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# Risk Assessment of Diabetes Using Indian Diabetes Risk Score in non Diabetic Individuals: A Cross Sectional Study

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**ABSTRACT**

The prevalence of diabetes in India has become a significant public health concern owing to a substantial increase in the incidence of diabetes cases. The implementation of screening methods and early interventions, such as lifestyle modifications and treatment, can contribute to the prevention of diabetes and its associated complications by identifying individuals at high risk at an early stage. The objective of this study was to evaluate the likelihood of developing type 2 diabetes mellitus (T2DM) within an urban slum population by employing the Indian Diabetes Risk Score (IDRS). Additionally, the study aimed to identify the factors that are correlated with a higher risk score. A cross-sectional study was conducted in a tertiary care centre of central India. A total of 100 study participants were selected randomly. A pre-designed and pre-tested structured questionnaire was used for data collection. Assessment of risk of T2DM was done using the IDRS. Out of 100 study subjects, 53% were males, mean age was 40.13±15 years and 23% were illiterate. The overall prevalence of diabetes was 21.%, as per IRDS, 22% were in low-risk category. 44 and 34% were in moderate and high-risk category respectively. This study aimed to assess the efficacy of the Indian diabetes risk score in identifying individuals at high risk for diabetes in the urban population of India, with the objective of implementing appropriate interventions to mitigate the disease burden. The inclusion of stress within the IDRS is a possibility.

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**Key Words**
Determinants, diabetes, risk, screening, T2DM, IDRS

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## INTRODUCTION

According to a recent report by the World Health Organization, India is home to more than 19% of the global diabetic population[1]. The aforementioned data indicates that there are more than 35 million individuals affected by diabetes, with projections suggesting that this figure will rise to nearly 80 million by the year 2030. The aforementioned upward trajectory suggests a substantial projected impact on public health in India as a result of diabetes[2,3]. Regrettably, a significant proportion exceeding 50% of individuals with diabetes in India are uninformed about their diabetic condition, thereby contributing to the overall burden of the disease[4]. This highlights the necessity of implementing widespread awareness campaigns and screening initiatives in order to address and mitigate the prevalence of diabetes in India. The Indian government has implemented a National Diabetes Control Programme and is currently in the process of developing a diabetes prevention initiative. In order to achieve success in these programs, it is imperative to ascertain cost-effective strategies for identifying individuals with undiagnosed diabetes within our nation. This study presents a simplified version of the Indian Diabetes Risk Score (IDRS) that aims to identify undiagnosed individuals with diabetes. The simplified IDRS utilizes four easily measurable parameters, requiring minimal time and effort. By employing this simplified approach, the costs associated with screening can be significantly reduced.

## MATERIALS AND METHODS

This cross-sectional study was carried out at the Department of Medicine in tertiary care hospital of Central India over the 18 months period. Every patient who met the inclusion requirements was included in the study. Written informed consent was obtained. Data were gathered using a standardised questionnaire that had been previously created and evaluated. The information included sociodemographic factors, IDRS-related factors, blood pressure (BP) measurements and body mass index measurements (BMI). Following are the IDRS component scores: abdominal obesity (waist circumference): 80 cm in females and 90 cm in males; age: 35 year (0 score), 35-49 year (20 score) and 50 year (30 score).

## RESULT

Among the total sample size of 100 study participants, it was observed that 53 individuals, constituting 53.5% of the sample, were identified as males. Additionally, a majority of 85 participants, accounting for 85% of the sample, were found to belong to nuclear families. The data revealed that a majority of the participants, specifically 71 individuals (equivalent to 71.5% of the total sample), were married. Additionally, half of the participants, or 50%, resided in urban areas. Furthermore, a notable proportion of the participants, specifically 23%, were found to be illiterate. On the other hand, a significant number of individuals, specifically 44 participants (equivalent to 44% of the total sample), had pursued higher education by studying degree and professional courses. The average age of the participants was 40.13±15 years, with 18 individuals (18.5%) falling into the lower socio-economic status category, as shown in Table 1. The study revealed that 11.5% of the participants were below the age of 20, while 30.5% fell within the 21-35 age bracket. Additionally, 37% of the participants were found to be between the ages of 36 and 50. The study revealed that among the total sample size of 100 individuals, 72 (72.5%) were observed to consume high-salt and pickle foods, while 56 (56.5%) reported consumption of junk foods and 52 (51.5%) reported consumption of oily foods. The study participants exhibited a higher frequency of consuming non-vegetarian foods (66.5%) and milky foods (78%). Approximately 66.5% of the population consisted of individuals who adhered to a non-vegetarian diet. According to Table 2, a significant proportion of the population, specifically 20.5%, reported having less than 6 hrs of sleep per day. The presented pie chart illustrates the distribution of participants' exercise habits. It is evident that a majority of the participants, specifically 60 individuals or 60% of the total, did not engage in daily exercise. Conversely, a small proportion

Table 1: Socio-demographic details

| Variables | Number (n = 100) | Frequency |
|---|---|---|
| **Gender** | | |
| Male | 53 | 53 |
| Female | 47 | 47 |
| **Family type** | | |
| Joint | 15 | 15 |
| Nuclear | 85 | 85 |
| **Religion** | | |
| Hindu | 81 | 81 |
| Christian | 16 | 16 |
| Muslims | 3 | 3 |
| **Marital status** | | |
| Married | 71 | 71 |
| Unmarried | 23 | 23 |
| Divorced | 6 | 6 |
| **Place** | | |
| Urban | 50 | 50 |
| Rural | 50 | 50 |
| **Education** | | |
| Illiterate | 23 | 23 |
| Primary | 6 | 6 |
| Secondary | 21 | 21 |
| Inter | 6 | 6 |
| Degree and above | 44 | 44 |
| **Socio-economic status** | | |
| Upper Class | 19 | 19 |
| Upper middleClass | 15 | 15 |
| Middle Class | 32 | 32 |
| Lower Middle Class | 18 | 18 |
| Lower Class | 16 | 16 |
| **Age (years)** | | |
| <20 | 11 | 11 |
| 21-35 | 31 | 31 |
| 36-50 | 37 | 37 |
| >50 | 21 | 21 |

Table 2: Risk factors of diabetes mellitus

| Risk factors | Yes (n = 100) | Percentage |
|---|---|---|
| Smoking | 16 | 16 |
| Alcoholics | 11 | 11 |
| Eating of pickles/high salt food | 73 | 73 |
| High frequency of junk foods (yes) | 56 | 56 |
| High frequency of oily foods outside (>3/week) | 52 | 52 |
| High frequency of non-vegetarian food (>2/week) | 66 | 66 |
| High frequency of milk foods/ice-creams/butter/ghee/cheese | 78 | 78 |
| Duration of sleep<6 hours per day | 21 | 21 |
| High consumption of sweet foods (>3 times/week) | 57 | 57 |

Table 3: Status of BMI and waist circumference

| Variables | Yes (n = 100) | Percentage |
|---|---|---|
| BMI | | |
| <18.5 | 9 | 9 |
| 18.5-22.9 | 30 | 3 |
| 23-24.9 | 16 | 16 |
| 25 and above | 45 | 45 |
| Waist circumference (cm) | | |
| Males >100 | 6 | 6 |
| Females >90 | 33 | 33 |

Table 4: Diabetic score and risk assessment

| Variables | Score | N | % |
|---|---|---|---|
| **Age (years)** | | | |
| <35 | 0 | 40 | 40 |
| 35-49 | 20 | 31 | 31 |
| 50 and above | 30 | 29 | 29 |
| **Waist circumference (cm)** | | | |
| Waist <80 cm (F), <90 cm (M) | 0 | 25 | 25 |
| Waist >80 cm to 89 cm (F) and >90 cm to 99 cm (M) | 10 | 33 | 33 |
| Waist >90 cm (F) and >100 cm (M) | 20 | 42 | 42 |
| **Physical activity** | | | |
| Regular exercise+strenuous work | 10 | 9 | 9 |
| Regular exercise or strenuous work | 20 | 55 | 55 |
| No exercise or sedentary work | 30 | 36 | 36 |
| **Family history** | | | |
| No parent suffered with diabetes | 0 | 55 | 55 |
| Single parent | 10 | 30 | 30 |
| Both parents | 20 | 15 | 15 |

of the participants, comprising 6 individuals or 6%, reported exercising for less than 30 min per day. Furthermore, a significant portion of the participants, accounting for 34 individuals or 34%, indicated that they exercised for more than 30 min per day. This information is visually represented in the study determined that the average body mass index (BMI) was 24.7±0 kg $m^{-2}$. In the study, it was noted that according to the Asian classification of obesity, 9 individuals (9%) had a BMI below 18.5, while 59 individuals (29.5%) had a BMI ranging from 18.5 to 22.9. Additionally, 16 individuals (16%) fell within the BMI range of 23 to 24.9 and 91 individuals (45.5%) had a BMI of 25 or higher. According to the data presented in Table 3, it was observed that 6 out of the total number of males (6%) had a waist circumference greater than 100 cm, while 33 out of the total number of females (33%) had a waist circumference greater than 90 cm. The participants were classified into three risk categories for developing diabetes based on their IDRS scores: low risk (20 participants, 20.5%), moderate risk (45 participants, 45.4%) and high risk (34 participants, 34%). The study revealed that 40 individuals, accounting for 40% of the sample, were below the age of 35. Additionally, 31 individuals, representing 31% of the sample, fell within the age range of 35 to 49. Furthermore, 29 individuals, comprising 29% of the sample, were found to be above the age of 50. Out of the total number of participants, 9 individuals (9%) engaged in strenuous physical activity, while 55 individuals (55.5%) reported engaging in moderate physical activity. The remaining 36 individuals (35.5%) indicated a sedentary lifestyle. A waist circumference of greater than or equal to 90 cm for females and greater than or equal to 100 cm for males was observed in 42 participants, accounting for 42% of the total sample. Conversely, a waist circumference of less than 80 cm for females and less than 90 cm for males was identified in 24 participants, representing 24.5% of the sample (Table 4). The study revealed that the average perceived stress score was 19.5±4.03. The data revealed that a majority of participants, specifically 65 individuals (constituting 65% of the sample), achieved scores ranging from 11-20 points. Additionally, 31 participants (31% of the sample) obtained scores within the same range of 11-20 points, while only a small proportion of the sample, specifically 2 individuals (2% of the sample), achieved scores exceeding 30 points. The study revealed that among high-risk groups, the most common stress-relieving strategies were the sharing of ideas (45%) and meditation (26%). In contrast, among moderate and low-risk groups, the predominant stress-relieving strategies were the sharing of ideas (68%) and meditation (35%), respectively. A notable correlation was observed between gender, body mass index (specifically obesity and overweight), non-vegetarian dietary habits, fruit consumption and the likelihood of developing diabetes ($p<0.05$). The study revealed that there is no significant association between stress, sleep and the risk of diabetes, as indicated by the p-value of greater than 0.05 (Table 5). The sensitivity of the IDRS was found to be 50.6%, indicating its ability to correctly identify individuals with the condition. The specificity was determined to be 71.6%, reflecting its capacity to accurately identify individuals without the condition. The positive predictive value was calculated to be 33.8%, indicating the likelihood of a positive test result accurately indicating the presence of the condition. Conversely, the negative predictive value was determined to be 86.3%, indicating the likelihood of a negative test result accurately indicating the absence of the condition (Table 6).

Table 5: Factor influencing the diabetic risk status

| | Risk factors | High risk (n = 34) | Moderate + low risk (n = 66) |
|---|---|---|---|
| Gender | Male | 11 | 34 |
| | Female | 23 | 32 |
| Chi-square value: 8.3 p<0.05 significant | | | |
| BMI | Obese+over weight | 27 | 37 |
| | Normal | 7 | 29 |
| Chi-square value: 6.64 p<0.05 significant | | | |
| Type of food consumption | Non-vegetarian | 21 | 23 |
| | Vegetarian | 13 | 43 |
| Chi-square value: 14.6 p<0.05 significant | | | |
| Fruits consumption | Yes | 6 | 49 |
| | No | 28 | 17 |
| Chi-square value: 56.8 p<0.05 significant | | | |
| Stress | Yes | 11 | 22 |
| | No | 23 | 44 |
| Chi-square value: 0.019 p>0.05 non-significant | | | |
| Sleep | Yes | 28 | 52 |
| | No | 6 | 14 |
| Chi-square value: 0.514 p>0.05 non-significant | | | |

Table 6: Sensitivity and specificity of IDRS

| Risk | Diabetic | Pre-diabetic + non-diabetic | Total |
|---|---|---|---|
| High | 12 | 22 | 34 |
| Moderate + low risk | 9 | 57 | 66 |
| | 21 (21%) | 79 (79%) | 100 |

Sensitivity: 57.14%, Specificity: 72.15%, PPV: 9.75%, NPV: 96.97%

## DISCUSSION

In our study, a significant proportion of the participants (37%) fell within the age range of 36-50 years. Additionally, 21% of the participants were observed to be above 50 years of age, while 11.5% were found to be below 20 years of age. In the study conducted by Acharya *et al*.[5] it was determined that 75% of the participants fell within the age range of 30 to 49 years. In the conducted study, the researchers observed an average age of 43.38±11.26 years, with a range spanning from 30 to 75 years. Our study revealed that the average age was 40.13±15 years. In their study, Sarkar *et al*. (year) reported a mean age of 33.1±8.15 years, with the majority (64%) falling within the age group of less than 35 years. These findings align with the results of our study[6]. In our study, we observed a prevalence rate of 21.0% for diabetes. This finding is in contrast to the results of a meta-analysis conducted by ICMR[7], which reported a lower prevalence rate of 6.25% for diabetes in adults during the period of 1990-2002.

In our study, an examination of the IDRS score revealed that 34 individuals (34%) were identified as being at high risk for developing diabetes. Comparatively, the percentage of individuals classified as high-risk in studies conducted by Jain *et al*.[8] (14.9%), Panda *et al*.[9] (17.9%), Khandhedia *et al*.[10] (22.8%) and Brahmbhatt *et al*.[11] were lower. However, it is worth noting that study yielded similar findings to ours, with a high-risk category percentage of 34%. Conversely, the study conducted by Mani *et al*.[12] reported a higher percentage of individuals at high risk for diabetes, at 59%. According to the IDRS score, 45 individuals (45.4%) were classified as having a moderate risk in our study. The study conducted by Gupta *et al*.[13] (50.9%), Shobha *et al*. (56%), Arun *et al*. (67.7%) and Khandhedia *et al*.[10] (66.8%) revealed a greater proportion of the population falling into the moderate risk category[8,10,13,14]. In contrast to the current study, Gupta *et al*.[13] (24.5%) and Nagalingam *et al*.[15] (18%) reported a higher proportion of individuals classified as low-risk. According to Gupta et al's study, it was observed that 50.3% of the participants were classified as being at moderate risk for diabetes, while 18.5% were categorized as being at low risk.

Majority In our study, a total of 55 individuals, accounting for 55% of the population, reported a negative family history. The results of this study align with the findings of Sonkar *et al*.[16], who also observed that a majority of participants did not have a family history of diabetes. This is consistent with the research conducted by Acharya *et al*.[5], where 88.87% of the participants reported a negative family history of diabetes[16]. In our research, the majority of the population (85.5%) were identified as sedentary workers, while 55.5% were classified as moderate workers. In contrast, Acharya *et al*.[5] study reported a lower proportion of sedentary workers (15.79%) and a higher proportion of moderate workers (82.39%). In a separate study conducted by Singh *et al*., it was found that the majority of participants (62.9%) were classified as moderate workers, while 31.2% were categorized as sedentary workers[13,17]. Engaging in physical activity has been shown to have several beneficial effects on body composition, including a reduction in body fat

and an increase in muscle mass. Additionally, regular physical activity has been associated with a decreased risk of developing obesity. According to a study conducted by ICMR-INDIAB, the prevalence of physical inactivity among women was found to be 83.2% in Chandigarh, 55.3% in Jharkhand, 68.5% in Maharashtra and 77.4% in Tamil Nadu[18]. Waist circumference serves as a reliable indicator of abdominal obesity, which in turn represents a significant risk factor for the development of diabetes. The waist circumference of females is greater than or equal to 90 cm.

A waist circumference of greater than or equal to 100 cm was observed in 42 participants, accounting for 42% of the total sample. In terms of gender-specific waist measurements, a waist circumference of less than 80 cm for females and less than 90 cm for males was found in 24 participants, representing 24.5% of the total sample. In a study conducted by Brinda *et al*., it was found that 53.5% of the subjects exhibited abdominal obesity. The study participants demonstrated a higher frequency of consuming non-vegetarian foods (66.5%) and milky foods (78%). In the conducted study, it was observed that females exhibited a higher IDRS score in comparison to males. This discovery aligns with the research conducted by Turale *et al*.[18], Arora *et al*.[19], Patil and Gothankar[20], Chaturvedi *et al*.[19]. The findings of our study demonstrate a significant correlation between body mass index (BMI) and the prevalence of diabetes. Specifically, we observed that 79.41% of individuals classified as high risk for diabetes were classified as obese or overweight based on their BMI, while 56.81% of individuals in the moderate and low risk categories exhibited the same classification. This finding aligns with previous research conducted by Dugg *et al*., Shoba *et al*. and Gupta *et al*.[13], which also reported a similar association. The body mass index (BMI) values of 28, 29 and 36 are significant determinants of the individual's diabetes risk score (IDRS). Our findings are in line with previous studies that have demonstrated a positive correlation between higher body mass index (BMI) and an increased risk of developing diabetes in the future. A notable correlation was observed between gender, body mass index (specifically, obesity and overweight), non-vegetarian dietary habits, fruit consumption and the risk of developing diabetes ($p<0.05$).

The study revealed that the sensitivity and specificity were determined to be 50.6 and 71.6% correspondingly. The study conducted by Chaturvedi et al revealed comparable values, with a sensitivity of 65.79% and specificity of 73.91%. Similarly, Adhikari *et al*.[22] reported sensitivity and specificity values of 62.2 and 73.7%, respectively[22,23]. According to the study conducted by Mohan *et al*., the Invasive Ductal Carcinoma Risk Score (IDRS) demonstrates a sensitivity of 72.5% and a specificity of 60.1% as reported in CURES[24]. According to the research conducted by Dudeja *et al*.[24], the IDRS demonstrates a sensitivity of 72.5% and specificity of 60.1%. This scoring system is derived from the extensive population-based study on diabetes in India known as CURES[25]. The risk score exhibits a moderate level of sensitivity, measuring at 75.4% and specificity, measuring at 70%, in its ability to identify cases of undiagnosed DM[26].

The progression of various diseases is influenced by psychological stress. Severe forms of psychological stress have an impact on both the central nervous system and the peripheral nervous system[27]. There is a perceived association between stress and diabetes due to shared risk factors, including suboptimal dietary habits and a sedentary way of life.

The study revealed a mean perceived stress score of 19.5±4.03. It was observed that 65 participants (65%) scored between 11-20 points, while 31 participants (31%) scored within the same range. Only 2 participants (2%) scored above 30 points. The study revealed that among high-risk groups, the practices of sharing of ideas (31, 45%) and meditation (18, 26%) were identified as effective strategies for reducing stress levels.

## CONCLUSION

In conclusion, the IDRS can serve as a straightforward and efficient instrument for early screening, with the added advantage of being easily accessible, even in remote regions. This study additionally emphasizes the impact of an individual's lifestyle and dietary choices on the likelihood of developing diabetes. The findings reveal a significant association between high body mass index (BMI) and a sedentary lifestyle with an increased risk of diabetes. Conversely, individuals who consume a healthy diet, including fruits and vegetables, demonstrate a reduced risk of developing diabetes. Hence, through the implementation of early risk assessment utilizing the Integrated Disease Risk Score (IDRS) and the adoption of straightforward lifestyle modifications, a reduction in the economic burden can be achieved. While no statistically significant correlation was found between stress and a heightened risk for diabetes, it was evident that a majority of individuals experiencing high levels of stress fell within the categories of moderate and low risk. These individuals are more susceptible to developing diabetes in the future. There exists a

necessity to incorporate stress as a constituent within the framework of the IDRS (Individual Differences in Response to Stress) construct, thereby warranting the development of future research endeavors in this domain.

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