International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2022): 7.942

Comparative Assessment of ADA, IDRS and FINDRISC as a Screening Tool for Diabetes Mellitus in Adults Attending Rural Health Training Centre OPD Affiliated with IGGMC, Nagpur

Dr. Uma Mahesswaran[1], Dr. Ashok Jadhao[2], Sanjay Agrawal[3]

[1]Junior Resident, Department of Community Medicine, Indira Gandhi Government Medical College, Nagpur

[2]Professor and Head, Department of Community Medicine, Indira Gandhi Government Medical College, Nagpur

[3]Statistician cum Assistant Professor, Indira Gandhi Government Medical College, Nagpur

Abstract: ***Introduction: Diabetes risk-screening tools are validated and implemented across various countries. There is a need for improvement in these risk scores with suitable modifications so as to make them more sensitive, specific, and suitable to the local population. The aim of this study was to assess and compare the diagnostic accuracy of the Indian diabetes risk score (IDRS), the American diabetic association (ADA) risk score, and the Finnish Diabetes Risk Score (FINDRISC) and to correlate these risk scores with the blood glucose levels in the study population. Methods: A total of 125 subjects attending the outpatient department of rural health training centre affiliated with Indira Gandhi Government Medical College, Nagpur were included in the study. Data collection was done by interview method. Details obtained using the questionnaire was assessed as per the three diabetic risk scores. Random blood sugar was estimated in the study subjects. Data analysis was done using SPSS version 20.Descriptive data was analysed using mean and standard deviation. Chi square test/ Fischer exact test was applied to study association between qualitative variables. Pearson correlation was used to compare continuous variables, with p < 0.05 considered statistically significant. Sensitivity, specificity, positive predictive value, negative predictive value, accuracy were calculated for each risk tool. Results : According to ADA 25(20.00%) study participants were found to have high risk while according to IDRS and FINDRISC 44(35.20%) and 2(1.60%) study participants were found to behaving high risk of developing Type 2 Diabetes Mellitus. As far as ROC curve is concerned the IDRS score had the highest AUC among the three risk tools (AUC=0.612) with a cut off score of 55(moderate risk zone) which gave sensitivity of 51.9% and specificity of 69.4%. Conclusion: This study showed that IDRS was a better risk score for assessing the diabetes in the current study population. It also highlights the importance of screening program for early identification of diabetes in undiagnosed individuals attending OPD on a routine basis.***

Keywords: ADA, IDRS, FINDRISC, Diabetes, risk score

1. Introduction

Diabetes mellitus is rampant in developing countries, and India is named the diabetes capital of the world with the prevalence of 77 million. According to the International Diabetes Federation 2019, the global prevalence of diabetes is 463 million and is expected to increase to 700 million by 2045. The various causes contributing to this exponential increase are multiple risk factors attributing to diabetes mellitus, a prolonged pre-symptomatic stage in >50% of patients and usually present to the physician with complications and irreversible damage.[1,2] Hence, early diagnosis and management are important in delaying the progression and complication of the disease, in addition to preventing socio-economic burden.[3]

Although WHO does not advocate any specific screening programs, it recommends an organization of programs specific to particular regions/ countries; this aims at targeting the local population so as to identify persons who are at high risk. Diabetes risk score system using a simple questionnaire utilizing non invasive variables has been a time-tested and cost-effective screening tool, which can be applied to screen a large population which is still undiagnosed of diabetes mellitus, though increasing evidence suggests risk scores cannot be generalized from one country to another but can be modified as per the requirement of the local population.[4-6]

The two popular internationally accepted risk scores are the American Diabetes Association (ADA) and the Finnish Diabetic Risk Score (FINDRISC).[4-6] In India, Indian Diabetic Risk Score (IDRS), as shown in developed by Chennai Urban Rural Epidemiology Study (CURES) cohort study, has been validated across various parts of India and accepted and endorsed by various studies. To our knowledge, there are no studies that have compared these three screening questionnaires in the Central Indian population; hence, the comparison is vital. In this study, we aim to screen healthy subjects for the risk of diabetes mellitus type 2 with these three standard risk test questionnaires.[7,8]

Objectives:

1) To assess and compare the diagnostic utility of IDRS, ADA risk score, and FINDRISC in predicting the risk of diabetes mellitus in healthy subjects of Central Indian origin.
2) To correlate the risk scores with random glucose levels.
3) To study the socio demographic characteristics of study population.
4) To suggest recommendations based on study findings

2. Material and Methods

An observational cross- sectional study was conducted for a month duration from July to August 2022 at a rural health training centre out- patient department affiliated with Indira Gandhi Government Medical College, Nagpur. Before commencing the study permission from Institutional Ethics Committee was sought. By taking the prevalence of diabetes in India as per Indian Diabetes Federation report of 2020 as 8.9% and substituting it in the formula:

$n= Z^2p*q/r^2$ where,

p= 0.089 (Prevalence of diabetes)

q=1-0.089=0.911

Z= standard normal variate at 95% CI=1.96

r= 5 % (absolute precision)

The required sample size we derived was 125.

Thus a total of 125 adults above 18 years of age who does not have Type 1 and Type 2 diabetes mellitus were chosen for the study conveniently. Adults having Type 1/ Type 2 Diabetes Mellitus, pregnant females and those not willing to participate in the study were excluded. All the subjects who provided consent and satisfied the inclusion criteria were requested to answer the questions mentioned in the proforma, which included all the required parameters to fill the three diabetes risk scores: IDRS, ADA risk score, and FINDRISC. Anthropometric measurements were recorded with calibrated instruments according to standardized methods. Body mass index (BMI) was measured using the formula: weight (kg) divided by height (m^2). Random Blood Glucose measurement was done **using Dr Meropen's Gluco-one digital glucometer** which was used according to standard operating manual for estimating the random blood glucose of study participants through their capillary blood. This measurement was done as a control and participants with their Random Blood Sugar level ≥140 mg/dl were considered as pre-diabetic. A face to face interview was conducted for the study participants and the following risk score sheets were filled:

ADA risk score:

This is developed by the American Diabetes Association. It predicts the risk of having type 2 diabetes based on certain cut off scores:

<5: low risk; ≥5: high risk

FINDRISC:

Finnish diabetes risk score predicts the risk of having type 2 diabetes based on certain cut off values:

<7: low risk; 7-11: slightly elevated risk; 12-14: moderate risk; 15-20: high risk; > 20: very high risk.

IDRS (Indian Diabetes risk score):

It was developed by Madras diabetes research foundation based on a large population based study on diabetes in India," The Chennai Urban Rural Epidemiology Study (CURES)."It predicts the risk of having type 2 diabetes based on certain cut off scores:

< 30: low risk; 30-50: moderate risk; ≥60: high risk

Statistical Analysis:

Data analysis was done using SPSS 22/23. Descriptive variables were expressed as mean ± standard deviation for continuous data and as percentages for categorical data. Pearson correlation was used to compare continuous variables, with $p< 0.05$ considered statistically significant. The optimum cut- off for IDRS, ADA, and FINDRISC was obtained using receiver operative characteristic curve. Sensitivity, specificity, positive predictive value, negative predictive value, positive likelihood ratio, negative likelihood ratio, were calculated for each risk tool. Agreement between the different scores in predicting the risk of diabetes mellitus was analyzed by using Inter class correlation.

3. Results

Table 1: Baseline characteristics of study population

Baseline Characteristics		Study Participants (N= 125)	
		Number	Percentage
Age	<40	67	53.60
	≥40	58	46.40
Gender	Male	77	61.60
	Female	48	38.40
Education	Illiterates	12	09.60
	Literates	113	90.40
Occupation	Working	73	58.40
	Non- Working	52	41.60
Socio-Economic Status	Upper Class	65	52.00
	Lower Class	60	48.00
Random Blood Sugar (in mg/dl)	<140	96	76.80
	≥140	29	23.20

From the above table it is evident that majority of study participants 67(53.60%) have age <40 years. ***Mean age of participants is 41.52±15.70 years and the range being 63 (18-81) years.*** 77(61.60%) study participants are male. Majority 113(90.40%) are literates, working 73(58.40%), upper class (class I+II+III) 65(52.00%) by socioeconomic status. As far as religion and type of diet are concerned majority are Hindu 88(70.4%) by religion and belong to nuclear family 85(68.0%).

Table 2: Distribution of study participants according to ADA risk scores:

ADA Risk Score	Study Participants	
	Number	Percentage
Low Risk (<5)	100	80.00
High Risk (≥5)	25	20.00
Total	125	100.00

From the above table it is evident that only 25(20%) of study participants have high risk of type 2 diabetes mellitus as per ADA risk score.

Table 3: Distribution of study participants according to IDRS

IDRS	Study Participants	
	Number	Percentage
Low Risk (<30)	6	04.80
Moderate Risk (30-50)	75	60.00
High Risk (>60)	44	35.20
Total	125	100.00

From above table it is evident that 44(35.20%) of study participants have high risk of type 2 diabetes mellitus as per IDRS.

Table 4: Distribution of study participants according to FINDRISC

FINDRISC	Study Participants	
	Number	Percentage
Low Risk (<7)	81	64.80
Slightly Elevated Risk (7-11)	33	26.40
Moderate Risk (12-14)	9	7.20
High Risk (15-20)	2	1.60
Very High Risk (>20)	0	0.00
Total	125	100.00

From the above table it is evident that only 2(1.60%) of study participants have high risk of type 2 diabetes mellitus while none of the participants had very high risk of acquiring type 2 diabetes mellitus as per FINDRISC.

Table 5: Comparison of validity measures of three screening test scores:

Validity Measures	ADA Rik Score (≥5)	IDRS (≥60)	Findrisc (≥15)
Sensitivity (%)	37.93	55.17	6.90
Specificity (%)	85.42	70.83	100.00
PPV (%)	44.00	36.36	100.00
NPV (%)	80.00	83.95	78.05
Accuracy (%)	74.40	67.20	78.40

From the above table it is evident that sensitivity is maximum for IDRS (55.17%) while specificity is maximum for ADA risk score (85.42%). The negative predictive value of IDRS is 83.95% which is also very much feasible. The accuracy is maximum for ADA which is 74.40%.

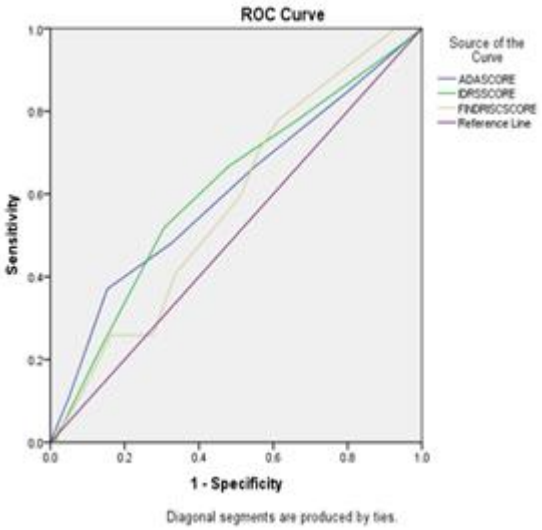

Figure 1: ROC curve for three risk scores:

From the above figure it is evident that the AUC for ADA=0.603 ;**IDRS=0.612**; FINDRISC=0.519.Hence IDRS is considered a better predictor of risk in study population with a cut off score of 55 (moderate risk zone) which gives sensitivity of 51.9% and specificity of 69.4%. But it is also to be noted that none of the AUC are statistically significant.

Table 6: Pearson's correlation between three risk scores:

		IDRS	FINDRISC	ADA
ADA risk score	Pearson correlation coefficient (r)	0.750	0.667	1
	P value	0.000	0.000	-
IDRS	Pearson correlation coefficient (r)	1	0.750	0.761
	P value	-	0.000	0.000
FINDRISC	Pearson correlation coefficient (r)	0.667	1	0.761
	P value	0.000	-	0.000

From the above table it is evident that there is significant correlation between all the three risk scores the highest correlation between IDRS and ADA **with r=0.761;p value=0.000.**

Table 7: Association between baseline characteristics and ADA risk score among study subjects

Baseline characteristics		Study subjects n (%)		
		ADA risk score		P value
		<5	≥5	
Age	<40 years	67(100.00)	0(0.00)	0.000*
	≥40 years	33(56.9)	25(43.10)	
Gender	female	42(87.5)	6(12.5)	0.098*
	male	58(75.3)	19(24.7)	
Education	literates	91(80.5)	22(19.5)	0.939*
	illiterates	9(75.0)	3(25.0)	
Occupation	Working	64(87.7)	9(12.3)	0.011*
	Not working	36(69.2)	16(30.8)	
Socioeconomic class	Upper class (I+II+III)	56(86.2)	9(13.8)	0.073*
	Lower class(IV+V)	44(73.3)	16(26.7)	
Family type	Nuclear	70(82.4)	15(17.6)	0.338*
	others	30(75.0)	10(25.0)	
Religion	Hindu	70(79.5)	18(20.5)	0.213*
	Muslim	4(80.0)	1(20.0)	
	Buddhist	26(81.2)	6(18.8)	
Diet	vegetarian	26(74.3)	9(25.7)	0.319*
	Mixed diet	74(82.2)	16(17.8)	
BMI(kg/m^2)	Underweight(<18.5)	20(80.0)	5(20.0)	0.240#
	Normal (18.5-22.9)	47(87.0)	7(13.0)	
	Overweight (23.0-24.9)	13(76.5)	4(23.5)	
	Obese (≥25.0)	20(69.0)	9(31.0)	
Blood pressure (mm/hg)	<140/90	95(86.4)	15(13.6)	0.000*
	≥140/90	5(33.3)	10(66.7)	
RBS(mg/dl)	<140	82(85.4)	14(14.6)	0.006*
	>140	18(62.1)	11(37.9)	

***- chi square test ; #- Fischer exact test**

From the above bivariate analysis it is evident that there is significant association between age (p value=0.000) , occupation (p value=0.011) , blood pressure (p value=0.000) Random blood sugar (p value=0.006) and ADA risk score among the study participants. This implies that those with age ≥40 years , non -working subjects, having blood pressure ≥140/90 mm/hg and having Random blood sugar level >140 mg/dl are at a increased risk of acquiring Type 2 diabetes mellitus as per ADA risk score classification in this study population.

Table 8: Association between baseline characteristics and IDRS among study subjects

Baseline characteristics		Study subjects n(%)		
		IDRS		P value
		<60	≥60	
Age	<40 years	63(94.0)	4(6.0)	0.000*
	≥40 years	18(31.0)	40(69.0)	
Gender	male	55(71.4)	22(28.6)	0.04*
	female	26(54.2)	22(45.8)	
Education	literates	77(68.1)	36(31.9)	0.037*
	illiterates	4(7.8)	8(4.2)	
Occupation	Working	56(76.7)	17(23.3)	0.001*
	Not working	25(48.1)	27(51.9)	
Socioeconomic class	Upper class(I+II+III)	49(75.4)	16(24.6)	0.01*
	Lower class(IV+V)	32(53.3)	28(46.7)	
Family type	Nuclear	60(70.6)	25(29.4)	0.048*
	others	21(52.5)	19(47.5)	
Religion	Hindu	59(67.0)	29(33.0)	0.470#
	Muslim	4(80.0)	1(20.0)	
	Buddhist	18(56.2)	14(43.8)	
Diet	vegetarian	17(48.6)	18(51.4)	0.018*
	Mixed diet	64(71.1)	26(28.9)	
BMI	Underweight(<18.5)	19(76.0)	6(24.0)	0.066*
	Normal (18.5-22.9)	38(70.4)	16(29.6)	
	Overweight (23.0-24.9)	11(64.7)	6(35.3)	
	Obese (≥25.0)	13(44.8)	16(55.2)	
Blood pressure (mm/hg)	<140/90	78(70.9)	32(29.1)	0.000*
	≥140/90	3(20.0)	12(80.0)	
RBS(mg/dl)	<140	68(70.8)	28(29.2)	0.010*
	>140	13(44.8)	16(55.2)	

*- chi square test; #- Fischer exact test

From the above bivariate analysis it is evident that except BMI and Religion rest all the baseline characteristics have significant association with risk of having type 2 diabetes mellitus according to IDRS.

Similarly an association table between FINDRISC and baseline characteristics was constructed but it showed no significant association.

4. Discussion

Screening of population using non-invasive diabetes risk scores helps in early identification of pre-diabetes and diabetes so that the associated complications can be delayed or prevented through dietary and lifestyle interventions. Different countries have adopted indigenous risk scores per-training to their population. Comparison and validation of different risk scores in local population help in identifying the gaps in the respective indigenous risk scores so that suitable modifications can be adapted to enhance the sensitivity of the risk score in screening diabetes.

In this study according to IDRS, 35.20% subjects had a score of > 60, indicating high risk to diabetes that is in agreement with other studies[5, 8] whereas FINDRISC showed only 2 subjects with a score > 15. This was contradictory to the study done by ***Pawar et al***, who observed 12.6% subjects with a score > 15[13]. However, in our study, as per the classification based on the ADA risk score, diabetic subjects with scores < 5 and ≥ 5 were 80.0% and 20.0%, respectively. This was quite contradictory with the study conducted by ***Doddamani et al.***[20], which showed 63.2% and 36.8% respectively for low and high risk.

According to a CURES study, IDRS has a sensitivity of 72.5%, specificity of 60.1%, and is derived based on the largest population-based study on diabetes in India. In addition, some recent studies showed a significantly higher sensitivity and specificity[8, 14] whereas our study observed a stark difference, with sensitivity of 55.17% and specificity of 70.83% . On the other hand, the specificity observed in our study was not aligned with the study done by ***Sowmiya et al.,***[15] .The possible reasons might be a smaller sample size. In comparison to the IDRS sensitivity and specificity levels, FINDRISC showed a specificity of 100.00%, whereas the risk score had very low sensitivity of 6.90% in our study group representing Central Indian population. However, studies have shown significant sensitivity and specificity with the FINDRISC score.[16,17]. A probable reason for this dis- parity might be the variation in dietary habits that are not applicable to our local population, apart from being influenced by the socioeconomic status of Indian population in general. As shown in Fig. 1, area under the curve (AUC) was largest for IDRS (0.612) when compared with IDRS and FINDRISC, though there was no statistically significant difference between ADA and the other two risk scores. The AUC for ADA risk score(0.603) in our study was lower when compared with 0.668 observed in Boloor community and 0.882 in ***Sharma et al.***[14,18]. The AUC for IDRS was lower as compared to the study conducted by ***Agrawal AK etal.,***[21] which showed AUC of 0.77. The probable reason might be our study was conducted in rural area but the above mentioned study was conducted in urban area.

5. Conclusion and Recommendations

Our study showed that IDRS was in agreement with and was found to be a better risk score for assessing diabetes in the current study population. Though our recommendation would be to use IDRS for screening diabetes in the Central Indian population, the comparison needs to be validated in a larger population, considering all the pertinent variables affecting the diagnosis of diabetes. Furthermore, we would suggest that the inclusion of the history of gestational diabetes and hypertension in IDRS might improve its sensitivity as a screening tool in our local population.

6. Limitations

Multiple logistic regression analysis for exploring factors and odds of acquiring diabetes mellitus in study population could have been done in this study.

Conflicting Interest: None

Sources of support: None

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