glucose tolerance in urban South India - The Chennai Urban Rural Epidemiology Study (CURES-17). *Diabetologia* 2006;49:1175-8.
5. Joshi SR. Indian diabetes risk score. *J Assoc Physicians India* 2005;53:755-7.
6. World Health Organization. STEPwise Approach to Surveillance (STEPS). Geneva: World Health Organization; 2015. Available from: <http://www.who.int/chp/steps/en/>. [Last cited on 2016 Jun 15].
7. Mitchell AJ. Sensitivity 3 PPV is a recognized test called the clinical utility index (CUI+). *Eur J Epidemiol* 2011;26:251-2.
8. Bland JM, Altman DG. Measurement statistical methods for assessing agreement between two methods of clinical measurement. *Int J Nurs Stud* 2010;47:931-6.
9. American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes Care* 2011;34:s62-9.
10. Vandersmissen GJ, Godderis L. Evaluation of the Finnish Diabetes Risk Score (FINDRISC) for diabetes screening in occupational health care. *Int J Occup Med Environ Health* 2015;28:587-91.