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SOCIO-DEMOGRAPHIC AND LIFESTYLE DETERMINANTS OF DIABETES RISK: INSIGHTS FROM A CROSS-SECTIONAL STUDY IN ASSAM, INDIA

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Abstract

Background: Type 2 diabetes mellitus (T2DM) is currently a significant public health problem worldwide and is a condition that should be diagnosed early to achieve adequate management. The Indian Diabetes Risk Score (IDRS) helps to decide the risk of type 2 diabetes based on socio-demographic and lifestyle factors. The study was conducted in adult residents of the Dibrugarh district of Assam. The study aims to assess the efficacy of the Indian Diabetes Risk Score (IDRS) in estimating the risk of developing Type 2 diabetes mellitus (T2DM) among adults in Dibrugarh district, Assam. **Materials and Methods:** 200 adults from 12 municipal wards were interviewed, seeking information about age, family history, waist circumference, and physical activity. IDRS was used for categorizing individuals in different risk categories; the association of various categories with other risk factors was analysed by descriptive statistics and ROC curve analysis. **Result:** The mean age was 37.2 years, and the mean abdominal obesity was 84.6 cm. The risk distribution was 70% low risk, 21.5% moderate risk, and 8.5% high-risk individuals. The ROC analysis resulted in an AUC of 0.86; it indicated that IDRS had high discriminatory power at higher thresholds. **Conclusion:** The present study validates the effectiveness of the IDRS in stratifying risk for T2DM and the potential of the IDRS tool for community health programs. As a screening tool, IDRS is highly predictive and promising in detecting diabetes at early stages and preventing diabetes by other health-related strategies.

INTRODUCTION

Diabetes mellitus is characterized as one of the vast health crises of the 21st century, considerably affecting the adult population with its chronic complications and rising incidence worldwide. The International Diabetes Federation estimates that, in 2019, some 463 million adults were living with diabetes, projected to rise to 578 million by 2030 and 700 million by 2045.[1] This steep rise has been driven by various reasons, including ageing populations, urbanization, and lifestyle changes leading to lower physical activities and more obesity.[2]

The diabetes burden is very high in India, making it the country's sixth-leading cause of death. It is the second-largest country in the world for adults with diabetes, with a population of more than 77 million.[3] Strikingly, a large number of people with diabetes do not have a diagnosis, which is of prime public health concern because, without a diagnosis, complications associated with diabetes increase significantly.[4]

The Indian Diabetes Risk Score was designed as a tool for early detection and management. It is a cost-effective way of identifying diabetes risk using easily obtainable parameters that include age, family history of diabetes, waist circumference, and physical activity. IDRS is a simple, inexpensive instrument widely used in community settings to promote early diagnostic interventions and prevention.[5]

Despite the recognized benefits of early diabetes diagnosis and management, Assam, a highly diverse northeastern state with varying health disparities, lacks comprehensive community-based studies using IDRS. An earlier study revealed that lifestyle differences exist in dietary patterns and physical activity in the region compared to other parts of India.[6]

The community urgently needs proper screening tools that are simple to implement due to the massive burden of undiagnosed diabetes and associated complications. The study aims to evaluate the effectiveness of IDRS in detecting undiagnosed diabetes among the adult urban population of the Dibrugarh district, Assam. This creates an opportunity for research to provide valuable insights into what might be a regionally adaptable and effective IDRS in various Indian contexts.

The study would also explain the critical information for the targeted development of interventions that will focus on the association between socio-demographic factors and the diabetes risk score. Such an intervention might significantly reduce certain risk factors found in the selected communities, thus reducing the overall incidence and burden of diabetes.[7]

Research justification and objectives

The study's justification stems from a gap in effective diabetes screening and management in Assam. The demographic has not received adequate study on the use of IDRS, and the unique socio-cultural and lifestyle characteristics of the Assam population may render the currently available evidence from other Indian regions inapplicable.

The objectives of the study are:

1. To estimate the risk factors of Type 2 diabetes mellitus among the urban adult population in Dibrugarh District using the IDRS.
2. To investigate the association between socio-demographic factors and diabetes risk scores among the adult population, providing a basis for tailored preventive strategies.

By focussing on objectives, the current study will confirm whether IDRS is a practical, scalable, feasible, and easily implementable screening tool that could help in the early detection and management of diabetes in a population of diverse ethnicities. Eventually, such a study may lead to more focused and effective public health interventions, which will reduce the burden of diabetes in Assam and other similar settings worldwide.

MATERIALS AND METHODS

The community-based cross-sectional study was conducted from February to October 2023. The study aimed to assess the risk for Type 2 diabetes mellitus in the adult urban population residing in the Dibrugarh district, Assam, using the Indian Diabetes Risk Score (IDRS). The study subjects were all adults over 18 years and older in 12 out of 24 municipal wards from a simple random sampling of the Dibrugarh District. The study included two hundred participants to achieve statistical significance due to a non-response rate of about 10%.

The random sampling using stratified random sampling, which included representation from strata with diverse demographics and risk profiles was employed for the study. Data collection was done from house to house. The household selection was done through a lottery method and then selected subsequent households sequentially. The direct interviews were conducted using a pre-designed semi-structured interview schedule, which included questions on socio-demographic profiles, family history of diabetes, lifestyle, and anthropometric measurements. The anthropometric data, such as stature, weight, and waist circumference, was measured following World Health Organization guidelines8.

The Indian Diabetes Risk Score (IDRS), developed by Mohan et al., is designed to evaluate the risk of developing diabetes5. This assessment tool calculates a score from 0 to 100 based on several factors: age, family history of diabetes, waist circumference, and levels of physical activity, which can range from none, mild, moderate, to vigorous exercise.[6] None indicates no physical activity, mild includes activities like walking or light household chores, moderate encompasses brisk walking or recreational swimming, and vigorous includes running, aerobics, or competitive sports9. A score of 60 or above is classified as high risk for developing diabetes, scores between 30 and 60 indicate moderate risk, and scores below 30 are considered low risk (Figure 1).

Categorized risk factors	Score
Age (in years)	
<35	0
35–49	20
≥50	30
Abdominal obesity	
Waist circumference female <80 cm, Male <90 cm (Reference)	0
Female 80–89 cm, Male 90–99 cm	10
Female ≥90 cm, Male≥100 cm	20
Physical activity	
Vigorous exercise or strenuous at work	0
Moderate exercise at work/home	10
Mild exercise at work/home	20
No exercise and sedentary at work/home	30
Family history	
Two non-diabetic parents	0
Either parent diabetic	10
Both parents' diabetic	20
Total	100

Figure 1: Indian Diabetes Risk Score (IDRS) distribution. Ashturkar et al., (2019).[10]

The Institutional Ethical Committee of Assam Medical College & Hospital, Dibrugarh, Assam, has approved the study protocol. We collected an informed consent form from all participants before data collection to uphold ethical standards, respect for participant confidentiality, and autonomy.

The data was entered into Microsoft Excel, coded it, and, when necessary, cleaned and edited it for analysis. Descriptive statistics (mean, standard deviation) provided summaries of the data. We tested relationships between diabetes risk scores and

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demographic and lifestyle factors using Chi-square tests for categorical variables and t-tests for continuous variables. Statistical Analyses were set to a significance level of p<0.05. We computed the sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV) of IDRS to assess its effectiveness in the screening tool. IBM SPSS Statistics Version 25.0 (IBM Corp., Armonk, NY, USA) was used for data analysis.[11] The diagnosis and criteria for diabetes and prediabetes followed standard diagnostic criteria based on fasting blood sugar measured by the glucometer (Accu-Chek Active, Roche Diagnostics, Germany). The diagnosis followed the World Health Organization's definition of diabetes, fasting blood sugar ≥ 126 mg/dL; impaired fasting glucose, 110 to 125 mg/dL.[12]

RESULTS

In the study of 200 subjects, the mean age of subjects was 37.2 years with a standard deviation of 14.8 years, and the measurement for abdominal obesity was 84.6 cm with a standard deviation of 10.5 cm. For physical measurements, the average height was 165.4 cm. Individuals varied in height from 145 cm to 190 cm. In general, the sample for the measurement showed a mean weight measurement of 70.3 kg within a range of 45 kg to 110 kg. The blood pressure measurements reflect the following: the mean systolic is 120.5 mmHg; the standard deviation is 15.8 mmHg; and the range is 90 mmHg to 160 mmHg. The average pulse rate was 72.1 beats per minute, with variability ranging from 55 to 95 beats per minute.

In the study, 51.0% are males while 49.0% are females (Table 2). Further, 64.0% reported having no family history of diabetes, 25.0% having one parent diagnosed with diabetes, and only 11% having both parents diagnosed with diabetes. The categorical data about physical activity, smoking, alcohol consumption, marital status, and dietary habits have been presented to provide the big picture. It could be seen that in physical activities, a significant proportion of the studied cohort was involved as 18.0% in vigorous, 28.0% in moderate, and 37.0% in mild activities, whereas 17.0% reported not to be engaged in any physical activity. Given the smoking habits, 21.0% were smokers, and the rest of them were non-smokers. Alcohol consumption was reported only among 24.0% of the participants, whereas 76.0% did not consume alcohol. As regards marital status, 46.0% were single, and the rest of them, 54.0%, were married. On dietary preferences, 31.0% of the subjects were vegetarians; the rest, 69.0%, were non-vegetarians.

The mean age is significantly higher in the diabetes group, with 35.00 ± 13.39 years compared to 26.73 ± 7.88 years and 26.16 ± 6.16 years in the normal and prediabetes groups, respectively (P = 0.001). Similarly, waist circumference was more significant in the diabetes group than in the normal (86.94 ± 15.29 cm) and prediabetes groups (71.23 ± 7.50 cm); however, it showed a significant difference (P = 0.001).

It can be observed that height does not differ across the groups, with means of 151.81 ± 7.61 cm, 151.14 ± 8.44 cm, and 154.32 ± 10.37 cm for the normal, prediabetes, and diabetes groups, respectively (P-value = 0.382). Weight slightly varies among the groups but is not significant, with means of 56.92 ± 9.33 kg for the normal group, 55.09 ± 8.92 kg for the prediabetes group, and 59.23 ± 5.54 kg for the diabetes group (P-value = 0.248).

Pulse rates are roughly similar across the board to show no marked difference: 79.61 ± 11.73 for the normal, 81.81 ± 10.82 for prediabetes, and 79.94 ± 11.32 for the diabetes group (P-value = 0.548). The groups' fasting blood sugar (FBS) levels are very different. The diabetes group had the highest levels (151.65 ± 15.34 mg/dL), followed by the prediabetes group (110.67 ± 7.59 mg/dL), and finally the normal group (89.44 ± 6.11 mg/dL), as shown by the P-value. The difference in the level of physical activity between the groups is also statistically significant (P-value = 0.001). The sample in the normal group contains 39 mild, 42 moderate, 16 no activities, and 43 vigorous activities. In terms of prediabetes, there are two moderate activities, 39 no activities, and two vigorous activities. Diabetes group contains two mild activities, 14 no activities, and one vigorous activity. Family history of diabetes also shows huge differences (P-value = 0.001). The normal group consists of 128 patients with no family history, 1 reporting one parent, and 11 reporting both parents having diabetes. In the pre-diabetes group, there are 4 with no family history, none with one parent, and 13 with both parents having diabetes. In the diabetes group, there are 14 people with no family history, 12 with one parent, and 17 with both parents having diabetes.

The results display sensitivities, specificities, positive predictive values (PPV), and negative predictive values (NPV) for different IDRS score thresholds. For an IDRS score threshold more significant than 20, sensitivity is 0.88, specificity is 0.89, PPV is 0.77, and NPV is 0.95. Increasing the threshold to >30 would result in a drop in sensitivity to 0.70, a slight increase in specificity to 0.91, a PPV of 0.78, and an NPV of 0.88.

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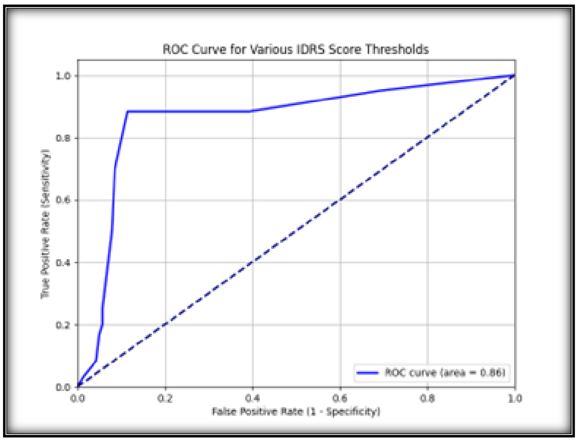

Figure 2: ROC Curve for Various IDRS Score Thresholds

Raising the threshold to >40, sensitivity and specificity are 0.50 and 0.92, respectively; the corresponding PPV and NPV values are 0.73 and 0.81, respectively. The sensitivity markedly decreases to 0.25 with thresholds above 50, while the specificity improves to 0.94: PPV is 0.65 and NPV is 0.75. For thresholds above 60 and 70, the sensitivity decreases to 0.20 and 0.17, whereas the specificity remains high at 0.94 and 0.95. The PPV and NPV values for these cut-offs are 0.60 and 0.73 for >60 and 0.59 and 0.73 for >70, respectively.

Using a cut-off >80 further reduces the sensitivity to 0.08, while increasing the specificity to 0.96; however, the cut-off does not lead to any improvement. Only with a threshold of more than 90 does sensitivity begin to drop, as specificity peaks at 0.99, the maximum value, with PPV and NPV at 0.50 and 0.70, respectively. Thus, these results indicate a trade-off between sensitivity and specificity as the IDRS score threshold increases.

The ROC curve illustrates the performance of different IDRS score thresholds in discriminating between normal and abnormal conditions. The area under the curve (AUC) is 0.86, indicating good discriminatory power of the IDRS thresholds.

The AUC scores for various IDRS thresholds, ranging from 20 to 90 in intervals of 10, are provided in Table 5. The AUC scores measure the ability of the IDRS thresholds to discriminate between normal and abnormal conditions. For example, an IDRS threshold of 30 yields an AUC score of 0.89, indicating good discriminatory power, while a threshold of 90 results in an AUC score of 0.96, reflecting even better discrimination.

Table 1: Summary Statistics of Health Parameters in the Study Population

Variable	Mean	Std Dev	Min	25%	50%	75%	Max
Age	37.2	14.8	18	24.0	36.0	49.0	80
Abdominal Obesity	84.6	10.5	60	76.0	85.0	93.0	120
IDRS	40.2	22.6	0	20.0	40.0	60.0	90
Height (cm)	165.4	10.2	145	157.0	165.0	173.0	190
Weight (kg)	70.3	15.4	45	57.0	70.0	83.0	110
Blood Pressure (BP)	120.5	15.8	90	110.0	120.0	130.0	160
Pulse	72.1	10.3	55	65.0	72.0	80.0	95

Table 2: Frequency and Percentage Distribution of Health and Demographic Indicators

Variable	Category	Frequency	Percentage
Existing Condition	Normal	140	70.0%
	Prediabetes	43	21.5%
	Diabetes	17	8.5%
Test Detection	Normal	142	71.0%
	Prediabetes	39	19.5%
	Diabetes	19	9.5%
Sex	Male	102	51.0%
	Female	98	49.0%
Family History	No	128	64.0%
	One parent	50	25.0%
	Both parents	22	11.0%
Physical Activity	Vigorous	36	18.0%
	Moderate	56	28.0%
	Mild	74	37.0%
	None	34	17.0%
Smoking	Yes	42	21.0%
	No	158	79.0%
Alcohol	Yes	48	24.0%
	No	152	76.0%
Marital Status	Single	92	46.0%
	Married	108	54.0%
Vegetarian	Yes	62	31.0%
	No	138	69.0%

Table 3: Comparison of Anthropometric and Clinical Variables Across Normal, Prediabetes, and Diabetes Sub-Groups

Variable	Normal (mean ± sd)	Prediabetes (mean ± sd)	Diabetes (mean ± sd)	P-Value
Age	26.73 ± 7.88	26.16 ± 6.16	35.00 ± 13.39	0.001
Waist Circumference (cm)	71.10 ± 9.78	71.23 ± 7.50	86.94 ± 15.29	0.001

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Height (cm)		151.81 ± 7.61	151.14 ± 8.44	154.32 ± 10.37	0.382
Weight (Kg)		56.92 ± 9.33	55.09 ± 8.92	59.23 ± 5.54	0.248
Pulse		79.61 ± 11.73	81.81 ± 10.82	79.94 ± 11.32	0.548
FBS		89.44 ± 6.11	110.67 ± 7.59	151.65 ± 15.34	0.001
Physical Activity	Mild	39	0	0	0.001
	Moderate	42	2	2	
	None	16	39	14	
	Vigorous	43	2	1	
Family History	None	128	4	14	0.001
	One Parent	1	0	12	
	Both Parents	11	13	17	

Table 4: Performance Metrics of Indian Diabetes Risk Score (IDRS) at Various Threshold Levels

IDRS Score Threshold	Sensitivity	Specificity	PPV	NPV
>20	0.88	0.89	0.77	0.95
>30	0.70	0.91	0.78	0.88
>40	0.50	0.92	0.73	0.81
>50	0.25	0.94	0.65	0.75
>60	0.20	0.94	0.60	0.73
>70	0.17	0.95	0.59	0.73
>80	0.08	0.96	0.45	0.71
>90	0.03	0.99	0.50	0.70

Table 5: AUC Scores Across Different IDRS Thresholds

IDRS Score Threshold	AUC Score
20	0.87
30	0.89
40	0.91
50	0.92
60	0.93
70	0.94
80	0.95
90	0.96

DISCUSSION

The results concerning the Indian Diabetes Risk Score (IDRS) of the study are consistent with the results of the other regional studies conducted in India, though showing slight differences since demography and lifestyle differ. Similar to the analysis performed by Nagalingam et al., the research confirms that IDRS helps determine diabetes risk in the urban environment with significant influence by lifestyle factors that determine the prevalence of the disease.[13] Both studies underline the utility of IDRS in the early detection of diabetes, which is essential for timely intervention to prevent or delay the onset of diabetes.

Abdominal obesity and increasing age are also significant predictors of diabetes, as identified here. The study calculated a mean abdominal circumference of 84.6 cm, while Gupta et al. reported 85.0 cm. [14] This trend is indicative of the consistency of risk factors in different urban settings. The study findings on IDRS scores are also supported by Arun et al., who state that IDRS's performance as a predictor is good across the varied settings, from hospital visitors to Lucknow at the community level in general, showing IDRS's flexibility.[15]

The study results are marginally lower than the CUPS-19 study by Mohan et al., where the Sensitivities and specificities for diabetes and pre-diabetes in a South Indian urban population were reported to be 72.5% and 60.1%, respectively, reflecting dietary habits and activity levels typical of different urban populations.[16] The study also differed from the study of Mani et al., who reported the sensitivity and specificity as 85.7% and 43%.[17]

Adhikari et al. and Patel et al. research in varied South Indian populations, police personnel, etc., validated the high sensitivity and specificity of the IDRS in varied strata of an urban population and its use as a widespread screening tool.[18,19] The efficacy of the score was well demonstrated in different environmental and socio-economic conditions in studies by Dudeja et al. and Taksande et al. of testing out IDRS in urban slums and rural areas.[20,21]

Studies by Bhadoria et al. and Kaushal et al. on central and northern India, respectively, similarly stress the requirement for regional modifications to strengthen the accuracy of IDRS in screening. [22,23] It was conducted in an urban area where the prevalence of diabetes is 8.5%.

Although comprehensive, the study has some drawbacks due to its cross-sectional nature and the moderate ability to establish causal relationship between risk factors and disease. Determining lifestyle factors relies on self-reported data and is therefore susceptible to bias. Also, focusing on an urban population might not reflect other demographic settings. Future research should be longitudinal in design and include a more diversified demographic with validation and further refinement of the predictive accuracy.

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CONCLUSION

The present study moderately supports the current literature on IDRS as an effective tool in diabetes screening and underlines the need for continual adaptation and validation across Indian populations. Higher IDRS score thresholds improve overall model performance (AUC), but there is a trade-off between sensitivity and specificity. Lower thresholds are better for detecting true positives, while higher thresholds are better for detecting true negatives.

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