Evaluation of Indian Diabetic Risk Score and Its Association with Body Mass Index and HbA1c Levels in Mixed Urban and Rural Population of Western U.P.

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ABSTRACT

BACKGROUND

In the recent times, risk assessment based on anthropometric and demographic characteristics is done to identify individuals with high risk. Indian Diabetes Risk Score (IDRS) that was developed by the Madras Diabetes Research Foundation (MDRF) in the year 2005. The present study was conducted to evaluate Indian Diabetic Risk Score and its relationship with Body Mass Index and HbA1c levels in the mixed urban and rural population of Western U.P.

METHODS

The current study was done among 500 subjects in the Department of Medicine at Chhatrapati Shivaji Subharti Hospital from November 2018 to April 2020. HbA1c was measured for the confirmation of diabetes. Patients were interviewed and the demographic details, socioeconomic status, medical history and previous history of taking any medications and supplements were recorded. Diabetes mellitus, physical activity and diabetic score using IDRS (Indian Diabetes Risk Score) and data were collected. Anthropometric measurements such as height, weight, and waist circumference were measured. T2DM (Type 2 Diabetes Mellitus) was defined according to the criteria provided by The ADA (American Diabetes Association), as HbA1c $\geq$ 6.5 %. Generalized obesity was defined as BMI (Body Mass Index) $\geq$ 25 Kg / m^2, and for abdominal obesity (AO), the upper limit for WC of men and women was defined as 90 and 80 cms, respectively. Two-millilitre blood sample was drawn in EDTA vial for HbA1c estimation. HbA1c was measured by high-performance liquid chromatography-based method using D10 HbA1c analyser (Bio-Rad). Data so collected was analysed using SPSS version 24.

RESULTS

Maximum obese, overweight and normal subjects belonged to high risk, moderate risk and no risk diabetes category with statistically significant difference as p < 0.01. Out of 260 diabetic subjects, 76.92 % were at high risk, and of the 103 prediabetic subjects, 76.69 % were at moderate high risk of developing diabetes as per IDRS. Significant association was found between subjects with higher risk score and HbA1c.

CONCLUSIONS

Significant association was noted between Indian Diabetic Risk Score and age, systolic blood pressure, smoking, BMI and HbA1c levels in mixed urban and rural population of Western U.P.

KEYWORDS

BMI, HbA1c, Diabetes, IRDS

BACKGROUND

Diabetes is the 7th leading cause of death[1] and with the combination of obesity and hypertension (HTN), this leads to cardiovascular diseases (CVDs) which are the first leading cause of death globally. The prevalence of diabetes mellitus (DM) and obesity are increasing parallel in worldwide.[1] Globally, the prevalence of diabetes has increased in both gender equally, in men from 43 % in 1980 to 90 % in 2014 and in women from 50 % to 79 % in women.[2] Our nation has the reputation of terming Diabetes mellitus capital ranking next to Chinese, accounting to 62.4 million cases that is thought to increase to 100 million by end of 2030. One in every 5 diabetic across the globe is from India.[3]

As insulin is an anabolised hormone which helps conserve energy and hence signals the body to give fatty mass. With increase in BMI, resistance to insulin also enhances there by shooting the glucose levels in body higher. As weight of body is related to BMI, it might be thought that BMI is related to glucose levels in blood.[4]

Obesity is multifactorial existence, having complicated social and psychological determinants affecting literally every age and socioeconomic group and threatening to outcast developing and developed countries. Occurrence of obesity varies according to age, sex, and region. In India, the percentage of overweight or obese married women between aged 15 and 49 years increased from 11 % in National Family Health Survey - 2 (NFHS - 2) to 15 % in NFHS - 3.[5] The epidemiological survey used BMI as an indicator of obesity, waist circumference (WC) and waist-hip ratio (WHR) as indictors of abdomen obesity (A O).

In the recent times, risk assessment contemplated on basis of anthropometric and demographic characteristics are developed to identify individuals with high risk termed Indian Diabetes Risk Score (IDRS) that was developed by the Madras Diabetes Research Foundation (MDRF) in the year 2005.[6] Majority of the descriptive studies in Indian scenario are done in metro cities and few in rural sectors but none of the study had assessed it in rural as well as at urban level. Hence current study was performed to evaluate Indian diabetic risk score and its association with body mass index and HbA1c levels in mixed urban and rural population of Western U.P.

METHODS

The present study was done in the Department of Medicine at Chhatrapati Shivaji Subharti Hospital from November 2018 to April 2020. The study section was made of 500 patients, aged between 25 and 70 years. HbA1c was also measured as one the diagnostic parameter for the confirmation of diabetes. Cases were recruited into the study after informed consent was obtained and approval from Institutional Ethical Committee. A study done in Pondicherry by Sanjay Gupta[7] found that the prevalence of risk of diabetes mellitus using IDRS Score among adult population was 51 %. Based on this prevalence and keeping 95% alpha error and 11 % of relative precision, sample size was

calculated. Based on the formula, the calculated sample size was 305. Considering the unknown error and attrition, the sample size was increased to 500.

Inclusion Criteria
Age more than 25 years and UN - diagnosed diabetic subjects.

Exclusion Criteria
Known cases of DM, Ischemic heart disease, chronic liver disease, hypothyroidism, chronic renal failure and women using oral contraceptives or pregnant.

The patients were interviewed that requests for the demographic, socioeconomic status, medical history and previous history of taking any medications and supplements. Diabetes mellitus, physical activity and Diabetic score using IDRS and data was collected based on the questionnaire pattern. Anthropometric measurements such as height, weight, and waist circumference were measured.

T2DM was defined according to the criteria provided by the ADA, HbA1c ≥6.5 %. Generalized obesity (GO) was defined as BMI ≥25 Kg / m², and for AO, the upper limit for WC of men and women was defined as 90 and 80 cm, respectively. We classified AO as:
A. Normal (waist <80 cm in female, <90 in male),
B. 1° obese (waist ≥80–89 cm in female, ≥90–99 cm in male), and
C. 2° obese (waist ≥90 cm in female, ≥100 cm in male).

Analysis for high risk was done as per Indian diabetes risk score (IDRS) developed by Mohan et al. and parameters comprising two modifiable (waist circumference, physical activity) and two non-modifiable risk factors (age, family history) for diabetes (figure 1)[6]. It is helpful to identify subjects at high risk for diabetes and also raised awareness about diabetes and its risk factors. Association of diabetic risk was assessed with factors like physical activity, habits like alcohol and smoking, family history of diabetes and body mass index. Subjects were classified as:-
a. High Risk - IDRS Score >60
b. Moderate Risk- IDRS Score 30 – 50
c. Low Risk- IDRS Score < 30

Particulars	Score
Age (years)	
< 35	0
35 - 49	20
≥ 50	30
Abdominal Obesity	
Waist < 80 cm (female), < 90 (male)	0
Waist ≥ 80 - 89 cm (female), ≥ 90 - 99 cms (male)	10
Waist ≥ 90 cm (female), ≥ 100 cm (male)	20
Physical Activity	
Exercise (regular) + Strenuous Work	0
Exercise (regular) or Strenuous Work	20
No Exercise and sedentary Work	30
Family History	
No Family History	0
Either Parent	10
Both Parents	20
Minimum Score	0
Maximum Score	100
No Risk	<30
Moderate Risk	30-50
High Risk	>60
Table 1. Indian Diabetes Risk Score	

Anthropometric Measurements

1. Waist Circumference: was measured in the standing position by positioning a plastic tape at 180 degree midway between 12th rib and iliac crest on the mid-axillary line. The measurements were repeated twice by using the same device, and mean value was recorded.
2. Body Mass Index Estimation: Weight variable was measured as Kilograms to nearest unit with patients made to stand on weighers without foot wear and minimal clothing.
3. All cases were weighed on the same machine, and a particular set of weights was used to test for errors. Height of subjects was measured with subjects at erect position, with no foot wear, approximated feet, back and heels against the upright bar of height scale, head upright in Frankfort horizontal plane "look straight ahead." BMI was calculated from the formula - (BMI = weight in kilogram / [height in meters].

Laboratory investigations: Two millilitres blood sample was withdrawn in EDTA vial for HbA1c estimation. HbA1c was measured by high-performance liquid chromatography-based method using D10 HbA1c analyser (Bio-Rad).

Statistical Analysis

Data obtained was transferred to spreadsheets, following coding. SPSS 24 version was used for analysing statistics. For each assessment point, data were statistically analysed using ANOVA test. Difference between two groups was determined using chi square test and the level of significance was set at p<0.05. Pearson correlation test was used to analyse correlation between IDRS and BMI, HbA1c, abdominal obesity.

RESULTS

The present study comprised of 500 subjects, out of which 377 (75.4 %) and 123 (24.6 %) were males and females accordingly. High, moderate and low diabetes risk score was found among 52.2 % (261), 42.4 % (212) and 5.4 % (27) of the subjects respectively. There was no statistically significant difference among males and females in relation to diabetes risk score. Mean age was 44.31 ± 8.69 years in subjects with high risk diabetes whereas the same was found to be 39.47 ± 8.95 years among subjects with no risk of diabetes with statistically significant difference as p<0.05.

Table 2 depicts the distribution of diabetes risk in relation to BMI (Kg / m²) using IDRS. Maximum obese, overweight and normal subjects belonged to high risk, moderate risk and no risk diabetes category with statistically significant difference as p<0.01 (Table 2).

Current smoker (13 %) was found maximum among high risk diabetes subjects followed by moderate risk subjects (7.1 %). When smoking status was compared statistically according to diabetes risk, it was found to be statistically

significant, but the same association was not found in relation to smokeless tobacco (Table 3).

It was found that as the mean systolic blood pressure increases, diabetes risk also increased with statistically significant difference but the same was not reported in case of diastolic blood pressure (Table 4).

When HbA1c level was analysed, it was found that around 103 (26 %) were in prediabetic (24 %) and diabetic range (52 %). The remaining 137 subjects (27.4 %) had normal HbA1c level. Of the 260 diabetic subjects, 76.92 % were at high risk, and of the 103 prediabetic subjects, 76.69 % were at moderate high risk of developing diabetes as per IDRS criteria. Significant association was found between subjects with higher risk score and HbA1c [χ2 = 28.69, P < 0.001, Table 5].

Pearson correlation revealed statistically significant positive correlation between IDRS and BMI, HbA1c (Graph 1), abdominal obesity as p<0.01 (Table 6).

Simple linear regression revealed significant association between IDRS and BMI, HbA1c, abdominal obesity (Table 7).

Diabetes Risk		BMI (Kg / m²)		
		Normal	Obese	Overweight
High Risk (N=261)	N	210	28	23
	%	80.46 %	10.73 %	8.81 %
Moderate Risk (N=212)	N	174	16	22
	%	82.08 %	7.55 %	10.37 %
No Risk (N=27)	N	24	1	2
	%	88.9 %	3.7 %	7.4 %
Total (N=500)	N	408	45	47
	%	81.6 %	9 %	9.4 %
Chi Square		20.39		
p value		<0.01*		
Table 2. Distribution of Diabetes Risk in Relation to BMI (Kg / m²) Using IDRS				

*: statistically significant

Diabetes Risk		Smoking		
		Current Smoker	Ex-Smoker	Non-Smoker
High Risk (N = 261)	N	34	0	227
	%	13.0 %	0.0 %	87.0 %
Moderate Risk (N = 212)	N	15	16	181
	%	7.1 %	7.5 %	85.4 %
No Risk (N = 27)	N	2	2	23
	%	7.4 %	7.4 %	85.2 %
Total (N = 500)	N	51	18	431
	%	10.2 %	3.6 %	86.2 %
Chi Square		20.39		
P Value		<0.01*		
		Smokeless (Chewing) Tobacco		
		Current Tobacco Chewer	Ex-Tobacco Chewer	Non-Tobacco Chewer
High Risk (N = 261)	N	14	13	234
	%	5.4 %	5.0 %	89.7 %
Moderate Risk (N = 212)	N	8	16	188
	%	3.8 %	7.5 %	88.7 %
No Risk (N = 27)	N	1	2	24
	%	3.7 %	7.4 %	88.9 %
Total (N = 500)	N	23	31	446
	%	4.6 %	6.2 %	89.2 %
Chi Square		2.02		
P Value		0.73		
Table 3. Distribution of Diabetes Risk in Relation to Smoking and Smokeless (Chewing) Tobacco Using IDRS				

*: statistically significant

IDRS		SBP	DBP
High Risk	Mean	130.18	78.90
	N	261	261
	SD	14.123	8.562
Moderate Risk	Mean	127.40	78.74
	N	212	212
	SD	12.936	8.395
No Risk	Mean	120.15	78.89
	N	27	27
	SD	9.718	8.563
Total	Mean	128.46	78.83
	N	500	500
	SD	13.615	8.475
Anova Test		7.97	1.32
p value		<0.01*	0.49

Table 4. Distribution of Diabetes Risk in Relation to Blood Pressure Using IDRS

*: statistically significant

Diabetes Risk		HbA1c (%)		
		Normal (<5.7)	Prediabetic (5.7-6.4)	Diabetic (≥6.5)
High Risk (N=261)	N	38	23	200
	%	27.74 %	22.33 %	76.92 %
Moderate Risk (N=212)	N	73	79	60
	%	53.29 %	76.69 %	23.08 %
No Risk (N=27)	N	26	1	0
	%	18.98 %	0.98 %	0 %
Total (N=500)	N	137	103	260
	%	100 %	100 %	100 %
Chi Square		28.69		
p value		<0.01*		

Table 5. Association of Indian Diabetes Risk Score with Glycated Haemoglobin

*: statistically significant

Variables	r Value	P Value
IDRS and BMI	0.61	<0.01*
IDRS and HbA1c	0.72	<0.01*
IDRS and Abdominal Obesity	0.58	<0.01*

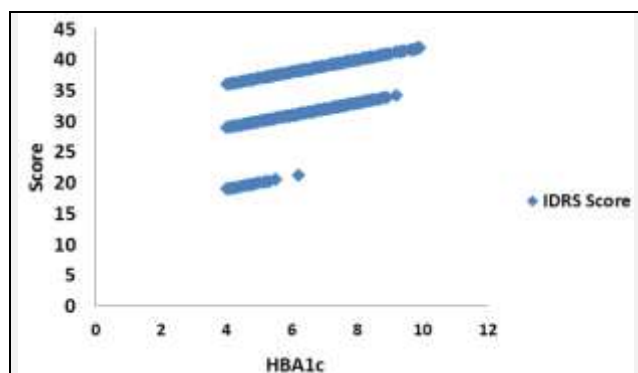**Table 6. Correlation between IDRS and BMI, HbA1c, Abdominal Obesity**

r: Pearson Correlation *: statistically significant

Variable	B	95 %CI	β	t	p	r
BMI	2.62	-1.67-10.84	0.23	2.71	0.009*	0.45
HbA1c	1.81	0.91-8.69	0.54	3.78	0.001*	0.58
Abdominal Obesity	2.51	-1.44-9.19	0.22	2.63	0.02*	0.43

Table 7. Simple Linear Regression to Assess Association between IDRS and Other Continuous Variables

*: statistically significant, CI: Confidence Interval for B

Graph 1. Correlation between IDRS and HbA1c

DISCUSSION

In our study, high, moderate and low diabetes risk score was found among 52.2 % (261), 42.4 % (212) and 5.4 % (27) of the subjects respectively. Khan, et al[8] revealed that nearly 29.6 % and 67.2 % subjects were found moderate risk to high risk of diabetes in their study. The previous studies were conducted in Chennai by Mohan et al[6] and in Puducherry and Tamil Nadu[9] by Gupta et al. 43 %, 19 %, and 31.2 % of the subjects, respectively, were found in high -risk category. This risk difference may be due to variance in ethnicity and lifestyles of the population as our study was done in Meruth and adjoining areas which is located in North India, whereas Mohan et al. conducted their study in Chennai and Gupta et al. conducted their study in rural and urban areas of South India. Gutch et al. reported that North diseases such as dyslipidaemia because of rapid westernization in lifestyles and diet and continuous migration from small towns and rural areas to metropolitan cities for Indians are becoming more prone for diabetes and obesity-related employment.[10]

Our study indicated that the prevalence of overweight and obesity increases with increasing diabetes risk and found higher prevalence of overweight and obesity at moderate to high risk for diabetes. It was previously reported that chances of high diabetic risk increases with increase in BMI. In our study, a significant association was found for BMI in relation with diabetes risk. Similar results were reported by Khan et al.[8]

In our study, around 103 (26 %) were in pre - diabetic (24 %) and diabetic range (52 %). The remaining 137 subjects (27.4 %) had normal HbA1c level. Of the 260 diabetic subjects, 76.92 % were at high risk, and of the 103 pre - diabetic subjects, 76.69 % were at moderate high risk of developing diabetes as per IDRS criteria. Significant association was found between subjects with higher risk score and HbA1c in the present study. Our findings are close to the reports of Mohan et al., in which they had also found that subjects with diabetes had higher risk of developing diabetic complications.[6]

It was observed that with increasing duration of disease, diabetic patient loss weight and has low BMI; however, severe obese patients have gradually high BMI. Both conditions are alarming stage for obese and diabetes patients and need regular monitoring. Zhao et al[11] demonstrated in a prospective cohort study that BMI has U -shaped association with all-cause mortality risk among Afro-American and white patients with T2DM and they reported that both Afro-American and white have significantly increased risk of all-cause mortality in low BMI and in high BMI as compared to moderate BMI.

In our study, we found that MDRF - IDRS is the simple and cost - effective tool to serve for a primary care physician or a health worker to screen diabetes. This tool is also useful to monitor diabetes and obesity and early detection of diabetes complications, especially CAD and peripheral vascular disease.

CONCLUSIONS

The results of the present study found significant association between Indian Diabetic Risk Score and systolic blood pressure, smoking, body mass index and HbA1c levels in mixed urban and rural population of Western U.P. Also, our

study fully supports the validity of IDRS as it could be utilised as a cost-effective tool for mass screening of diabetes. This scoring system can be used for strict monitoring of diabetes and obesity so that timely management can be done to decrease the early development of diabetes complications and severe obesity comorbidities.

Ethical permission was taken from the Institutional Ethical Committee of Chhatrapati Shivaji Subharti Hospital.

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REFERENCES

[1] International Diabetes Federation. IDF Diabetes Atlas. 6th edn. Brussels, Belgium: International Diabetes Federation, 2013.

[2] NCD Risk Factor Collaboration (NCD-RisC). Worldwide trends in diabetes since 1980: a pooled analysis of 751 population-based studies with 4·4 million participants. Lancet 2016;387(10027):1513-30.

[3] Wild S, Roglic G, Green A, et al. Global prevalence of diabetes: estimates for the year 2000 and projections for 2030. Diabetes Care 2004;27(5):1047-1053.

[4] Janghorbain M, Hedley AJ, Jones RB. Is the association between blood glucose levels and "all causes" and cardiovascular mortality risk, dependent on body mass index? Met J Islamic Republic Iran 1991;6(3):205-212.

[5] Nutrition in India. National Family Health Survey (NFHS-3) India 2005-2006. International Institute for Population Sciences Deonar, Mumbai. http://www.rchiips.org/nfhs/nutrition_report_for_webs ite_18sep09. Pdf. [Last accessed on 2020 Apr 28].

[6] Mohan V, Deepa R, Deepa M, et al. A simplified Indian diabetes risk score for screening for undiagnosed diabetic subjects. J Assoc Physicians India 2005;53:759-763.

[7] Gupta SK, Singh Z, Purty AJ, et al. Diabetes prevalence and its risk factors in urban Pondicherry. Int J Diabetes Dev Ctries 2009;29(4):166-169.

[8] Khan MM, Sonkar GK, Alam R, et al. Validity of Indian Diabetes Risk Score and its association with body mass index and glycosylated hemoglobin for screening of diabetes in and around areas of Lucknow. J Family Med Prim Care 2017;6(2):366-373.

[9] Gupta SK, Singh Z, Purty AJ, et al. Diabetes prevalence and its risk factors in rural area of Tamil Nadu. Indian J Community Med 2010;35(3):396-399.

[10] Gutch M, Razi SM, Kumar S, et al. Diabetes mellitus: trends in northern India. Indian J Endocrinol Metab 2014;18(5):731-734.

[11] Zhao W, Katzmarzyk PT, Horswell R, et al. Body mass index and the risk of all-cause mortality among patients with type 2 diabetes mellitus. Circulation 2014;130(24):2143-2151.