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ORIGINAL RESEARCH

Utility of Indian diabetes risk score and finnish diabetes risk score for screening of undiagnosed diabetic adults

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ABSTRACT:
Background: Diabetes Mellitus is one of the most common diseases in the world and is acquiring epidemic proportions. Its prevalence is growing in developed and developing countries. There is an emergent need of effective screening instrument to identify "diabetes risk" individuals. In this study we aim to evaluate Indian Diabetes Risk Score (IDRS) and Finnish Diabetes Risk Score (FINDRISC) for predicting risk of diabetes mellitus and to assess utility of Indian Diabetes Risk Score (IDRS) and Finnish Diabetes Risk Score (FINDRISC) for predicting risk of diabetes mellitus. **Material and methods:** This Hospital based observational study was conducted on 1200 not known diabetic subjects who came to outdoor department or admitted in GGS Medical College Faridkot. All the patients underwent complete clinical evaluation and then both IDRS and FINNISH Diabetic Risk Score were applied on all the patients. Simultaneously FBS, RBS and HbA1C was done on each patient. **Results**: FINDRISC score had sensitivity 84.2% and specificity 97.2%. IDRS score had sensitivity 98.68% and specificity 16.5%. **Conclusion**: FINDRISC shows fairly good diagnostic accuracy and clinical utility for detecting diabetes. FINDRISC can be used as a tool for identifying people at risk for diabetes and therefore requiring further evaluation.
Key words: Diabetes Mellitus, Finnish Diabetes Risk Score, Indian Diabetes Risk Score, Screening tool.

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INTRODUCTION:

Diabetes Mellitus is one of the most common diseases in the world and is acquiring epidemic proportions. Its prevalence is growing in developed and developing countries.[1] The term Diabetes Mellitus, (derived from greek words meaning - siphon and sweet) refers to a group of common metabolic disorders that share the phenotype of hyperglycemia which results from reduced insulin secretion and/or action, decreased glucose utilization, and increased glucose production.[2] Incidence of diabetes is increasing worldwide due to population ageing and growth, obesity, unhealthy diets and sedentary life style.[3] India is diabetic capital of the world with home to 64.5 million diabetic patients.[4] It has been acknowledged that diabetic screening can add quality of life years.[5] There is an emergent need of effective screening instrument to identify "diabetes risk" individuals.[6] In this study we aim to evaluate Indian Diabetes Risk Score (IDRS) and Finnish Diabetes Risk Score (FINDRISC) for predicting risk of diabetes mellitus and to assess utility of Indian Diabetes Risk Score (IDRS) and Finnish Diabetes Risk Score (FINDRISC) for predicting risk of diabetes mellitus.

MATERIALS AND METHODS:

Study Population

This Hospital based observational study was conducted on 1200 not known diabetic subjects who came to outdoor department or admitted in GGS Medical College Faridkot. The study was carried out after approval from Institutional Ethics Committee,

GGS Medical College, Faridkot. Written informed consent was obtained from the patients.

The sample size was calculated considering the sensitivity of IDRS as 0.790 and FINDRISC as 0.553 and prevalence of disease in the population as 0.049.[27] To detect a difference of 0.237 between these risk scores, using a two sided Mc Nemar test with a significance level of 0.1 and 80% power, considering the proportion of discordant parts as 0.470, the study required a minimum sample size of 1143 subjects. Hence 1200 subjects were included for the purpose of this study.

INCLUSION CRITERIA

1. Not known Diabetics
2. Age>30yrs

EXCLUSION CRITERIA

1. Known case of Diabetes
2. Age<30yrs
3. Pregnant women
4. Patients with renal failure, hepatic failure, electrolyte imbalance
5. Patients not giving informed consent
6. Patients taking steroids
7. Patients on drugs causing hypoglycemia and hyperglycemia

Study tools:

INDIAN DIABETES RISK SCORE(IDRS): IDRS was developed using four simple parameters namely age, abdominal obesity, family history of diabetes and physical activity. A maximum score of 100 is given for these categories. It has shown to be highly cost effective way of testing for diabetes in a resource poor setting like India.[7]

FINNISH DIABETES RISK SCORE (FINDRISC): FINDRISC is a prediction tool to identify patients at risk of developing diabetes. It requires not laboratory testing. It uses age, BMI, physical activity, vegetable and fruit intake, medical treatment of hypertension, history of hyperglycemia and family history to determine risk of developing diabetes. By using FINDRISC to identify high risk people and applying an educational intervention, it has been shown possible to reduce the incidence of diabetes.[8]

METHODOLOGY

After taking informed consent detailed history of each patient was taken. All of them underwent complete clinical evaluation and then both IDRS and FINNISH Diabetic Risk Score were applied on all the patients by single and same observer and patients were categorized accordingly. Simultaneously FBS, RBS and HbA1C was done on each patient. The results were analyzed using appropriate statistical methods.

High risk subjects predicted by both scores were compared with those who have been recently diagnosed with diabetes mellitus. The results were analyzed using appropriate statistical methods.

OBSERVATIONS & RESULTS

TABLE 1: AGE DISTRIBUTION

Age (in years)	Diabetic (n= 76)	Non diabetic (n=1124)	P value
30-40	7 (9.2%)	285 (25.3%)	0.0015
>40	69 (90.7%)	839 (74.6%)	
Mean age ± S.D	57.2±10.7	52.44±14.5	0.004

TABLE 2: GENDER DISTRIBUTION

Gender	Diabetic (n= 76)	Non diabetic (n=1124)	Significance
Males	48 (63%)	685 (61%)	Not Significant
Females	28(37%)	439 (39%)	
Male : female ratio	1.7:1	1.5:1	

TABLE 3: OCCUPATION

Occupation	Diabetic (n= 76)	Non diabetic (n=1124)
Housewife	27 (35.5%)	376 (33.5%)
Farmer	17 (22.4%)	210 (18.7%)
Shopkeeper	14 (18.4%)	185 (16.5%)
Laborer	10 (13.2%)	183 (16.3%)
Driver	3 (3.9%)	28 (2.5%)
Unemployed	2 (2.6%)	79 (7%)
Others	1 (1.3%)	63 (6.5%)
Total	76	1124

TABLE 3: HABITS

Habit	Diabetic (n= 76)	Non diabetic(n=1124)	P value
No addiction	45 (59.2%)	759 (67.5%)	0.135
Alcohol	25 (32.9%)	267 (23.8%)	
Smoking	5 (6.6%)	76 (6.8%)	
Tobacco	2 (2.6%)	12 (1.1%)	
Opium	2 (2.6%)	60 (5.3%)	
Tramadol	1 (1.3%)	2 (0.2%)	
Multisubstance abuser	-	5 (0.4%)	
Heroin	-	3 (0.3%)	

TABLE 4: Variables

Variables	Diabetic (n= 76) (Mean ± S.D)	Non diabetic (n=1124) (Mean ± S.D)	P value
Weight (in kgs)	73.3±14	63.5±11.7	0.0001
Height (in cm)	163.9±7	164.2 ±8.6	0.74
BMI	27.2±4.60	23.4± 3.67	0.00
Hip circumference (in cm)	91.1 ±10.1	83.5±10.7	0.0001
Waist circumference (in cm)	96.5 ±13.2	85.3 ±11.7	0.0001
Systolic blood pressure	131.3 ± 22.8	120.7 ± 16	0.0001
Diastolic blood pressure	81.6 ± 12	77.4 ± 10.4	0.0007
Fasting blood sugar	144.42 ± 25.1	81.85 ± 11.3	0.0001
Random blood sugar	232.7± 46.1	129.6± 19.9	0.0001
HbA1c	7.5± 1.3	4.7 ± 0.3	0.0001

TABLE 5: HYPERTENSION

Hypertension	Diabetic (n=76)	Non diabetic (n=1124)	P value
Present	55 (72.4%)	226 (20.1%)	0.0001
Not present	21 (27.6%)	898 (79.9%)	

TABLE 6: FAMILY HISTORY OF DIABETES

Family history of diabetes	Diabetic (n= 76)	Non diabetic (n=1124)	P value
Present	57 (75%)	59 (5.2%)	0.00001
Not present	19 (25%)	1065 (94.7%)	

TABLE 7: FINNISH DIABETES RISK SCORE

FINDRS	Diabetic	Non diabetic	Total
Low Risk (0-6)	5 (6.6%)	771 (68.6%)	776 (64.7%)
Slightly Elevated (7-11)	7 (9.2%)	323 (28.7%)	330 (27.5%)
Moderate (12-14)	37 (48.7%)	27 (2.4%)	64 (5.3%)
High (15- 20)	27 (35.5%)	3 (0.3%)	30 (2.5%)
Very High (>20)	0	0	0
Total	76 (100%)	1124 (100%)	1200 (100%)

TABLE 8: INDIAN DIABETES RISK SCORE

IDRS	Diabetic	Non diabetic	Total
Low Risk (0-29)	1 (1.3%)	183 (16.3%)	184 (15.33%)
Moderate Risk (30-59)	13 (17.1%)	429 (38.2%)	442 (36.83%)
High Risk (>60)	62 (81.5%)	512 (45.6%)	574 (47.83%)
Total	76 (100%)	1124 (100%)	1200 (100%)

TABLE 9: ASSOCIATION OF FINDRS WITH DIABETIC STATUS

FINDRS Score	Diabetic	Non diabetic	Odds ratio	95% CI	P
<15	49	1122	30.1	7.1 -13.13	P < 0.0001
≥15	27	2			
Total	76	1124			

TABLE 10: ASSOCIATION OF IDRS WITH DIABETIC STATUS

IDRS Score	Diabetic	Non diabetic	Odds ratio	95% CI	P
<60	14	612	5.3	2.9-9.6	P < 0.0001
≥60	62	512			
Total	76	1124			

TABLE 11: ROC CURVE OF FINDRS AND IDRS

	FINDRS Score	IDRS Score
Area under fitted curve (Az)	0.9	0.8
Estimated std. error	0.01	0.02

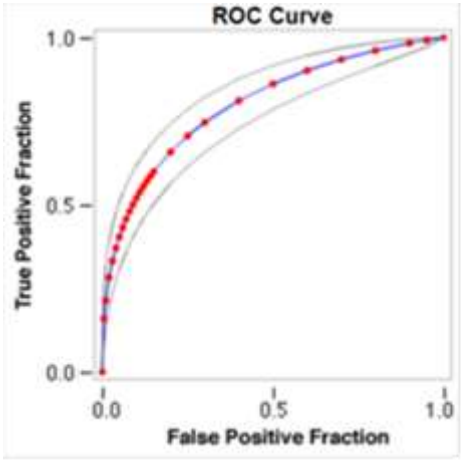

Figure 1a: ROC CURVE OF FINDRS SCORE

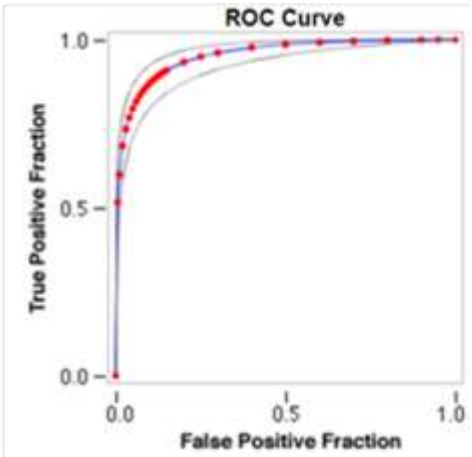

Figure 1B: ROC CURVE OF IDRS SCORE

TABLE 12: COMPARISON OF AREA UNDER CURVE OF FINDRS AND IDRS

Difference between areas	0.2
Standard error	0.3
Z static	4.3
P value	0.00

TABLE 13: roc curve of FINDRS and IDRS

	FINDRS Score	IDRS Score
Area under fitted curve (Az)	0.9	0.8
Estimated std. error	0.01	0.02

TABLE 14: SCREENING TEST CHARACTERSTICS FOR FINDRS AMD IDRS

Statistic	Value (95% CI)	
	FINDRS	IDRS
Sensitivity	84.2% (74.0% - 91.6%)	98.7% (92.89% - 99.9%)
Specificity	97.2% (96.1% - 98.1%)	16.5% (14.3% - 18.8%)
Positive Likelihood Ratio	30.6(21.3 - 43.9)	1.2 (1.1 - 1.2)
Negative Likelihood Ratio	0.2 (0.1 - 0.3)	0.1 (0.0 - 0.6)
Disease prevalence	6.3% (5% - 7.9%)	6.3% (5% - 7.9%)
Positive Predictive Value	67.4% (59.0% - 74.8%)	7.4% (7.2% - 7.7%)
Negative Predictive Value	98.9% (98.2% - 99.4%)	99.5% (96.3% - 99.9%)
Accuracy	96.4% (95.2% - 97.4%)	21.7% (19.4% - 24.1%)

DISCUSSION:

In present study amongst 1200 not known diabetic subjects, 76 had diabetes. In the present study, the prevalence of diabetes was 6.33%. The study conducted by Indian Council of Medical Research-India diabetes shown the prevalence of diabetes in Maharashtra in 2011 was 8.4%[9] while the WHO 2016 report shows 7.8%[10]. Pawar SD reported that the prevalence of diabetes in their study was 4.98%.[6] Reasons for difference in prevalence of above mentioned studies might be sampling procedure.

Most of the subjects included in this study were more than 40 years of age. The mean age of diabetic subjects (57.2 years) was more than those of non diabetic subjects (52.4 years). This difference in age was statistically significant. Age itself is a reported risk factor for increased prevalence of T2DM.[11] The findings of our study are in concordance with the study done by Omech B et al[12] who conducted a cross-sectional study designed to assess the validity of the Finnish Diabetes Risk Score for detecting undiagnosed type 2 diabetes among general medical outpatients in Botswana they reported that the mean age of the participants was 50.1 years. Also Nagalingam S et al[13] intended to use the IDRS risk score as screening tool for assessing the risk of developing diabetes among the semi urban population of Chennai near Ponamallee and Avadi and reported that mean age of patients was 41.5 years.

Amongst both the diabetic and non-diabetic subjects males were higher in proportion (63% vs 61%) in comparison to females (37% vs 39%). Our results are in concordance with the studies done by Pawar S et al[6] and Patel M et al[14] who also reported that majority of diabetic patients in their study were males. On contrary Omech B et al[12] and Nagalingam S et al[13] reported female predominancy.

Among females majority were housewives in both diabetics and non diabetics. As far as males were concerned most in both the groups that is diabetics and non diabetics were shopkeeper and farmer by occupation. Umar MS et al[15] in their study reported that amongst rural population maximum number of patients were housewives (44%) followed by farmers/laborers (30%), businessperson/shopkeepers, officers/teachers (4%). Among urban population maximum number of subjects were businessperson/shopkeepers (38%), housewives (34%), officer/teacher (10%) and mechanic/driver (skilled labour) (16%), farmer/labourer (unskilled labourer) (2%) respectively.

The mean weight of diabetic subjects (73.3kgs) was more than the mean weight of non diabetic subjects (63.5kgs). This difference was statistically significant.

The mean hip circumference of diabetic subjects (91.1 cm) was more than the mean hip circumference of non diabetic subjects (83.5 cm). This difference was statistically significant.

The mean waist circumference of diabetic subjects (96.5 cm) was more than the mean waist circumference of non diabetic subjects (85.3cm). This difference was statistically significant.

Considerable amount of literatures have shown obesity to be a major modifiable risk factor for type 2 diabetes.[16-19] Overweight and obesity has further been linked with poor control of blood pressure, cholesterol and blood glucose levels among individuals with type 2 diabetes.[20]

The mean systolic blood pressure of diabetic subjects (131.3) was more than the mean systolic blood pressure of non diabetic subjects (120.7). This difference was statistically significant.

The mean diastolic blood pressure of diabetic subjects (81.6) was more than the mean diastolic blood pressure of non diabetic subjects (77.4). This difference was statistically significant.

Hypertension was present in 72.4% of diabetic subjects and 20.1% of non diabetic subjects. This difference was found to be statistically significant.

Various studies including that of Ravikumar P et al,[21] Valliyot B et al,[22] Pan XR et al,[23] and Shrivastava SR[24] reported increased blood pressure in diabetics. Hence for reducing blood pressure, physical activity needs to be increased which would subsequently lower the risk of diabetes.

The mean BMI of diabetic subjects (27.2) was more than the mean BMI of non diabetic subjects (23.4). This difference was statistically significant. Our findings are in concordance with the studies done by Gopalakrishnan et al[25] and Chowdhury R et al[26] who stated that higher BMI is associated with increased diabetes risk.

The mean fasting blood sugar of diabetic subjects (144.4) was more than the mean fasting blood sugar of non diabetic subjects (81.9). This difference was statistically significant. The mean random blood sugar of diabetic subjects (232.7) was more than the mean random blood sugar of non diabetic subjects (129.6). This difference was statistically significant. The mean HbA1c of diabetic subjects (7.5) was more than the mean HbA1c of non diabetic subjects (4.7). This difference was statistically significant.

75% patients had family history of diabetes amongst diabetic subjects and amongst non diabetic subjects only 5.2% of patients gave positive family history of diabetes. This difference was found to be statistically significant. Our findings are in concordance with the study done by Sakurai M et al[27] who found that family history of diabetes was associated with the incident risk of diabetes. Shaten BJ et al,[28] Sargeant LA et al[29] and Helmrich SP et al[30] reported that individuals with a family history of diabetes are at increased risk of developing diabetes, and lifestyle modification can help reduce this risk.

When the subjects were categorized according to Finnish Diabetes Risk Score, maximum subjects were at low risk followed by slightly elevated, moderate risk and high risk. None of the subject was at very high risk of diabetes.

When the patients were categorized according to Indian Diabetes Risk Score, maximum subjects were at high risk followed by moderate risk and low risk.

With respect to high-risk categories of people with their diabetic status, individuals with high risk by FINDRISC (≥15) were at 30.1 times higher odds (95% confidence intervals 7.1 -13.13) of being affected by diabetes than low, slightly elevated and moderate risk group individuals.

With respect to high-risk categories of people with their diabetic status, Individuals with high risk by IDRS (>60) were at 5.23 times higher odds (95% CI 2.9-9.56) of diabetes than low to moderate risk group individuals.

Both IDRS and FINDRISC scores of each individual were compared using ROC curve using AUC of each score. There was the significant difference between AUC's of both scores.

FINDRISC score had optimum cut off point of score value ≤11 with sensitivity 84.2% and specificity 97.2%. However, study conducted by Vandersmissen GJ et al[31] found sensitivity of 67.7% and specificity of 67.2%. This difference in specificity may be because of low false positives and higher true negatives in the present study.

Positive Likelihood Ratio is 30.6 Hence, those who were in high risk category according to Finnish score were 30.6 times more likely to be diabetic than non diabetics. The probability of having diabetes when FINDRISC detects high risk was 67.4 (PPV). Diagnostic accuracy of FINDRISC scale is 96.5%

IDRS score had optimum cut off point of score value ≤29 with sensitivity 98.68% and specificity 16.5%. While Mohan et al[32] found sensitivity of 72.5% and specificity of 60.1%. This difference in senstivity may be because of high true positives and low false negatives, the difference in specificity may be because of high false positives in our study.

Positive Likelihood Ratio is 1.2. Hence, those who were in high risk category according to IDRS were 1.2 times more likely to be diabetic than non diabetics. The probability of having diabetes when IDRS detects high risk was 7.4% (PPV). Diagnostic accuracy of IDRS scale is 21.7%.

Our study suggests that FINDRISC is better at "ruling out" than "ruling in" of diagnosis of diabetes 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 carry limitations like with all risk assessment tools. By considering fair agreement between these screening tools and above facts, it is recommended to use FINDRISC than IDRS in the Indian scenario.

CONCLUSION

In conclusion, FINDRISC shows fairly good diagnostic accuracy and clinical utility for detecting diabetes. In resource-poor settings of developing countries like India, where there is an increasing incidence of diabetes, there is a need of most useful and most cost effective tool to screen out the population. When compared with IDRS; FINDRISC has much better screening utility than IDRS.

FINDRISC can be used as a tool for identifying people at risk for diabetes and therefore requiring further evaluation. It helps people decide whether further evaluation and medical advice is required or not. The study also highlights the importance of need of more interaction between health care facilities and providers thereby screening higher proportion of population for undiagnosed diabetes.

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