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Original Research Article

Indian diabetic risk score as a screening tool for assessment of diabetes in urban and rural areas in Andhra Pradesh

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ABSTRACT

Background: Diabetes mellitus is a major public health problem in Andhra Pradesh and Indian diabetes risk score (IDRS) is a cost-effective tool for screening of undiagnosed diabetic individuals in the community. The objectives of this study were to assess the sensitivity and specificity of IDRS method as a screening tool in community as well as to determine the importance of stress scale in relation with diabetes.
Methods: This cross-sectional study was conducted from April 2022 to May 2022 among 18 years and above residing in select areas of Prakasam and Visakhapatnam districts. House to house survey was done for collecting data on IDRS with pretested questionnaire. Cohen's perceived stress scale was used to assess the level of stress.
Results: Out of 200 study subjects, 53.5% were males, mean age was 40.13±15 years and 23% were illiterate. The overall prevalence of diabetes was 21.0%, as per IRDS, 20.5% were in low-risk category. 44.5% and 31.5% were in moderate and high-risk category respectively. No physical exercise- 45 (71.7%), consumption of non-vegetarian food- 43 (65%), low consumption of fruits- 47 (74.6%) among high-risk category. Sensitivity of IDRS was 50.6%, specificity 71.6%, positive predictive value 33.8% and negative predictive value 86.3%. Mean perceived stress score was found to be 19.5±4.03.
Conclusions: This study estimated the usefulness of Indian diabetes risk score for identifying high risk diabetic subjects in Indian urban population so that proper intervention can be done to reduce the burden of disease. Stress may be included in the IDRS.

Keywords: Diabetes mellitus, IDRS, Perceived stress scale, Physical activity, BMI

INTRODUCTION

In India, diabetes prevalence among adults was estimated to be 11.3% and chronic diseases such as diabetes and hypertension lead to higher healthcare costs due to loss of productivity from sickness.[1-4] The prevalence of type-2 diabetes mellitus (DM) is increasing and it is a major risk factor for death and complications which contributes a large burden to the patients and their families.[5] Indian diabetic subjects may be at greater risk for these complications due to the earlier onset of their disease.[6] Unfortunately, more than half of the diabetics in India remain unaware of their diabetic status, which adds to the disease burden.[7]

It is well understood that earlier detection of population at risk and subsequent follow-up with interventional strategies can prevent type 2 DM.[8] DM risk scores is an easy, less time consuming, non-invasive, and cost-effective approach to assess an individual's risk of undiagnosed type 2 DM. Indian diabetes risk score (IDRS) was developed by Madras Diabetes Research Foundation

and Ramachandran et al which is one of the most frequently used instruments for assessing the risk of DM.[9-11]

Various risk factors like increased age, central obesity, and positive family history of diabetes, physical inactivity, stress and dietary habits for type 2 diabetes were well established. As a result, many risk prediction tools have been developed globally such as American Diabetes Association Risk Tools, and Nutrition Examination Survey risk score, and study to prevent non-insulin dependents DM risk score in developed countries.[12] Many diabetic patients can be cured at primary care level by efficiently applying routine modification after recognition of under high risk population.[13]

The IDRS has a sensitivity of 72.5% and specificity of 60.1% and is derived based on the largest population-based study on diabetes in India CURES.[3,14] The advantage of IDRS is its simplicity, low cost and is easily applicable for mass screening programmes. Prospective follow up studies on non-diabetic subjects with high-risk score are needed to assess the predictive nature of IDRS. National family health survey (NFHS 4) indicated that common age group of 15-49 years are affected the most with the prevalence of 8% among men and 6% among women having blood sugar levels >140 mg/dl.[15]

Stress is a nonspecific bodily response to any demand made upon it.[16] The detrimental effects conveyed both directly through neuroendocrine and autonomic responses and indirectly through untoward changes in health behaviors. Cohen perceived stress scale- 10 (PSS-10) was used to capture the perceived stress levels among diabetic patients. PSS-10 is one of the more popular tools for measuring psychological stress. It is a self-reported questionnaire that was designed to measure 'the degree to which individuals appraise situations in their lives as stressful'.[17] There is a paucity of literature from rural India regarding the stress levels existing among the diabetic patients and also factors associated with such stress.

We performed this study to evaluate the performance of Indian diabetic risk score for screening of undiagnosed type 2 DM to estimate the proportion of participants at high risk for developing type 2 diabetes, to determine the association of participants at high risk for developing diabetes with various risk factors, i.e.; age, waist circumference, family history of diabetes, physical activity and socio-demographic variables and to explore whether there are associations between perceived stress type 2 diabetes.

METHODS

A community-based cross-sectional study was conducted in the 20 years and above age group residing in Ongole and Visakhapatnam towns of Andhra Pradesh State from April 2022 to May 2022. The study participants consisted both males and females residing in urban of both the cities. Severely ill patients, pregnant women, and those who were not willing to give consent were excluded from the study, along with non-diabetics pre-diabetics and diabetics with already tested and diagnosed were included in the study.

House to house survey was conducted and face to face interview was done by using predesigned questionnaire (schedule), which was based on IDRS variables. For an estimated prevalence of population at high risk of developing DM (P) at 14% with maximum acceptable difference of 5% and with 95% confidence level, the sample size 201 was calculated using the formulae after taking 10% non-response rate.[18]

$$\frac{4pq}{L^2}$$

Purposive sampling method with simple random technique was used for inclusion of participants in the study. All eligible individuals in the visited house were included in the study. As per the previous studies, Indian diabetic risk score >60 as found to be highly sensitive and specific for predicting diabetes hence we have used scores more than 60 as a cut-off for diabetes. Permission was obtained from institutional authorities and the study was approved by the Institutional Ethics Committee. The questionnaire used in the study had six sections. The first section had questions related to socio-demographic details, clinical history and family history, second section consists of personal history and risk factors like smoking, alcoholism, consumption of junk foods, sweets and fatty foods and also intake of fruits and vegetables. Third section had questions related to physical activity, duration and number of days of exercise and also Anthropometric Measurements like weight, height, BMI and waist circumference The height was recorded in centimeters using non-stretchable measuring tape with least count of 0.1 cm and weight was measured in Kilogram. BMI was calculated based on the formula-weight in kilograms/square of height in meters. Asian cut-off for BMI was used to classify it into three categories: <18.5 (underweight), 18.5-22.9 (normal), 23-24.9 (overweight), and ≥25 (obese).

Fourth section was about vitals like PR, RR and blood pressure. BP was measured using automatic BP monitor. Important aspects of general examination and clinical examination were also included. If study participants under gone for any type investigations related to blood sugar levels, they were included in the study. Fifth section had IDRS scale which had questions regarding physical activity, family history of diabetes, and waist circumference. Subjects were categorized as low (<30), moderate risk (30-50), and high risk (≥60) based on IDRS. Sixth section had questions related to perceived stress scale as a measure of risk in diabetes. Cohen's perceived stress scale each item is rated on 5-point scale ranging from never (0) to almost always (4) for negatively worded- 0-4: never; 1=3: almost never; 2=2: sometimes 3=1: fairly often 4=0: the rating was summed with high score indicating more

perceived stress. Total of 10 items and the maximum score was 40. Score of 20 or higher were considered high stress.

Statistical analysis

Data were entered into Microsoft excel spreadsheet and checked for errors and after cleaning was subsequently analyzed using SPSS 20.0 software for identifying associated factors, bivariate analysis was done using Chi-square test with level of significance taken as $p<0.05$. Socio-demographic characteristics were tabulated as descriptive statistics, explained by frequency and percentages. Various diagnostic parameters like sensitivity, specificity, PPV, NPV assessed.

RESULTS

Out of total 200 study participants 107 (53.5%) were males and 170 (85%) belong to nuclear families. It was observed that 143 (71.5%) were married, 50% belong to urban population and 23% were illiterate and 88 (44%) studied degree and professional courses. The mean age was 40.13±15 years and 37 (18.5%) belong lower socio-economic status (Table 1). It was found that 11.5% were found to be below 20 years age, 61 (30.5%) were between 21 to 35 years age group and 74 (37%) were among 36 to 50 years age. It was observed that out of total 200, 145 (72.5%) consuming high salt and pickle foods, 113 (56.5%) were taking junk foods and 103 (51.5%) were taking oily foods. Frequency of consumption of non-vegetarian foods 133 (66.5%) and milky foods 156 (78%) was higher in this study participants. Approximately 66.5% of the population were non-vegetarians and. 20.5% of the population had <6 hours of sleep per day (Table 2). The following pie chart shows that 120 (60%) of the participants did not exercise every day, while 13 (6%) exercised <30 min/day and 67 (34%) exercise for more than 30 min/day (Figure 1). The mean BMI (kg/m^2) was found to be 24.7±0.4, it was observed that as per Asian classification of obesity 18 (9%) had BMI<18.5 and 59 (29.5%) had BMI between 18.5 to 22.9 and 32 (16%) had BMI between 23 to 24.9 and 91 (45.5%) had BMI of 25 and above. Upon taking waist circumference 12 (6%) males had waist circumference >100 cm and 66 (33%) females had >90 cm (Table 3). The IDRS scores were used to categorize the participants into low risk 41(20.5%) moderate risk 91 (45.4%) and high risk 68 (34%) for developing diabetes (Figure 2). It was found that 80 (40%) were below 35 years age 62 (31%) were between 35 to 49 and 58 (29%) were above 50 years of age. 18 (9%) of the participants were involved in strenuous physical activity and 111 (55.5%) had moderate physical activity while 71 (35.5%) had sedentary lifestyle. Waist ≥90 cm (F) and ≥100 cm (M) noticed in 84 (42%) of participants and waist <80 cm (F), <90 cm (M) identified in 49 (24.5%) (Table 4). Mean perceived stress score was found to be 19.5±4.03. It was observed that 129 (65%) participants scored between 11 to 20 points, 62 (31%) scored between 11 to 20 points only 3 (2%) scored above 30 points. Sharing of ideas 31 (45%) and meditation 18 (26%) were found to be stress busters among high-risk groups, whereas among moderate and low risk groups these were found to 90 (68%) and 31 (35%) respectively. There was significant association found between gender, BMI (obese and overweight, non-vegetarian, fruit consumption and risk of diabetes ($p<0.05$). Association between stress, sleep and risk of diabetes found to be insignificant ($p>0.05$) (Table 5). Sensitivity of IDRS was 50.6%, specificity 71.6%, positive predictive value 33.8% and negative predictive value 86.3% (Table 6).

Table 1: Socio-demographic details.

Variables	Number (n=100)	Frequency
Gender		
Male	107	53.5
Female	93	46.5
Family type		
Joint	30	15
Nuclear	170	85
Religion		
Hindu	161	80.5
Christian	33	16.5
Muslims	6	3
Marital status		
Married	143	71.5
Unmarried	46	23
Divorced	11	5.5
Place		
Urban	100	50
Rural	100	50
Education		
Illiterate	46	23
Primary	12	6

Continued.

Variables	Number (n=100)	Frequency
Secondary	42	21
Inter	12	6
Degree and above	88	44
Socio-economic status		
Class-I	37	18.5
Class-II	31	15.5
Class-III	65	32.5
Class-IV	35	17.5
Class-V	32	16
Age (years)		
<20	23	11.5
21-35	61	30.5
36-50	74	37
>50	42	21

Table 2: Risk factors of diabetes mellitus.

Risk factors	Yes (n=200)	%
Smoking	32	16
Alcoholics	23	11.5
Eating of pickles/high salt food	145	72.5
High frequency of junk foods (yes)	113	56.5
High frequency of oily foods outside (>3/week)	103	51.5
High frequency of non-vegetarian food (>2/week)	133	66.5
High frequency of milk foods/ice-creams/butter/ghee/cheese	156	78
Duration of sleep<6 hours per day	41	20.5
High consumption of sweet foods (>3 times/week)	115	57.5

Table 3: Status of BMI and waist circumference.

Variables	Yes (n=200)	%
BMI		
<18.5	18	9
18.5 to 22.9	59	29.5
23 to 24.9	32	16
25 and above	91	45.5
Waist circumference (cm)		
Males>100	12	6
Females>90	66	33

Table 4: Diabetic score and risk assessment.

Variables	Score	N	%
Age (years)			
<35	0	80	40
35-49	20	62	31
50 and above	30	58	29
Waist circumference (cm)			
Waist <80 cm (F), <90 cm (M)	0	49	24.5
Waist≥80 cm to 89 cm (F), and ≥90 cm to 99 cm (M)	10	67	33.5
Waist ≥90 cm (F) and ≥100 cm (M)	20	84	42
Physical activity			
Regular exercise+strenuous work	10	18	9
Regular exercise or strenuous work	20	111	55.5
No exercise or sedentary work	30	71	35.5
Family history			
No parent suffered with diabetes	0	110	55

Continued.

Variables	Score	N	%
Single parent	10	61	30.5
Both parents	20	29	14.5

Table 5: Factor influencing the diabetic risk status.

Risk factors	High risk (n=68)	Moderate+low risk (n=132)
Gender		
Male	21	69
Female	47	63
BMI	Chi-square value: 8.3 p<0.05 significant	
Obese+over weight	54	75
Normal	14	57
Type of food consumption	Chi-square value: 6.64 p<0.05 significant	
Non-vegetarian	43	46
Vegetarian	25	86
Fruits consumption	Chi-square value: 14.6 p<0.05 significant	
Yes	13	99
No	55	33
Stress	Chi-square value: 56.8 p<0.05 significant	
Yes	22	44
No	46	88
Sleep	Chi-square value: 0.019 p>0.05 non-significant	
Yes	56	103
No	12	29
	Chi-square value: 0.514 p>0.05 non-significant	

Table 6: Sensitivity and specificity of IDRS.

Risk	Diabetic	Pre-diabetic+no diabetic	Total
High	23	45	68
Moderate + low risk	18	114	132
	41 (20.5%)	159 (79.5%)	200
Sensitivity=56.09%, specificity=71.6%, PPV=33.8%, NPV=86.3%			

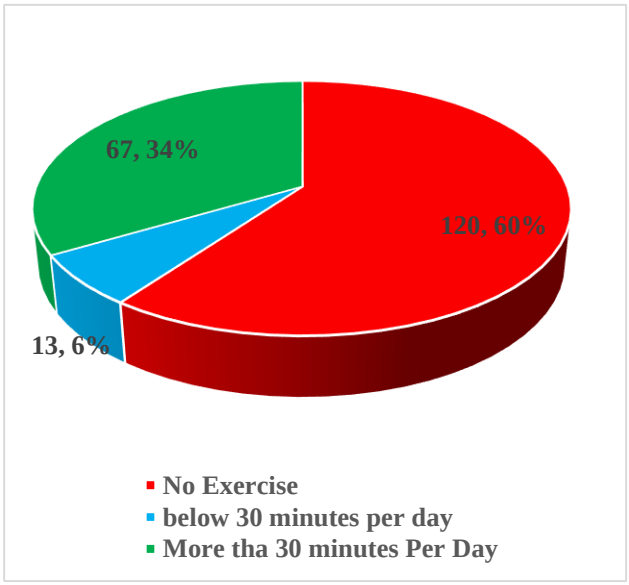

Figure 1: Status of exercise among study participants.

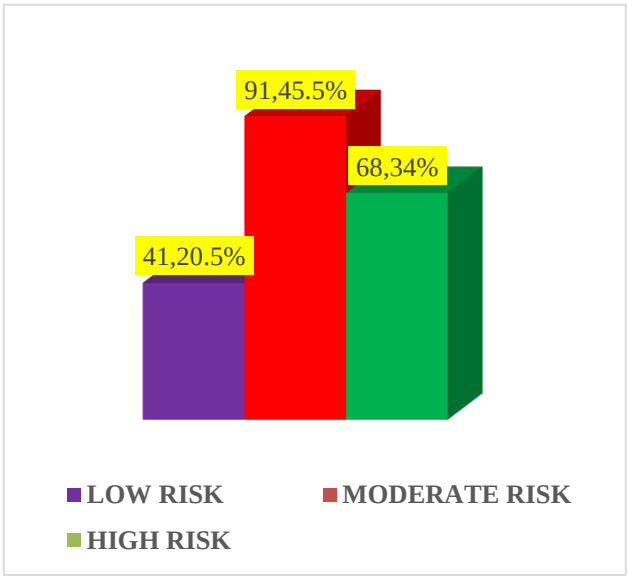

Figure 2: IDRS score and classification.

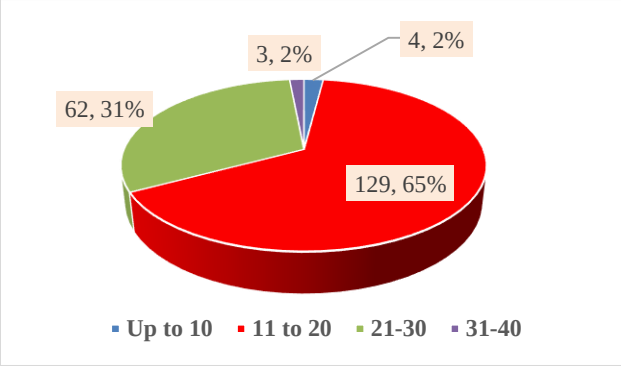

Figure 3: Mean perceived stress scale among participants.

DISCUSSION

In our study majority of the participants were 74 (37%) were among 36 to 50 years age, and 42 (21%) observed to be above 50 years age and 11.5% were found to be below 20 years age. Acharya et al found that 75% the study subjects belonged to 30-49 age group. The overall mean age was 43.38±11.26 years with range 30-75 years in their study.[20] The mean age is 40.13±15 years was found in our study. Sarkar et al in their study found mean age of 33.1±8.15 years and majority 64% belonging to less than 35 years which was similar to our study.[21] The prevalence of diabetes in our study was found to be 21.0%, ICMR (2004) a meta-analysis study from 1990-2002 reported a comparatively lower (6.25%) prevalence of diabetes in adults.[22]

In our study as per IDRS score high risk was found in 68 (34%) for developing diabetes whereas high-risk category percentage was lower in the studies done by Arun et al (14.9%), Panda et al (17.9%), Khandhedia et al (22.8%), and Brahmbhatt et al, revealed similar findings like our study (34%), but it was higher in the study done by Mani et al (59%).[23-27] In our study as per IDRS score moderate risk were 91 (45.4%). Higher percentage of population in moderate risk category was found in the study done by Sowmiya et al (50.9%), Shobha et al (56%), Arun et al (67.7%), and Khandhedia et al (66.8%).[23,25,28,29] Compared to the present study, proportion of low-risk population was also reported higher by Sowmiya et al (24.5%), Nagalingam et al (18%)). while Gupta et al found 50.3% of participants at moderate risk and 18.5% at low risk for diabetes.[28,30]

Majority 110 (55%) of the population in our study had a negative family history. This was similar to the findings by Khan et al in his study majority had no family history of diabetes this was also in line with study by Acharya et al where 88.87% of the participants had negative family history.[20,31] In our study majority 85.5% of population were sedentary workers, 55.5% were moderate workers while in the study conducted by Acharya et al the sedentary workers were 15.79% and moderate workers were 82.39%. In another study by Singh et al majority (62.9%) were moderate workers and 31.2% were sedentary workers.[28,32] Physical activity reduces body fat, increases muscle mass, helps in reducing the risk of obesity. ICMR-INDIAB study reported that 83.2% women were physically inactive in Chandigarh, 55.3% in Jharkhand, 68.5% in Maharashtra and 77.4% in Tamil Nadu.[33] Waist circumference is an indicator of abdominal obesity and abdominal obesity is one of the risk factors for diabetes. Waist ≥90 cm (F) and ≥100 cm (M) was noticed in 84 (42%) of participants and waist <80 cm (F), <90 cm (M) was identified in 49 (24.5%). Similarly, a study by Brinda et al reported abdominal obesity in 53.5% subjects. Frequency of consumption of non-vegetarian foods 133 (66.5%) and milky foods 156 (78%) was higher in this study participants. In our study the females were found to have higher IDRS score than males. This finding is synonymous to study by Dugg et al, Arora et al and Patil et al.[36-38] Our study shows an association of BMI with diabetes 79.41% of the high risk and 56.81% of moderate and low risk categories were obese and overweight. This is in accordance with studies conducted by Dugg et al, Shoba et al and Gupta et al who showed similar association.[28,29,36] BMI is one of the important factors affecting the IDRS. Our finding is consistent with other studies showing that people with higher BMI are more likely to have diabetes in future.[28] There was significant association found between gender, BMI (obese and overweight, non-vegetarian, fruit consumption and risk of diabetes ($p<0.05$)

In the study the sensitivity and specificity were found to be 50.6% and 71.6% respectively. Similar values were found in study conducted by Chaturvedi et al sensitivity 65.79% and specificity 73.91% and Adhikari et al sensitivity 62.2% and specificity 73.7%.[39,40] The IDRS has a sensitivity of 72.5% and specificity of 60.1% according to CURES by Mohan et al.[41] As per Dudeja et al study, the IDRS has a sensitivity of 72.5% and specificity of 60.1% and is derived based on the largest population-based study on diabetes in India CURES.[42] This risk score has moderate sensitivity of 75.4% and specificity of 70% in detecting undiagnosed DM.[43]

Psychological stress is involved in the progression of multiple diseases. Severe types of psychological stress affect both the nervous and peripheral systems.[44] Stress is believed to be closely related to diabetes because both have common risk factors such as inadequate eating behaviors and sedentary lifestyle.[45]

Mean perceived stress score was found to be 19.5±4.03 found in our study it was observed that 129 (65%) scored between 11 to 20 points, 62 (31%) scored between 11 to 20 points only 3 (2%) scored above 30 points. Sharing of ideas 31(45%) and Meditation 18 (26%) were found to be stress busters among high-risk groups.

Limitations

Survey was conducted in few slum areas, and sample was small, more frequent studies on different groups of

population will yield better result. Since it was cross-sectional study, analysis does not permit observation of trend of diabetes risk among the subjects.

CONCLUSION

In conclusion the IDRS can be used as a simple and effective tool for the early screening and easy to access even in remote areas. This study also highlights that life style and eating habits of a person can influence the risk of developing diabetes to a greater extent as we can find in the study that participants with high BMI values and sedentary lifestyle were associated with high risk for developing diabetes while people consuming healthy food like fruits and more vegetables were likely to have less risk for developing diabetes. Therefore, by early assessment of risk using IDRS and making simple lifestyle modifications reduces the economic burden. Although there was no significant association between stress and high risk for diabetes but it was clearly observed that majority of people with high stress fell under moderate and low risk, who are more prone to develop diabetes in future. There is a need to include stress as one of the factor under IDRS and further studies will be planned in this area.

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