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Original Research Article

Risk assessment of type 2 diabetes among the adult population using Indian Diabetes Risk Score: a community-based cross-sectional study in Central India

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ABSTRACT

Background: Diabetes mellitus is one of the leading causes of long term morbidity and is a major health hazard in a developing country like India. Because of the disease's growing burden, its iceberg nature, its consequences, and the ability to prevent the complications through early identification and treatment, strong efforts for early diabetes diagnosis are essential. Early identification of the high risk individuals would help in taking appropriate intervention thus helping to prevent, or at least delay, the onset of diabetes. Indian Diabetes Risk Score (IDRS) is a cost-effective tool for screening of undiagnosed diabetic individuals in the community.
Methods: A community based cross sectional study was conducted in the urban field practice area of Indira Gandhi Government Medical College, Nagpur, Maharashtra among 360 participants above 18 years of age. Indian Diabetes Risk Score (IDRS) was used to assess risk of diabetes. Chi-square test was applied to determine association between variables.
Results: Out of the 360 study participants, 86 (23.89%), 156 (43.33%) and 118 (32.78%) participants were in low risk, moderate risk and high risk categories respectively. Risk of diabetes was significantly associated with age, socioeconomic status, physical activity, adequate fruit and vegetable intake, high consumption of sweet foods, history of hypertension, family history of diabetes, body mass index and waist circumference.
Conclusions: Risk assessment using IDRS is useful for screening of individuals. This would help to take necessary interventions for their early diagnosis and treatment.

Keywords: Community based, Diabetes, IDRS, Risk, Screening

INTRODUCTION

Diabetes mellitus is a major clinical and public health problem. Diabetes mellitus is one of the leading causes of long term morbidity and a major health hazard in a developing country like India.[1] In India, there are estimated 77 million people above the age of 18 years suffering from type 2 diabetes and nearly 25 million are prediabetics, that is they are at a higher risk of developing diabetes in near future.[2] India is deemed as the world's capital of diabetes. The diabetic population in the country is close to hitting the alarming mark of 69.9 million by 2025 and 80 million by 2030.[3] More than 50% of people are unaware of their diabetic status which leads to health complications if not detected and treated early.[2]

The risk complications of diabetes are far worse if the individual who is prone to diabetes for various reasons doesn't get diagnosed and treated properly. Some of the complications include coronary artery disease, stroke, diabetic retinopathy, diabetic neuropathy, diabetic nephropathy. Because of the disease's growing burden, its iceberg nature, its consequences, and the ability to prevent these complications through early identification and treatment, strong efforts for early diabetes diagnosis are essential.[4] Early identification of the high-risk individuals would help in taking appropriate intervention thus helping to prevent, or at least delay, the onset of diabetes.[5] Screening for any disease is fruitful when there is benefit from its early diagnosis and intervention.[6]

Screening in case of diabetes is especially crucial to help identify those at higher risk of prediabetes and diabetes. Given the rapid escalation of the diabetes epidemic, all levels of prevention (primary, secondary and tertiary prevention) need to be put into action simultaneously. Unfortunately, more than 50% of people with type 2 diabetes mellitus (T2DM) remain undiagnosed. Thus, the priority is to screen, diagnose and treat as many people with T2DM as possible.[7] Indian diabetes risk score (IDRS) is a cost-effective tool for screening of undiagnosed diabetic individuals in the community.[8] It uses four simple characteristics such as age, waist circumference, family history of diabetes, and physical activity to assess risk of diabetes. 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%.[9]

Type 2 diabetes mellitus, which was once a disease occurring at older ages has now started to have occurred even at younger ages more frequently in the past 2 to 3 decades.[10] According to an all India register for youth-onset diabetes, more than 25% were diagnosed with T2DM at <25 years of age; incidence was 0.5 cases/100 000 under 19 years.[11] Hence it is necessary to screen even young adults for diabetes. The purpose of this study was to assess diabetes risk among the adult population and to study association between risk score with some risk factors of diabetes.

METHODS

Study design and settings

This was a community-based cross-sectional study conducted in the urban field practice area of a tertiary health care hospital in central India between September 2023 to February 2024.

Study population

Individuals aged 18 years and above who were not currently diagnosed with diabetes mellitus and were willing to participate in the study were included in the study whereas known cases of diabetes mellitus, pregnant and lactating women upto 12 weeks postpartum were excluded.

Sample size estimation

From a study conducted by Patil et al taken as reference, sample size was calculated using the formula $n=z^2 \times pq/e^2$, where z (1.96) was level of significance at 95% confidence interval, p (36.55%) was the prevalence of participants in high-risk group in the mentioned study, q (63.45) was 100-36.55%, e (5%) was the absolute error.[12] After substituting the values in the formula, the sample size derived was 356.2. The final sample size was rounded off to 360.

Data collection

Ethical approval from Institutional Ethics Committee was obtained before commencement of study. House to house visits were done for collection of data. The localities coming under the urban field practice area were identified and among them three localities were selected by cluster sampling. A lane was selected randomly in that locality.

The first house in that lane was visited and subsequently we proceeded to the next house. In every house, one family member meeting the inclusion criteria was randomly selected until sample size was achieved. Houses were covered one lane after the other.

Informed consent was obtained from participants after explaining the purpose of the study. Data was collected by questionnaire method.

A predesigned pre-tested proforma was used for collecting information regarding sociodemographic details, diet, physical activity, personal habits. General examination was done. Anthropometric measurements were taken and body mass index (BMI) was calculated. Random blood sugar was tested for participants in high-risk category.

Operational definitions

1. Education, occupation, socio-economic status were classified as per modified Kuppuswamy socioeconomic scale.[13,14]
2. Physical activity levels were graded as per WHO's STEPS definitions of sedentary, mild, moderate and vigorous exercise.
3. Adequate fruit and vegetable intake: For a daily caloric intake of 2000 kcal, the Indian Council of Medical Research (ICMR) recommends consuming approximately 100 grams of fruits and 400 grams of vegetables was considered adequate.[15]
4. High consumption of sweet foods included consumption of sweets, candies, fruit juices, cakes, candies, cold drinks >3 times a week.[8,15]

5. Alcohol and tobacco consumption: Current and former users of the alcohol and tobacco were considered as "ever" having a habit and those who never consumed it were considered as 'never' having a habit.
6. Body Mass Index (BMI) was calculated after measuring weight and height measurements and using the formula of BMI = weight (kg)/height (m^2). BMI was classified according to WHO Asian- BMI classification.[16]
7. Random Blood Sugar (RBS) was tested for high-risk individuals i.e. individuals with risk score of ≥60, using a Digital Glucometer.
8. Indian Diabetes Risk Score: The risk of diabetes was assessed using The Indian Diabetes Risk Score (IDRS) which consisted of 4 components and each one has it's scoring:

Age

It includes <35 years = 0, 35-49 years =20 and >50 years =30.

Abdominal obesity

Waist circumference of <80cm in females (F) and <90 cm in males (M) = 0, ≥80-89 cm in females and ≥90-99 cm in males = 10, ≥90 cm in females and ≥100 cm in males.

Physical activity

It includes vigorous exercise or strenuous (manual) activities at home/work = 0, mild to moderate exercise at home/work = 20, no exercise or sedentary activities at home/work = 30.

Family history

It includes no family history = 0, either parent = 10, and both parents = 20.

The maximum score is 100. A score of <30 is considered to be low risk, score of 30-50 is considered to be moderate risk and score of 60 or above is considered high risk.

Data analysis

Data was filled in MS Excel Sheet and analysed using Jamovi software. Qualitative data was expressed in number and percentage while quantitative data was expressed in mean and standard deviation. Chi-square test was applied to determine association between variables. P value of <0.05 was considered to be statistically significant.

RESULTS

The study included participants aged 18 years and above, with no history of diabetes. Table 1 shows risk score parameters of the study participants. Mean age of study participants was 49.34±6.47 years. It was seen that the majority of study participants 148 (41.11%) were more than 50 years of age. Among the 206 females in the study, 79 (38.35 %) had waist circumference of ≥90 cm while among the 154 males in the study, 62 (40.26%) had waist circumference of ≥90-99 cm. Maximum participants 155 (43.05%) did no exercise or did sedentary activities at home or work and 154 (42.78%) participants had either parent with a history of diabetes.

Table 1: Indian diabetes risk score parameters.

Indian diabetes risk score parameters	Number	Percentage
Age (years)		
<35	84	23.33
35-49	128	35.56
>50	148	41.11
Abdominal obesity (females): n=206		
Waist circumference <80 cm	52	25.24
Waist circumference ≥80-89 cm	75	36.41
Waist circumference ≥90 cm	79	38.35
Abdominal obesity (males): n=154		
Waist circumference <90 cm	40	25.97
Waist circumference ≥90-99 cm	62	40.26
Waist circumference ≥100 cm	52	33.77
Physical activity		
Vigorous exercise or strenuous (manual) activities at home/work	64	17.78
Mild to moderate exercise at home/work	141	39.17
No exercise or sedentary activities at home/work	155	43.05
Family history		
No family history	119	33.05
Either parent	154	42.78
Both parents	87	24.17

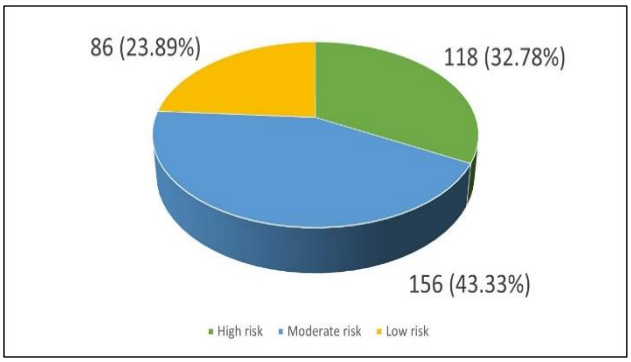

Figure 1: Distribution of study participants according to Indian Diabetic Risk Score.

Figure 1 shows distribution of study participants according to Indian Diabetes Risk Score. Maximum study participants 156 (43.33%) were found to be having moderate risk of diabetes whereas 118 (32.78%) and 86 (23.89%) participants had high and low risk respectively. Out of the 118 participants in high risk category, random blood glucose ≥140 mg/dl was found in 47 (39.83%) participants.

Table 2 shows association of some socio demographic characteristics of study participants with Indian Diabetic Risk Score. Maximum study participants, 93 (25.83%) had studied upto high school, 134 (37.22%) were homemakers, 123 (34.17%) belonged to lower middle class. There was significant association seen between Indian Diabetic Risk Score and age (p<0.001) and socioeconomic status (p = 0.010).

Table 2: Association of sociodemographic variables with Indian Diabetic Risk Score.

Sociodemographic variables	Low risk N (%)	Moderate risk N (%)	High risk N (%)	Total	χ^2, df, p value
Age (years)					
<35	38 (45.24)	31 (36.90)	15 (17.86)	84	41.01, 4, <0.001
35-49	34 (26.56)	54 (42.19)	40 (31.25)	128	
>50	14 (9.46)	71 (47.97)	63 (42.57)	148	
Gender					
Male	34 (22.08)	63 (40.91)	57 (37.01)	154	2.20, 2, 0.331
Female	52 (25.24)	93 (45.15)	61 (29.61)	206	
Education					
Graduate and professional degree	19 (28.36)	23 (34.33)	25 (37.31)	67	12.29, 8, 0.138
Intermediate/diploma	21 (24.42)	31 (36.05)	34 (39.53)	86	
High school	18 (19.35)	43 (46.24)	32 (34.41)	93	
Primary school	21 (28.77)	36 (49.32)	16 (21.91)	73	
Illiterate	07 (17.07)	23 (56.10)	11 (26.83)	41	
Occupation					
Professional	07 (23.34)	13 (43.33)	10 (33.33)	30	15.4, 8, 0.051
Skilled worker, shop and market sales workers	11 (19.64)	21 (37.50)	24 (42.86)	56	
Elementary occupation	17 (26.56)	29 (45.31)	18 (28.13)	64	
Homemaker	42 (31.34)	58 (43.28)	34 (25.37)	134	
Retired	09 (11.84)	35 (46.05)	32 (42.11)	76	
Socioeconomic status					
Upper middle (II)	16 (20.00)	33 (41.25)	31 (38.75)	80	16.75, 6, 0.010
Lower middle (III)	28 (22.76)	57 (46.34)	38 (30.89)	123	
Upper lower (IV)	17 (17.17)	45 (45.46)	37 (37.37)	99	
Lower (V)	25 (43.10)	21 (36.21)	12 (20.69)	58	

Table 3: Association of some risk factors of diabetes with Indian Diabetic Risk Score.

Some risk factors of diabetes	Low risk N (%)	Moderate risk N (%)	High risk N (%)	Total	χ^2, df, p value
Physical activity					
Vigorous exercise or strenuous (manual) activities at home/work	29 (45.31)	21 (32.81)	14 (21.88)	64	24.79, 4, <0.001
Mild to moderate exercise at home/work	34 (24.11)	65 (46.10)	42 (29.79)	141	
No exercise or sedentary activities at home/work	23 (14.84)	70 (45.16)	62 (40.00)	155	
Adequate food and vegetable intake					
Yes	48 (26.23)	86 (47.00)	49 (26.78)	183	6.095, 2, 0.047
No	38 (21.47)	70 (39.55)	69 (38.98)	177	
Type of diet					
Vegetarian	38 (26.57)	51 (35.66)	54 (37.76)	143	5.734, 2, 0.056
Mixed	48 (22.12)	105 (48.39)	64 (29.49)	217	
Tobacco consumption					
Ever	24 (22.64)	45 (42.45)	37 (34.91)	106	0.33, 2, 0.846
Never	62 (24.40)	111 (43.70)	81 (31.89)	254	

Continued.

Some risk factors of diabetes	Low risk N (%)	Moderate risk N (%)	High risk N (%)	Total	χ^2, df, p value
Alcohol consumption					
Ever	19 (29.69)	28 (43.75)	17 (26.56)	64	2.016, 2, 0.364
Never	67 (22.64)	128 (43.24)	101 (34.12)	296	
High consumption of sweet foods					
Yes	25 (16.45)	69 (45.39)	58 (38.16)	152	8.68, 2, 0.013
No	61 (29.33)	87 (41.82)	60 (28.85)	208	
History of hypertension					
Yes	22 (18.64)	36 (30.51)	60 (50.85)	118	27.98, 2, <0.001
No	66 (27.27)	120 (49.59)	56 (23.14)	242	
Family history of diabetes					
Yes	39 (16.18)	111 (46.06)	91 (37.76)	241	24.89, 2, <0.001
No	47 (39.49)	45 (37.82)	27 (22.69)	119	
Body mass index (BMI)					
Underweight	19 (44.19)	16 (37.21)	08 (18.60)	43	38.46, 6, <0.001
Normal	34 (32.38)	43 (40.95)	28 (26.67)	105	
Overweight	13 (14.94)	48 (55.17)	26 (29.89)	87	
Obese I	11 (15.94)	34 (49.28)	24 (34.78)	69	
Obese II	9 (16.07)	15 (26.79)	32 (57.14)	56	
Waist circumference					
<80cm in females (F) and <90 cm in males (M)	43 (46.74)	24 (26.09)	25 (27.17)	92	38.78, 4, <0001
≥80-89 cm in females and ≥90-99 cm in males	27 (19.71)	64 (46.72)	46 (33.57)	137	
≥90 cm in females and ≥100 cm in males	16 (12.21)	68 (51.91)	47 (35.88)	131	

Table 3 shows association of some risk factors of diabetes with Indian Diabetic Risk Score. It was observed that maximum study participants, 155 (43.06%) did no exercise or sedentary activities at home/work and 105 (29.17%) were in the normal weight category. Majority, 183 (50.83%) did have adequate fruit and vegetable intake,208 (57.78%) did not have high consumption of sweet foods, 217 (60.28%) had a mixed diet, 242 (67.22%) did not have a history of hypertension, 241 (66.94%) had family history of diabetes and never consumed alcohol or tobacco. There was significant association found between Indian Diabetic Risk Score and physical activity (p<0.001), adequate fruit and vegetable intake (p=0.047), high consumption of sweet foods (p=0.013), history of hypertension (p<0.001), family history of diabetes (p<0.001), BMI (p<0.001) and waist circumference (p<0.001). However, no significant association was observed between the risk score and type of diet (p=0.056), history of tobacco consumption (p=0.846), history of alcohol consumption (p=0.364).

DISCUSSION

Indian Diabetes Risk Score of ≥60 turned out to be the best cut point for identifying undiagnosed diabetes in a study by Jain et al.[13] In the current study, we found 118 (32.78%) participants to have a high risk of diabetes. This was in alignment with findings by Swetha et al with and Sri et al with 30.5% and 31.5% in high risk category respectively.[5,8]

Maximum study participants in our study were above 50 years of age and the same was also observed by Brahmbhatt et al and Kaur et al.[17,18] The reason was that in most homes, more females were present than males during the time of data collection. Studies by Angadi et al and Jain et al also had more female participants.[1,19] Our study showed no significant association between diabetes risk and gender which was in agreement with findings of Acharya et al.[20]

Majority of the participants in our study had studied upto high school whereas, a study by Brahmbhatt et al had maximum participants who were illiterates.[17] However, no significant association was found between diabetes risk and both education and occupation of participants. Our study found socioeconomic status to be a significant determinant (p=0.010), similar to studies by Patil et al.[12]

Physical activity is one of the important modifiable risk factors for diabetes. Globally, physical inactivity accounts for 14% of diabetes.[1] Our study found physical activity to be significantly associated with diabetes risk (p<0.001). Choudhary et al also reported similar findings.[21] We observed a statistically significant association between adequate fruit and vegetable intake and diabetes risk (p=0.047), however a study by Acharya et al had contrasting findings (p=0.49).[20]

In the current study, no significant association was observed between the risk score and type of diet

(p=0.228), history of tobacco consumption (p=0.397), history of alcohol consumption (p=0.930). A study by Singh et al observed similar findings (p=0.15).[22] Similarly, Wadhera et al did not find tobacco consumption to be associated with diabetes risk (p=0.73) whereas contrasting findings were observed by George et al where alcohol usage and tobacco usage were found to be significant factors (p=0.02 and 0.01 respectively.[23,24]

History of hypertension was found to be a significant factor associated with diabetes risk (p<0.001), similar to findings by Swetha et al and Acharya et al.[5,20] This study observed a significant association between IDRS and family history of diabetes, similar to studies by Choudhary et al (p<0.001) and George et al (p=0.00).[21,24]

In this study, the risk score was found to be significantly associated with BMI, which was in contrast to findings by Sidenur et al (p=0.31).[4] In this study, maximum females that is 52 (38.81%) had waist circumference of >80-89 cm while maximum males that is, 41 (49.40%) had waist circumference of >90-99 cm. Waist circumference was found to be a significant determinant of diabetes risk in our study, in line with findings by Choudhary et al.[21] A study by Susairaj et al identified that random blood glucose value of ≥140 mg/dl (7.8 mmol/L) could be used to identify people who should be subjected to confirmatory Oral glucose tolerance test (OGTT) to diagnose diabetes.[25] In this study, out of 118 participants in the high risk category, random blood glucose ≥140 mg/dl was found in 47 (39.83%) participants. These participants were advised to test for fasting blood glucose and postprandial blood glucose levels.

This study has few strengths. The study was conducted among individuals aged 18 years and above in order to find out risk among younger age group as well. The study helped identify 47 individuals from high-risk category who had elevated random blood sugar and were referred for further investigations.

This study has few limitations. There is a possibility of recall bias while reporting family history by participants. There is a possibility of social desirability bias while answering questions related to dietary habits and tobacco and alcohol consumption. Since this was a cross-sectional study, it will not be possible to observe overtime trend of diabetes risk in the individuals.

CONCLUSION

Our study found 118 (32.78%) study participants to be at high risk of diabetes. Out of the 118 participants in the high-risk category, random blood glucose ≥140 mg/dl was found in 47 (39.83%) participants. The risk of developing diabetes was found to be significantly associated with age, socioeconomic status, physical activity, adequate food and vegetable intake, high consumption of sweet foods, history of hypertension, family history of diabetes, BMI and waist circumference. Risk assessment using IDRS is useful for screening individuals and should be used as a tool to assess risk of developing diabetes. This would help to take necessary interventions for their early diagnosis and treatment.

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