

Indian Diabetes Risk Score (IDRS) as a strong predictor of diabetes mellitus: A cross sectional study among urban population of Jhalawar, Rajasthan

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Abstract

Introduction: The patients with Type 2 diabetes Mellitus may often remain asymptomatic for a longer period of time. The Indian Diabetes Risk Score (IDRS), a simple screening tool for prediction of undiagnosed diabetes. **Objective:** Validation of IDRS with standard test for type 2 diabetes among urban population of Jhalawar, Rajasthan. **Material and Methods:** A Community based Cross-sectional study was carried out in urban field practice area of Department of Community Medicine, Jhalawar Medical College, Jhalawar, Rajasthan. The study was conducted using a two-stage sampling design. A predesigned, pretested proforma and Indian Diabetes Risk Score (IDRS) sheet was used to collect data from the study participants. The IDRS is based on four parameters: age, family history of diabetes, waist circumference and physical inactivity. Data was collected using the World Health Organization stepwise approach to surveillance (STEPS). **Results:** Among 450 participants, 12.7% participants were in low risk, 59.1% were in moderate risk and 28.2% were in high risk of developing diabetes according to IDRS score. IDRS score of ≥ 60 turned out to be the best cut point for identifying undiagnosed diabetes with sensitivity 92.3% and specificity 82.6%. Positive Predictive value and Negative Predictive value were 47.3% and 98.5% respectively. **Conclusion:** Association of IDRS was found significant with diabetes. IDRS score of ≥ 60 turned out to be the best cut point for identifying undiagnosed diabetes. IDRS is found valid screening tool for early detection of Diabetes.

Keywords

Cross-Sectional Study; Diabetes Mellitus; Screening; Validation

Introduction

Over the past few decades, Non-communicable diseases (NCDs) have emerged as the leading causes of death globally, killing more people each year than all other causes combined (1). One of the important diseases in this respect is diabetes, which is considered a “disease of urbanization” (2,3,4). The increasing modernization, sedentary lifestyle and unhealthy dietary habits in rural and urban India has taken its toll on the health of the general public, especially the youth (5).

As per the International Diabetes Federation, 422 million people are living with diabetes across the world, and it is expected to rise to a whopping figure of 592 million in 2035, of which 79.4 million diabetics will be from India (6). In addition to high prevalence, the incidence rates of T2DM are also higher in south Asians compared to other ethnic groups (7).

The patients with Type 2 diabetes Mellitus may often remain asymptomatic for a longer period of time with abnormal blood glucose, cholesterol and triglycerides. In fact, their diagnosis is often delayed until the

development of complications or the disease is diagnosed incidentally by a health professional (8). Morbidity and early mortality occur as a result of inadequate health care facilities for early detection and initiation of therapy, as well as sub-optimal management of diabetes and associated morbidities. They develop multiple chronic complications leading to irreversible disability and death. Coronary heart disease, stroke, lower limb amputation is more common in diabetics than general population (9). Several tools that assess the risk of having undiagnosed or future diabetes have been developed and adapted for use in diverse populations. FINRISK: score is calculated using age, BMI, waist circumference, history of anti-hypertensive drug treatment and high blood glucose, physical activity, and daily consumption of fruits, berries or vegetables to estimate risk (10). AUSDRISK: a 10-item questionnaire that estimates risk of progression to T2DM over 5 years. Its scoring includes questions based on age, sex, ethnicity, family history of diabetes, history of abnormal glucose metabolism, smoking status, current hypertensive treatment, physical activity, fruit and vegetable consumption, and waist circumference (11). The Indian Diabetes Risk Score (IDRS), a simple screening tool for prediction of undiagnosed diabetes, has been developed by Mohan et al. at the Madras Diabetes Research Foundation (MDRF), Chennai. The score referred to as MDRF-IDRS was derived from the Chennai Urban Rural Epidemiology Population Study (CURES) (12). The IDRS is based on four simple parameters derived from known risk factors for diabetes; two modifiable risk factors (waist circumference and physical inactivity) and two non-modifiable risk factors (age and family history of diabetes)(13).

Screening is essential for early diagnosis and prevention of diabetes in these people so that they can be aware to adopt health life style for diabetes risk reduction and seek treatment if they developed frank diabetes. Of keeping this in view, the present study was planned for prediction of undiagnosed diabetes using Indian diabetic risk score among urban population of Jhalawar, Rajasthan.

Aims & Objectives

Prediction of undiagnosed diabetes using Indian diabetic risk score among urban population of Jhalawar, Rajasthan.

Material & Methods

Study design: Community based Cross-sectional study (Field operational research).

Study Setting: Field practice area catered by the Urban Health Training Centre (UHTC) of Department of Community Medicine, Jhalawar Medical College, Jhalawar, Rajasthan, India. Jhalawar city has total population of 66,919 individuals (34,765 Male and 32,154 Female) as per the census 2011 (14). Urban Health Training Centre covers approximate 24,506 populations.

Study Period: October 2017 to October 2018

Study population:

Inclusion criteria

- All adult men and women aged 18 years and more, residing in the study area.
- People providing written consent for inclusion as participants.

Exclusion criteria

- Pregnant and lactating women up to 12 weeks postpartum.
- Already diagnosed with diabetes and/or taking anti-diabetic medication.
- People not able to understand or answer (because of illness)
- People not providing written consent for inclusion

Sample size: Assuming that 50% of the screened population will be correctly diagnosed by MDRF-IDRS, 95% confidence interval, 10% margin of error, the sample size of 400 for the present study was calculated by using $4pq/l^2$ a formula for community based study. Considering 10% population as non-respondent, we added 10% of sample size to get adequate participants in study. So corrected sample size for present was 440 and to make it easy for analysis we included total 450 participants.

Method of data collection: With the help of data and map available at Community Medicine department of Jhalawar Medical College, the study was conducted using a two-stage sampling design. **In the first stage**, households were selected by systematic random sampling. For this a list of all household was prepared according to their number which was given by Community Medicine department. Sampling interval (**I**) was calculated by using formula N/n where **N** represents total household and **n** represent required sample. After putting data in formula ($3829/450=8.5 \text{ s} \sim 8$), sampling interval was found 8. The first unit (r^{th}) is selected at random by using random number table and it was found 7th household. Then subsequent units were selected by adding sampling interval in first unit ($(r+1, r+2I \dots \text{etc})$). These households will constitute the primary sampling unit.

In the second stage, if more than one eligible participants were present in the selected house, simple random sampling technique was used to select one eligible participant. If participant, who was selected by simple random sampling, was not available at home, then second member from household was selected through same procedure. These participants formed the secondary sampling unit.

First, all the study participants were explained in detail about the purpose and methodology of the study, potential risk and benefit. Thereafter, the participant information sheet was explained to each participants and written consent was obtained. Each interview began with a general discussion to build rapport with the participants and gain their confidence. During each house visit, data was collected using the World Health Organization stepwise approach to surveillance (**STEPS**) (15), which includes three steps for assessment of risk factors. Step 1

and step 2 activities were done on day 1 and step 3 activities were done on day 2. The three steps are as follows:

Step 1: A predesigned, pretested proforma and Indian Diabetes Risk Score (IDRS) sheet was used to collect data from the study participants.

Step 2: Anthropometric measurements were taken for all study participants using standard protocol and instruments with minimum possible error. Measurements include height, weight, and waist circumference.

Height was measured by portable stadiometer. Participants were asked to stand straight without shoes, in centre of stadiometer, with put their feet together. Their buttocks and upper part of their back should also be touch the stadiometer upright and head should be in the Frankfort plane. The height was recorded to the nearest 1 cm.

Weight was considered to be force the matter in the body exerts in a standard gravitational field. Weight was measured on Calibrated electronic weighing machine, after placing it on hard and flat surface. Participants were asked to stand on the centre of the scales without support, with their arms loosely by their sides, head facing forward and with their weight distributed evenly on both feet. A reading appeared in a few seconds. The weight was recorded to the nearest 100 grams.

Waist circumference was considered to be circumference of the abdomen at its narrowest point between the lower costal border and the top of the iliac crest, perpendicular to the long axis of the trunk. Participants were asked to stand upright in a relaxed manner, feet comfortably apart, weight evenly balanced on both feet and with their arms hanging by their side. The cross-hand technique was used for measuring waist girth.

Screening at steps 1 and 2 was done on the basis of the IDRS (16, 17).

Step 3: Biochemical testing: All individuals were further evaluated for the presence of T2DM. On first visit, all participants were informed about standard protocol and procedure of fasting blood glucose monitoring which include overnight fast of 8 hours and stay empty stomach next morning for blood sample. Next morning, after confirming an overnight fast of 8 hours and empty stomach, fasting blood glucose was checked, with a calibrated glucometer using glucose-oxidase peroxidase method (Accu-Chek Active Meter). The patient was diagnosed with type 2 diabetes if the fasting blood glucose (FBG) values will be ≥ 126 mg%, as per the WHO criteria (18).

The IDRS is based on four simple parameters age, family history of diabetes, waist circumference and physical inactivity. The MDRF-IDRS uses a scoring system of 0–100. After adding up scores of all the four parameters, if the score is ≥ 60 : the risk of having type 2 diabetes is very high, 30–50: Moderate risk, < 30 : Low risk.

IDRS parameters and Score (17):

Particulars	Score
1. Age in years	
<35	0
35 – 49	20
≥ 50	30
2. Abdominal obesity	
Waist <80cm (F); <90cm (M).	0
Waist 80-89cm (F); 90-99cm (M).	10
Waist >90cm (F); >100cm (M).	20
3. Physical activity	
Vigorous exercise [regular] or strenuous [manual] work at home / work	0
Moderate exercise [regular] or moderate physical activity At home / work	10
Mild exercise [regular] or mild physical activity at home / Work	20
No exercise and sedentary work home/work	30
4. Family history	
No family history	0
Either parents	10
Both parents	20

Assessment of risk of type 2 diabetes according to IDRS score (17):

IDRS score	Risk of type 2 diabetes mellitus
<30	Low risk
30 to < 60	Moderate risk
≥ 60	High risk

Ethical Consideration: The study was started after obtaining ethical approval from the Institutional Ethic Committee, Jhalawar Medical College, Jhalawar, Rajasthan. Participants were enrolled after ensuring confidentiality of their identity and information and taking written consent. All diagnosed participants were referred to Medical College, Jhalawar for further investigations and management.

Data entry and analysis: Data was coded, entered in MS Excel 10 and analyzed using SPSS trial version 22. Appropriate tables and figures are generated. Chi square test with yate’s correction for association was applied. P value < 0.05 was considered statistically significant at 5% level of significance.

Results

Data of 450 participants fulfilling the eligibility criteria were collected and analyzed. [Table 1](#) depicts socio-demographic characteristics of study participants. Distribution shows that most of participants (45.6%) were below 35 years of age and 74.7% were females. According to IDRS score, 57 (12.7%) participants were in low risk, 266 (59.1%) were in moderate risk and 127 (28.2%) were in high risk of developing diabetes. Most of participants (87.3%) are at moderate to high risk of developing diabetes.

[Table 2](#) depicts prevalence and association of diabetes with IDRS score of study participants. Out of 450

participants 65 were diabetic and out of these 65 diabetics, 60 (92.3%) were found at high risk, 05 (7.7%) at moderate risk of developing diabetes according to IDRS score. Association of IDRS score and presence of Diabetes was also found statistically significant ($p < 0.05$).

[Figure 1](#) depicts distribution of Diabetic participants according to IDRS score. None of diabetic was found with IDRS score below 40. After score of 50, percentage of diabetic increased and 100% participants were found diabetic who score 90 or above.

[Table 3](#) depicts Proportion of participants according to IDRS score and sensitivity, specificity, positive predictive value and Negative predictive value. As no participant was found diabetic in below 40 IDRS score so calculation of sensitivity and specificity was done from score ≥ 40 . Higher IDRS scores increased the specificity, but the sensitivity dramatically decreased. Sensitivity is decreasing but chances of correct diagnosis is increase with IDRS score as predicted with increase of positive predictive value. Present study thus confirms and validates IDRS score of ≥ 60 turned out to be the best cut point for identifying undiagnosed diabetes with sensitivity 92.3% and specificity 82.6%.

[Table 4](#) and [Figure 2](#) depict sensitivity and specificity analysis of IDRS. For the purpose of analysis low risk and moderate risk group were clubbed as one group. Sensitivity of IDRS is found 92.3% and Specificity is found 82.6%. Diagnostic efficacy which is defined by Positive Predictive value and Negative Predictive value were 47.3% and 98.5% respectively.

Discussion

Present study was conducted among 450 participants of urban field practice area of Department of Community Medicine, Jhalawar Medical College, Jhalawar. Out of 450 participants, 57 (12.7%) participants were in low risk, 266 (59.1%) were in moderate risk and 127 (28.2%) were in high according to IDRS score.

In a study conducted by Chowdhury Ranadip *et al* (19) in Daspara, Amdanga Block, out of 102 participants, 74(31.5%) respondents had IDRS score >60 (high risk) and 108 (46%) respondents between 30-50 (moderate risk) while 53(22.5%) respondent had score < 30 (low risk).

Nearly similar findings were observed in a study conducted in urban field practice area of Pune medical college by Reshma S Patil *et al* (20). Study included 383 participants and result showed that 140 (36.6%) had a high risk score, the majority of participants (209; 54.6%) were in the moderate-risk category and 34 (8.9%) participants were found to be at low risk for diabetes.

In present study, prevalence of diabetes was found 14.4%. Sensitivity of IDRS was 92.3% and Specificity was 82.6% with Positive Predictive value 47.3% and Negative Predictive value 98.5%. IDRS score of ≥ 60 turned out to be the best cut point for identifying undiagnosed diabetes.

Anil Kumar Agarwal *et al* (21) conducted a study at urban area of Gwalior and found that 55 (8.94%) out of 615 respondents were diagnosed as a newly diabetic cases. IDRS score of ≥ 60 has a sensitivity of 45.5% and specificity of 88.0%.

Study by Kanika Kaushal *et al* (22) in urban field practice area, IGMC, Shimla on 417 adults found prevalence of diabetes was 17.98%. IDRS value ≥ 70 had an optimum sensitivity of 61.33% and specificity of 56.14% for detecting undiagnosed type 2 diabetes in the community. Prabha Adhikari *et al* (23) conducted a study at Bloor locality in Mangalore on adults and found that sixty six of the 551(12.8%) study individuals were known Diabetic. IDRS ≥ 60 has the best sensitivity of (62.2%) and specificity of (73.7%) for detecting undiagnosed diabetes in the community.

V Mohan *et al* (17) found overall, 365 of the 2350 study subjects had diabetes (overall prevalence: 15.5%, males:18.0%, females:13.4%). An IDRS value ≥ 60 had the optimum sensitivity (72.5%) and specificity (60.1%) for determining undiagnosed diabetes with a positive predictive value of 17.0%, negative predictive value of 95.1%, and accuracy of 61.3%.

A community based cross-sectional study was conducted by Geetha Mani *et al* (24) on 100 subjects at rural area of Kancheepuram district. Prevalence of diabetes was 07% and at and above score of 60 as per IDRS sensitivity was 85.3% and specificity was 43%.

A community based cross-sectional study done in the urban and rural areas of Lucknow by Abhishek Arun *et al* (25). Out of total 820 participants, 13.8% were found diabetic. 555 (67.7%) of subjects were in moderate risk IDRS category while 143 (17.4%) were in low risk and only 122 (14.9%) were in high risk IDRS category. The sensitivity of IDRS was 81.40% in and specificity was 72.0%. Positive Predictive value of IDRS was 31.7% with Diagnostic accuracy of 73.3%.

Bitan Sengupta *et al* (26) found optimum sensitivity of 83.13% and specificity of 82.64%, with positive and negative predictive values 62.16% and 93.45%, respectively, observed at an IDRS score of ≥ 60 for identifying prediabetes and diabetes in their study in West Tripura District.

Garima Namdev *et al* (27) reported that out of 270 study subjects, 29% found to have high score. By applying IDRS, at score > 60 , they observed 32% sensitivity and 97% specificity.

Basavaraj S. Mannapur *et al* (28) found that prevalence of diabetes was 14.1%. Among 206 subjects, 39.6% and 55.1% were in moderate and high risk category respectively. Sensitivity of IDRS was 90%, specificity 50%, positive predictive value 43.8% and negative predictive value 96.74%.

Conclusion

Association of IDRS was found significant with diabetes. IDRS score of ≥ 60 turned out to be the best cut point for identifying undiagnosed diabetes. IDRS is found valid screening tool for early detection of Diabetes. Sensitivity of IDRS was found 92.3% and Specificity was found 82.6%.

Recommendation

Further studies with larger sample sizes involving multiple centres would be required to explore the appropriate cut off point for identifying undiagnosed diabetes using IDRS.

Relevance of the study

The patients with Type 2 diabetes Mellitus often remain undiagnosed for a longer period of time. The Indian Diabetes Risk Score is a simple screening tool for prediction of these undiagnosed cases. In present study, IDRS score of ≥ 60 turned out to be the best cut point for identifying undiagnosed diabetes with 92.3% Sensitivity and 82.6% Specificity.

Authors Contribution

All authors contributed equally in concept and design of study, data collection, data analysis, drafting of manuscript, its revisions and final approval of the article

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Tables

TABLE 1 SOCIO-DEMOGRAPHIC CHARACTERISTICS OF STUDY PARTICIPANTS (N = 450)

Socio-demographic characteristics	Variables	Number	Percentage (%)
Age	<35	205	45.6
	35-49	144	32.0
	≥50	101	22.4
Gender	Male	114	25.3
	Female	336	74.7
Religion	Hindu	339	75.3
	Muslim	111	24.7
Type of Family	Nuclear	253	56.2
	Joint	166	36.9
	Three generation	31	6.9

TABLE 2 PREVALENCE OF DIABETES IN STUDY PARTICIPANTS AND ITS ASSOCIATION WITH IDRS SCORES.

DM	IDRS			Total n = 450	p value
	Low risk (IDRS Score < 30)	Moderate risk (IDRS Score 30 - <60)	High risk (IDRS Score ≥ 60)		
Yes	00 (0.0)	05 (7.7)	60 (92.3)	65 (100)	<0.05
No	57 (14.8)	261 (67.8)	67 (17.4)	385 (100)	
Total	57 (12.7)	266 (59.1)	127 (28.2)	450 (100)	

* Parentages are calculated row wise.

TABLE 3 PROPORTION OF PARTICIPANTS ACCORDING TO IDRS SCORE AND SENSITIVITY, SPECIFICITY, PPV AND NPV.

IDRS	Participants proportion n=450 (%)	Number of Diabetic n (%)	Sensitivity %	Specificity %	PPV%	NPV%
≥40	269 (59.8)	65 (24.2)	100	47	24.2	100
≥50	218 (48.4)	65 (29.9)	100	60.3	29.8	100
≥60	127 (28.3)	60 (47.2)	92.3	82.6	47.3	98.5
≥70	79 (17.6)	46 (58.2)	70.8	91.4	58.2	94.9
≥80	46 (10.2)	29 (63.0)	44.6	95.6	63.1	91.1
≥90	04 (0.09)	04 (100)	6.3	100	100	80.3

PPV= Positive Predictive value, NPV= Negative Predictive value.

TABLE 4 SENSITIVITY AND SPECIFICITY OF HIGH IDRS SCORE WITH GOLD STANDARD.

IDRS	Diabetes		Total
	Yes	No	
High Risk (≥60 IDRS)	60	67	127
Low & Moderate Risk (≤60 IDRS)	05	318	323
Total	65	385	450

Figures

FIGURE 1 DISTRIBUTION OF STUDY PARTICIPANTS ACCORDING TO IDRS SCORE AND DIABETIC STATUS.

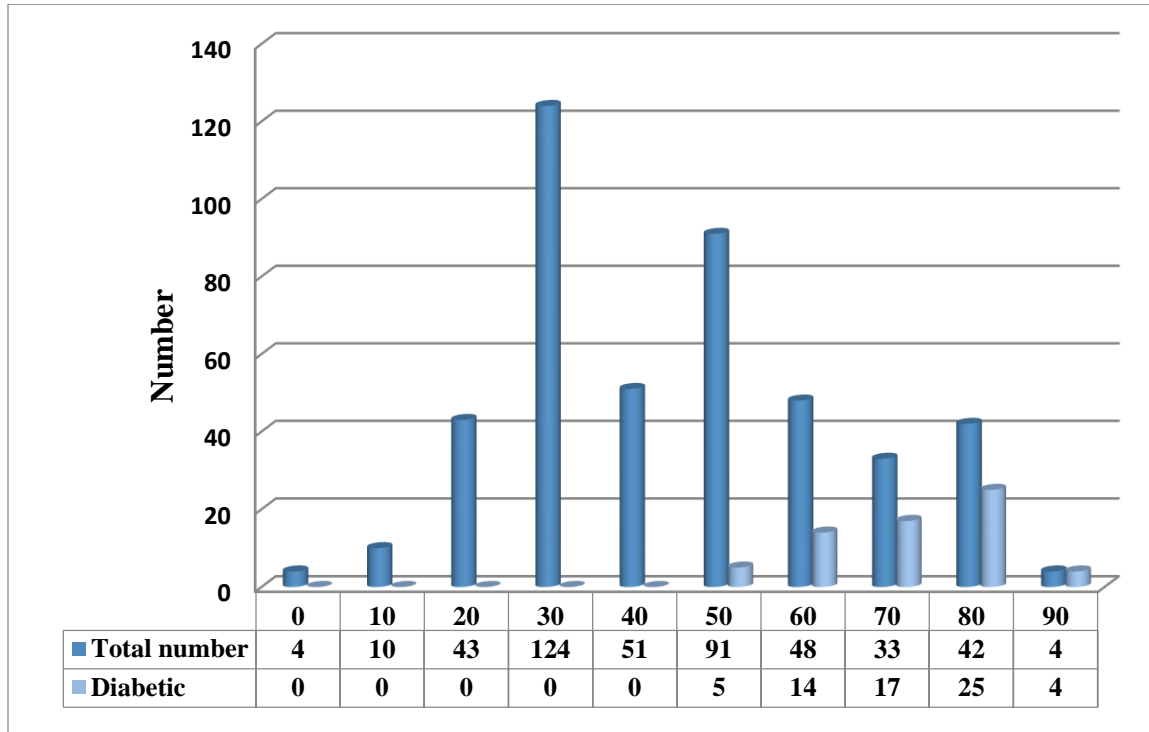
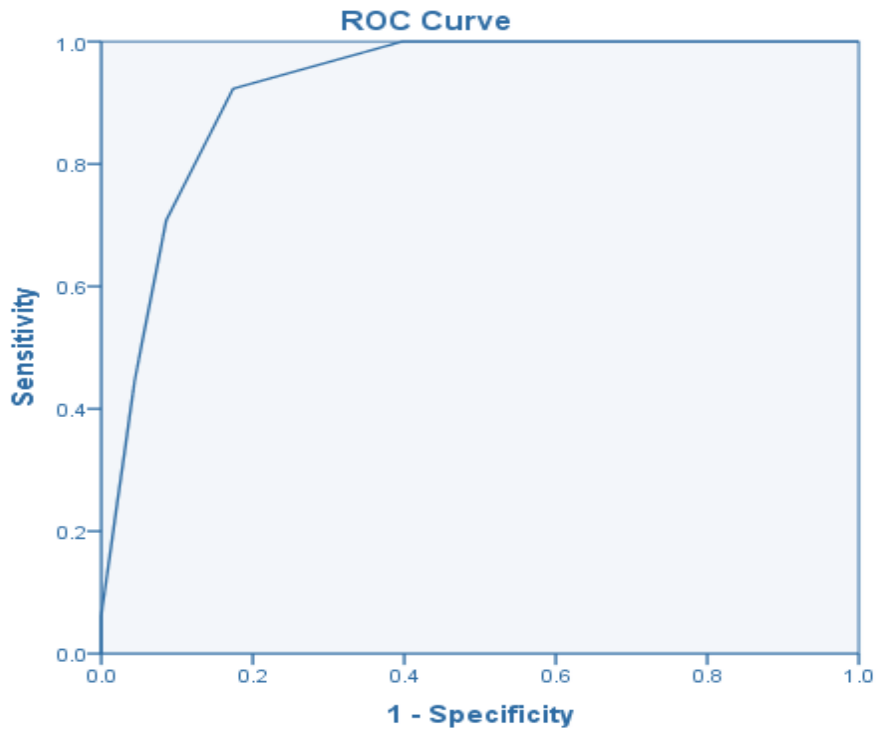


FIGURE 2 ROC CURVE BETWEEN SENSITIVITY AND 1- SPECIFICITY OF IDRS SCORE.



Diagonal segments are produced by ties.