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Original Research Article

Assessment of Type 2 Diabetes Risk among Apparently Healthy Adults Using the Indian Diabetes Risk Score in the Field Practice Area of an Urban Health Training Centre, Kota

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Conflict of interest: Nil

Abstract:

Background: Diabetes mellitus is a major public health problem, and many individuals remain undiagnosed until complications develop. Early identification of high-risk individuals through simple community-based screening tools can help in timely lifestyle modification and prevention. The Indian Diabetes Risk Score (IDRS) is a simple, inexpensive and non-invasive tool used to assess the risk of type 2 diabetes in the Indian population.

Objectives: To assess the risk of developing type 2 diabetes among apparently healthy adults using IDRS and to determine its association with socio-demographic and anthropometric factors.

Materials and Methods: A community-based cross-sectional descriptive observational study was conducted in the field practice area of the Urban Health Training Centre from June 2018 to May 2019. A total of 400 adults aged 20 years and above were selected by random sampling. Known diabetics, pregnant women, lactating mothers and seriously ill individuals were excluded. Data were collected using a pre-tested structured questionnaire. IDRS was calculated using age, waist circumference, physical activity and family history of diabetes. Data were analysed using descriptive statistics and chi-square test, with $p<0.05$ considered statistically significant.

Results: Out of 400 participants, 150 (37.5%) were at high risk, 214 (53.5%) at moderate risk and 36 (9.0%) at low risk of developing type 2 diabetes. Age, marital status and occupation showed significant association with IDRS category. Among anthropometric and risk-related factors, BMI, family history of diabetes, waist circumference and physical activity were significantly associated with diabetes risk.

Conclusion: More than one-third of apparently healthy adults were at high risk of developing type 2 diabetes. IDRS is a useful, simple and low-cost community screening tool. Lifestyle modification, regular physical activity and health education should be emphasized for prevention.

Keywords: Indian Diabetes Risk Score, Type 2 diabetes mellitus, Diabetes risk, Community screening, Waist circumference, Physical activity.

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Introduction

Diabetes mellitus is a chronic metabolic disease that occurs when the pancreas does not produce enough insulin or when the body is unable to use insulin effectively. [1] Persistent hyperglycemia in diabetes can gradually damage several organs, especially the eyes, kidneys, nerves, heart and blood vessels. [2] Diabetes is mainly classified into type 1 and type 2 diabetes. Type 1 diabetes occurs due to immune-mediated destruction of pancreatic β-cells, causing absolute insulin deficiency and requiring daily insulin therapy. Type 2 diabetes is the more common form and is mainly due to

insulin resistance with varying degrees of β-cell dysfunction. [1,3] It accounts for nearly 90% of diabetes cases worldwide. [1] Type 2 diabetes is increasing rapidly and has become an important public health problem. It increases the risk of myocardial infarction nearly two times and the risk of stroke by two to four times. It is also an important cause of blindness, kidney failure and limb amputation. [4,5] Major risk factors include increasing age, obesity, family history of diabetes, physical inactivity, stressful lifestyle and unhealthy dietary habits. Globally, diabetes affects about 8.3% of the adult population, and the World Health Organization has predicted that the number of people with diabetes may rise from 371 million in 2012 to 552 million by 2030. [6] India carries a particularly high burden and is often considered the diabetic capital of the world. In 2010, India had around 51 million diabetic patients, which is expected to increase to 87 million by 2030. [7] The prevalence of diabetes in India is around 8.7%, and nearly 52% of adult cases remain undiagnosed. [8] This is concerning because many individuals remain unaware of their diabetic status and may develop preventable complications. [9] Early identification of high-risk individuals provides an opportunity for timely lifestyle intervention through dietary modification, regular physical activity and weight control, which may prevent or delay the onset of type 2 diabetes. Several diabetes risk scoring systems have been developed worldwide, including the American Diabetes Risk Tool, Finnish Diabetes Risk Score, NHANES risk score and Indian Diabetes Risk Score. Among these, the Indian Diabetes Risk Score, developed by the Madras Diabetes Research Foundation, is especially useful in Indian community settings. It is based on four simple parameters: age, abdominal obesity measured by waist circumference, family history of diabetes and physical activity. [10]

The Indian Diabetes Risk Score is simple, inexpensive and does not require laboratory testing, making it suitable for community-based screening. It can be easily used by community health workers to identify individuals with undiagnosed diabetes or those at high risk of developing diabetes in the future. The score has a sensitivity of 72.5% and specificity of 60.1%, as reported from the Chennai Urban Rural Epidemiology Study by V. Mohan et al. [11] It has also been found useful for predicting incident diabetes, identifying cardiometabolic risk among apparently healthy individuals and assessing the risk of diabetes-related complications. Community-based screening is important because diabetes often remains silent for many years, and many individuals seek medical care only after complications have developed. Therefore, screening methods should be simple, quick, safe, affordable and acceptable to the community. With this background, the present study was undertaken to screen the adult population at risk of developing diabetes and to assess the risk of type 2 diabetes among apparently healthy adults using the Indian Diabetes Risk Score in the field practice area of the Urban Health Training Centre. The study also aimed to identify participants at high risk of developing type 2 diabetes, determine the proportion of such high-risk participants, and find the association of various socio-demographic and anthropometric measures with the degree of risk of developing diabetes.

Material and Methods

The present study was a community-based, cross-sectional, descriptive observational study conducted in the field practice area of the Urban Health Training Centre (UHTC). The study was carried out over a period of one year, from June 2018 to May 2019. A total of 400 individuals participated in the study. Written informed consent was obtained from all participants before enrolment, and socio-demographic details such as name, age, gender, address, education, occupation and socioeconomic status were recorded on a standard pre-designed proforma. Individuals aged 20 years and above, of either gender, who were residents of the identified study area for at least one year and who gave written informed consent were included in the study. Known diabetic individuals, pregnant women, lactating mothers up to 12 weeks postpartum and seriously ill individuals who were unable to participate were excluded from the study.

A systematic random sampling method was used for selection of participants. As per the family folder maintained at UHTC, the study area had an adult population of 5853 distributed across 1625 houses. On average, there were 3.6 adults per household; therefore, 120 houses were surveyed to achieve the desired sample size. The sampling interval was calculated as every 13th house. The first house was selected randomly by simple random technique using the chit-in-box method from numbers 1 to 13, and thereafter every 13th house was included until the required sample size was achieved.

Data collection was done through household survey by direct interview using a pre-tested, structured questionnaire. The questionnaire consisted of two parts. The first part included socio-demographic variables, while the second part included the Indian Diabetes Risk Score (IDRS) questionnaire developed by Mohan V et al.[11] The IDRS is a simplified screening tool for identifying undiagnosed diabetes and persons at risk of developing type 2 diabetes. It includes four parameters: age, abdominal obesity measured by waist circumference, physical activity and family history of diabetes. Of these, waist circumference and physical activity are modifiable risk factors,

while age and family history are non-modifiable risk factors.

Participants were classified according to their total IDRS score. A score of less than 30 was considered low risk, a score of 30 to less than 60 was considered intermediate/moderate risk, and a score of 60 or more was considered high risk for diabetes mellitus. The maximum possible IDRS score was 100. Participants falling in the high-risk category were considered eligible for further screening by random capillary blood glucose testing. Family history of diabetes was considered positive if either one or both parents of the participant had diabetes. Physical activity was graded according to WHO STEPS definitions as sedentary, mild, moderate or vigorous physical activity. Waist circumference was measured to the nearest 0.1 cm using a non-stretchable measuring tape at the midpoint between the lower margin of the last rib and the tip of the iliac crest posteriorly and at the level of the umbilicus anteriorly. The measurement was taken at the end of normal expiration with the participant standing erect in a relaxed position. Abdominal obesity was considered present when waist circumference was ≥80 cm in women and ≥90 cm in men. Occupation was classified as labourer, business, unemployed, housewife or household worker. A labourer was defined as a person involved in work for cash or kind, mainly including unskilled daily wage workers. Business included any well-established or semi-established organized activity owned by an individual for profit.

An unemployed person was defined as one who was able and willing to work but could not get work. A housewife was defined as a person caring for home and family, while a household worker was defined as a person employed for remuneration in cash or kind to perform household work on a temporary or permanent, part-time or full-time basis. Educational status was classified as illiterate, primary, secondary, and higher secondary and above. An illiterate person was defined as one who could neither read nor write, or could only read but not write in any language.

Primary education included completion up to sixth standard, secondary education included education from fifth to tenth standard, while higher secondary and above included higher secondary certificate, graduation, post-graduation and professional degree or diploma. Socioeconomic status was assessed according to modified Prasad's classification. Body mass index was classified according to the Asian classification of obesity, where BMI <18.5 kg/m² was considered underweight, 18.5–22.99 kg/m² normal weight, 23–24.99 kg/m² overweight, 25–29.9 kg/m² obese class I and ≥30 kg/m² obese class II. The Indian Diabetes Risk Score used in the study assigned scores for four variables. For age, a score of 0 was given for 20–34 years, 20 for 35–49 years and 30 for ≥50 years. For waist circumference, a score of 0 was given for waist circumference <80 cm in females and <90 cm in males, 10 for 80–89 cm in females and 90–99 cm in males, and 20 for ≥90 cm in females and ≥100 cm in males. For physical activity, a score of 0 was given for regular vigorous exercise or strenuous work, 10 for regular moderate exercise or moderate physical activity, 20 for mild exercise or mild physical activity, and 30 for no exercise or sedentary activity. For family history of diabetes, a score of 0 was given when neither parent had diabetes, 10 when one parent had diabetes and 20 when both parents had diabetes. The IDRS is based on the Chennai Urban Rural Epidemiological Study and has a reported sensitivity of 72.5% and specificity of 60% in the Indian community. Statistical analysis was performed using SPSS trial version 23 for Windows statistical software package and Primer software for generation of descriptive and inferential statistics. Qualitative data were expressed as numbers, proportions and percentages.

The difference in proportions was analysed using the chi-square test. A p-value of less than 0.05 was considered statistically significant.

Results: A total of 400 apparently healthy adults from the field practice area of Urban Health Training Centre were included in the study. Among them, the majority belonged to the age group of 35–49 years, followed by participants aged ≥50 years. Females were more commonly represented than males. Most participants were Hindu by religion, married, educated up to secondary level, and belonged to joint families. According to socioeconomic status, the highest proportion belonged to class II, followed by class III (Table 1).

Table 1: Socio-demographic profile of study participants

Variable	Category	Number	Percentage
Age group	20–34 years	76	19.0
	35–49 years	215	53.75
	≥50 years	109	27.25
Gender	Male	140	35.0
	Female	260	65.0
Religion	Hindu	247	61.75
	Muslim	107	26.75

	Sikh	37	9.25
	Christian	9	2.25
Marital status	Married	328	82.0
	Unmarried	72	18.0
Education	Illiterate	70	17.5
	Primary	141	35.25
	Secondary	163	40.75
	Higher secondary	26	6.5
Occupation	Business	42	10.5
	Household worker	56	14.0
	Housewife	173	43.25
	Labourer	64	16.0
	Unemployed	65	16.25
Type of family	Joint	253	63.25
	Nuclear	147	36.75
Socioeconomic status	Class I	45	11.25
	Class II	161	40.25
	Class III	129	32.25
	Class IV	47	11.75
	Class V	18	4.5

The distribution of participants according to major anthropometric and diabetes risk-related variables is shown in Table 2. Most participants had waist circumference in the middle-risk category according to IDRS waist circumference criteria. Family history of diabetes was present in 147 participants. Regarding physical activity, nearly half of the participants reported moderate physical activity, while 17% had no exercise or sedentary activity (Table 2).

Table 2: Distribution of participants according to IDRS-related risk factors

Variable	Category	Number	Percentage
Waist circumference	<80 cm female / <90 cm male	43	10.75
	80–89 cm female / 90–99 cm male	236	59.00
	≥90 cm female / ≥100 cm male	121	30.25
Family history of diabetes	No family history	253	63.25
	One parent diabetic	106	26.50
	Both parents diabetic	41	10.25
Physical activity	Vigorous	40	10.00
	Moderate	198	49.50
	Mild	94	23.50
	No exercise/sedentary	68	17.00
BMI	Underweight	38	9.50
	Normal	167	41.75
	Pre-obese	112	28.00
	Obese	83	20.75

According to the Indian Diabetes Risk Score, 150 participants were classified as high risk for developing type 2 diabetes, 214 participants were in the moderate-risk category, and 36 participants were in the low-risk category. Thus, the proportion of participants at high risk of developing type 2 diabetes was 37.5% (Table 3).

Table 3: Distribution of participants according to Indian Diabetes Risk Score

IDRS category	Number	Percentage
Low risk (<30)	36	9.0
Moderate risk (30–<60)	214	53.5
High risk (≥60)	150	37.5
Total	400	100.0

Association of socio-demographic variables with diabetes risk showed that age, marital status and occupation were significantly associated with IDRS risk category.

The high-risk group mainly consisted of participants aged 35–49 years and ≥50 years, whereas most low-risk participants were aged 20–

34 years. Married participants were more commonly represented in the high-risk group.

Gender, education, type of family and socioeconomic status did not show statistically significant association with IDRS risk category (Table 4).

Table 4: Association of socio-demographic variables with IDRS risk category

Variable	Category	High risk n (%)	Moderate risk n (%)	Low risk n (%)	Total n (%)	p-value
Age group	20–34 years	3 (2.00)	38 (17.76)	35 (97.22)	76 (19.00)	<0.001
	35–49 years	77 (51.33)	137 (64.02)	1 (2.78)	215 (53.75)	
	≥50 years	70 (46.67)	39 (18.22)	0 (0.00)	109 (27.25)	
Gender	Female	96 (64.00)	141 (65.89)	23 (63.89)	260 (65.00)	0.923
	Male	54 (36.00)	73 (34.11)	13 (36.11)	140 (35.00)	
Marital status	Married	143 (95.33)	179 (83.64)	6 (16.67)	328 (82.00)	<0.001
	Unmarried	7 (4.67)	35 (16.36)	30 (83.33)	72 (18.00)	
Education	Illiterate	25 (16.67)	42 (19.63)	3 (8.33)	70 (17.50)	0.667
	Primary	55 (36.67)	70 (32.71)	16 (44.44)	141 (35.25)	
	Secondary	59 (39.33)	89 (41.59)	15 (41.67)	163 (40.75)	
	Higher secondary	11 (7.33)	13 (6.07)	2 (5.56)	26 (6.50)	
Occupation	Business	17 (11.33)	23 (10.75)	2 (5.56)	42 (10.50)	<0.001
	Household worker	20 (13.33)	28 (13.08)	8 (22.22)	56 (14.00)	
	Housewife	69 (46.00)	98 (45.79)	6 (16.67)	173 (43.25)	
	Labourer	20 (13.33)	40 (18.69)	4 (11.11)	64 (16.00)	
	Unemployed	24 (16.00)	25 (11.68)	16 (44.44)	65 (16.25)	
Type of family	Joint	99 (66.00)	127 (59.35)	27 (75.00)	253 (63.25)	0.133
	Nuclear	51 (34.00)	87 (40.65)	9 (25.00)	147 (36.75)	
Socioeconomic status	Class I	15 (10.00)	22 (10.28)	8 (22.22)	45 (11.25)	0.218
	Class II	63 (42.00)	82 (38.32)	16 (44.44)	161 (40.25)	
	Class III	48 (32.00)	70 (32.71)	11 (30.56)	129 (32.25)	
	Class IV	19 (12.67)	27 (12.62)	1 (2.78)	47 (11.75)	
	Class V	5 (3.33)	13 (6.07)	0 (0.00)	18 (4.50)	

Among anthropometric and IDRS-related factors, BMI, family history of diabetes, waist circumference and physical activity showed statistically significant association with diabetes risk. In the high-risk group, 51 participants were obese and 80 participants had increased waist circumference. Family history of diabetes was also more common among high-risk participants. Participants with mild physical activity or no exercise were more frequently observed in the high-risk category (Table 5).

Table 5: Association of anthropometric and IDRS-related variables with IDRS risk category

Variable	Category	High risk n (%)	Moderate risk n (%)	Low risk n (%)	Total n (%)	p-value
BMI	Underweight	19 (12.67)	14 (6.54)	5 (13.89)	38 (9.50)	<0.001
	Normal	46 (30.67)	106 (49.53)	15 (41.66)	167 (41.75)	
	Pre-obese	34 (22.66)	63 (29.43)	15 (41.66)	112 (28.00)	
	Obese	51 (34.00)	31 (14.48)	1 (2.78)	83 (20.75)	
Family history	No diabetes in parents	57 (38.00)	165 (77.10)	31 (86.11)	253 (63.25)	<0.001
	One parent diabetic	58 (38.67)	43 (20.09)	5 (13.89)	106 (26.50)	
	Both parents diabetic	35 (23.33)	6 (2.80)	0 (0.00)	41 (10.25)	
Waist circum-ference	<80 cm F / <90 cm M	5 (3.33)	29 (13.55)	9 (25.00)	43 (10.75)	<0.001
	80–89 cm F/90–99 cm M	65 (43.33)	145 (67.76)	26 (72.22)	236 (59.00)	
	≥90 cm F /≥100 cm M	80 (53.33)	40 (18.69)	1 (2.78)	121 (30.25)	
Physical activity	Vigorous	4 (2.67)	27 (12.62)	9 (25.00)	40 (10.00)	<0.001
	Moderate	43 (28.67)	129 (60.28)	26 (72.22)	198 (49.50)	
	Mild	52 (34.67)	41 (19.16)	1 (2.78)	94 (23.50)	

	No exercise/sedentary	51 (34.00)	17 (7.94)	0 (0.00)	68 (17.00)	

Overall, the study showed that more than one-third of apparently healthy adults were at high risk of developing type 2 diabetes according to IDRS. Age, marital status, occupation, BMI, family history of diabetes, waist circumference and physical activity were significantly associated with the degree of diabetes risk (Tables 3–5).

Discussion

The Indian Diabetes Risk Score (IDRS), developed by Mohan V et al., is a simple, rapid, inexpensive and non-invasive tool for identifying individuals at high risk of developing type 2 diabetes. [11] In the present study, IDRS was used among apparently healthy adults in the field practice area of UHTC to assess diabetes risk and its association with socio-demographic and anthropometric factors.

In this study, out of 400 participants, 150 (37.5%) were at high risk, 214 (53.5%) were at moderate risk and 36 (9.0%) were at low risk of developing diabetes. These findings are comparable with Patil R S et al. and Gupta et al., who reported high-risk scores in 36.55% and 31.2% of participants, respectively. [12,13] Mohan et al. reported a higher proportion of high-risk individuals, 43%, in Chennai. [14] The difference may be due to variation in lifestyle, urbanization and study population. The high proportion of moderate- and high-risk participants in the present study indicates the need for early screening, health education and lifestyle intervention.

Age was significantly associated with diabetes risk. In the present study, the proportion of high-risk participants increased with advancing age, as 70 participants aged ≥50 years belonged to the high-risk category. Almost all participants in the low-risk category belonged to the 20–34 years age group. This finding is similar to that reported by Patil R S et al. [12] Gender was not significantly associated with diabetes risk, although females were more commonly represented in the high-risk group. Similar findings were reported by M. M. Singh et al. and Acharya et al. [15,16]

Marital status and occupation showed significant association with IDRS category. Married participants were more commonly found in the high- and moderate-risk groups, while unmarried participants were more commonly seen in the low-risk group. Housewives formed the largest occupational group among high-risk participants, which may be related to reduce regular physical activity apart from household work.

Similar observations were reported by Patil R S et al. and Arora et al. [12,17] Education, type of family and socioeconomic status did not show statistically significant association with diabetes risk. However, the presence of risk across socioeconomic classes suggests that diabetes is no longer limited to affluent groups and is increasingly affecting all sections of society.

Among anthropometric and IDRS-related factors, BMI, family history of diabetes, waist circumference and physical activity were significantly associated with diabetes risk. In the high-risk group, 51 (34.0%) participants were obese, supporting the role of obesity as an important predictor of diabetes. Family history was also important, as 58 (38.67%) high-risk participants had one diabetic parent and 35 (23.33%) had both parents diabetic. Increased waist circumference was seen in 80 (53.33%) high-risk participants, showing the importance of central obesity.

Physical activity was a major modifiable risk factor. Among high-risk participants, 52 (34.67%) had mild physical activity and 51 (34.0%) had no exercise or sedentary activity. Thus, most high-risk participants had inadequate physical activity. Similar findings were reported by Patil R S et al., Gupta et al. and M. M. Singh et al. [12,13,15]

Overall, the study shows that IDRS is a useful community-based screening tool. Since obesity, central obesity and physical inactivity are modifiable factors, lifestyle modification, dietary control, regular exercise and health education should be emphasized to reduce future diabetes risk.

Conclusion

The Indian Diabetes Risk Score is a simple, low-cost and useful tool for screening people at risk of diabetes in the community. People should be made aware about diabetes prevention through healthy diet, regular exercise, stress control and lifestyle changes. Special attention should be given to elderly people and those with a family history of diabetes. Since this study was done only in the UHTC area, larger studies are needed in different populations.

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