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Efficacy of Indian Diabetic Risk Score (IDRS) in Predicting Type 2 Diabetes Mellitus Among Adults of Kanpur Nagar, Uttar Pradesh- A Community-Based Cross-Sectional Study

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ABSTRACT

Every 5th patient visiting a physician is diabetic [1]. India is a resource-poor country, so we need to identify a low-cost, easy-to-use, noninvasive tool to screen the population for Diabetes mellitus [2]. More emphasis on the NCD program is needed in order to strengthen screening of the general population with the help of grassroots-level workers, so that maximum DM suspects can be identified and referred to the NCD Clinic. That's why the study was conducted on IDRS, BMI, and WC in the north Indian population [3][4]. The current study aimed to predict the effectiveness of the Indian Diabetes Risk Score in screening for Diabetes Mellitus (DM) among the people of Kanpur Nagar.

***Objective:** To assess the efficacy of the Indian diabetic risk score (IDRS) in predicting Diabetes mellitus among adults. To compare the efficacy of the Indian diabetic risk score (IDRS) BMI, WC in predicting Diabetes mellitus among adults of Kanpur Nagar.*

***Setting &Design:** A community-based cross-sectional study.*

***Methods & Materials:** Adults 20 years of age and older were involved in the study. A pre-designed, pretested questionnaire comprising anthropometry, lifestyle, and sociodemographic data was used to collect data through interviews. Diabetes was detected via blood sugar testing. SPSS version 29.0.2.0 (20) was used for statistical analysis, with Pearson's chi-square test applied.*

***Results:** The overall prevalence of diabetes was 13% with 9.2% in rural and 17.65% in urban regions. Age, physical activity, socioeconomic level, smoking, alcohol use, BMI (≥ 25), weight-height ratio (WHtR), waist-hip ratio (WHR), and family history of diabetes were all significantly associated with diabetes in both settings. There was no correlation between diabetes and caste, gender or religion.*

***Conclusions:** Urban areas have a higher prevalence of diabetes than rural ones. Diabetes mellitus and its consequences can be avoided or postponed with early identification and evaluation of high-risk persons in both areas.*

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***Keywords:** T2DM (Type 2 Diabetes Mellitus, Body fat percentage (BF%), Sagittal diameter(SAD), Weight-Height Ratio (WHtR), Waist-Hip Ratio (WHR), Body Mass Index (BMI), Waist Circumference (WC).*

INTRODUCTION

Globally, lifestyle diseases are becoming more common. With the number of persons with diabetes expected to increase from 537 million in 2021 to 643 million by 2030, T2DM in particular has become a significant global public health concern. They are becoming the leading cause of illness and mortality, surpassing communicable diseases [1]. With 26 million in 1990 to over 77 million by 2025, India has the fastest growing number of diabetic individuals worldwide, lending it the dubious title of "Diabetes Capital of the World". Diabetes affects every fifth patient who consults a physician[1][5][3]. Early identification of high-risk individuals through community-based screening is critical to curbing complications and health care costs, as India is a resource-poor country, so we need to identify a low-cost,easy-to-use, non-invasive method to screen the population for DM [3]. Non-invasive diabetes screening method (IDRS) includes waist circumference, physical activity, age, family history, and has with 72–87% sensitivity in South Indian cohorts. Simple Anthropometric indices-BMI (≥ 25 kg/m^2) to classify overweight and obesity; and WC thresholds (≥ 90 cm for men, ≥ 80 for women as indicators of central adiposity and insulin resistance, WHR (≥ 0.9/0.8), WHtR (≥ 0.5)[6], SAD an imitation of visceral adiposity [7], and body fat percentage (BF%) by bio impedance[8]Indian diabetic risk score, Body Mass Index, Waist circumference, Waist-Hip Ratio (WHR), Weight-Height Ratio (WHtR), Sagittal abdominal diameter (SAD) and Body Fat Percentage (BF%)have been validated in southern and western India, but their comparative performance in a North Indian urban district like Kanpur Nagar remains untested. More emphasis is needed on the NCD program to strengthen screening of the general population with the help of grassroots-level workers, so that as many DM suspects as possible can be identified and referred to the NCD Clinic. That's why the study was conducted of IDRS, BMI, and WC in the north Indian population [9]. This study aims to evaluate and compare the specificity, sensitivity, and area under the receiver operating curve (ROC-AUC)of IDRS, BMI, SAD, WC, Weight-Hip Ratio (WHR), Weight-Height Ratio (WHtR), and Body Fat Percentage (BF%) for detecting undiagnosed diabetes mellitus among adults in Kanpur Nagar. By identifying optimal cut-off values for this population, our findings will inform cost-effective, community-level screening programs in North Indian urban settings.

AIM AND OBJECTIVE

1. To assess the efficacy of the Indian diabetic risk score (IDRS) in predicting Type 2 diabetes mellitus among adults of Kanpur Nagar.
2. To compare the efficacy of the Indian diabetic risk score (IDRS), Body mass index (BMI), Sagittal abdominal diameter, waist circumference (WC), waist-hip ratio (WHR), weight-height ratio (WHtR), and Body fat percentage (BF%) in predicting diabetes mellitus among adults of Kanpur Nagar.

MATERIAL AND METHODS

This community-based cross-sectional study was carried out in the Kanpur Nagar district's rural and urban sections. Adults 20 years of age and older who gave written consent and lived in Kanpur for more than a year were included in the study, which took place over the course of a year. Patients who were bedridden, nursing mothers, pregnant, and those who refused to give consent were not included in the study.

SAMPLE SIZE: As per a previous study*, at an IDRS score of 60, sensitivity was 65.79% and specificity was 73.91%, with a prevalence (P) of 38%. At a 95% confidence interval (CI) and with 8% precision, using the formula for sample size for sensitivity, there were 355 individuals enrolled in the sample. The sample size was 187 using the sample size formula for specificity. The maximum sample size was 444 due to a higher sample size of 355, which included a 20% dropout rate.

SAMPLING TECNIQUE: A multistage random sampling procedure was used to cover the ideal sample size for achieving the study's goal. In the initial phase, two urban wards–Fazalgang and Maswanpur-were selected by sample random sampling without replacement. In the second phase, the Simple Random Sampling method was used to select one mohalla from each specified ward. Until the goal of 222 individuals from each chosen mohalla was reached, data was gathered through a house to house survey. Using simplerandom sampling without replacement, two rural blocks –Kalyanpur and Chaubapur-were chosen from a list of ten rural blocks. Village Devlapur and village Bairi from Kalyanpur block were chosen in the second stage using a simple random sampling technique. In order to achieve the ideal sample size needed for the study's goals.Research participants were chosen from each town.

A pretested and predesigned questionnaire was utilized to gather pertinent data. Direct interviews were used to complete the questionnaire. Surveys were carried out from house to house till the ideal sample size was reached. Using SPSS trail version 29.0.2.0. The gathered data were categorized, tabulated, and analysed; conclusions were then drawn.

The following instruments were employed to gather data: lists the following sociodemographic profile characteristics: name, age, married status, religion, caste, education, occupation, number of family members, type of family, family income, and socioeconomic status according to the Modified B.G. Prasad social classification 2022.

Lifestyle factors: include dietary habits, alcohol intake, smoking, and physical activity. Anthropometry includes height, weight, BMI, skin fold thickness, hip circumference, waist-hip ratio, sagittal abdominal diameter, random blood sugar, and a family history of diabetes.

STATISTICAL ANALYSIS: Microsoft Excel was used to compile the data Med-Calc version 22.013 was used to analyse the RC curves. Area under the ROC curve (AUC), IDRS, BMI, sagittal abdominal diameter (SAD), waist circumference (WC), waist-hip ratio (WHR), weight-height ratio (WHtR), and Body fat percentage (BF%) were measured for sensitivity and specificity. Statistical significance was defined as a p-value of less than 0.05.

RESULTS

Table 1: Comparison of IDRS Score, BMI, SAD, WC, WHR, WHtR, Skin fold thickness, BF% in subjects with and without diabetes

	Participants without Diabetes n=397		Participants with Diabetes n=47		
	Mean	SD	Mean	SD	P
IDRS Score	45.56	17.42	58.29	12.21	<0.001
BMI	25.5	4.52	28.07	4.48	<0.001
SAD	25.8	4.97	28.7	4.83	<0.001
WC	88.49	13.77	93.88	10.78	0.010
WHR(waist hip ratio)	0.961	0.4580	0.969	0.0899	0.908
WHtR	0.0447	0.0319	0.0315	0.0207	0.006
Skin Fold Thickness	23.37	9.2	24.81	10.7	0.319
% Body fat	34.00	6.28	35.12	5.82	0.247

Table 2: ROC Curve Analysis for IDRS, BMI, SAD, WC male, female, Total, Weight, WHtR

Parameters	IDRS	BMI	SAD	WC (Male)	WC (Female)	W:H Male	W:H Female	WHtR	Skin fold thickness	%Body Fat
AUC (Area under Curve)	0.731	0.676	0.674	0.569	0.522	0.639	0.573	0.695	0.528	0.0551
Standard Error	0.0334	0.0391	0.0440	0.0590	0.102	0.0549	0.0590	0.0337	0.0477	0.0451
95% Confidence Interval lower-Upper	0.687-0.772	0.630-0.719	0.628-0.711	0.502-0.642	0.453-0.593	0.574-0.700	0.502-0.642	0.650-0.737	0.480-0.575	0.503-0.598
P-value	<0.001	<0.001	<0.001	0.658	0.918	0.0113	0.216	0.001	0.5553	0.2610
Youden Index	0.4830	0.3408	0.3279	0.1586	0.2839	0.2983	1.238	0.3610	0.1235	0.1681
Associate Criteria	>50	>26.9	>28.5	≤90	≤86	>0.95	>0.91	≤0.03	>34	>36
Sensitivity	80.85	68.09	53.19	66.67	70.90	80.77	66.67	87.23	19.15	51.06
Specificity	67.45	65.99	79.60	49.19	55.10	49.06	49.19	48.87	93.20	65.74

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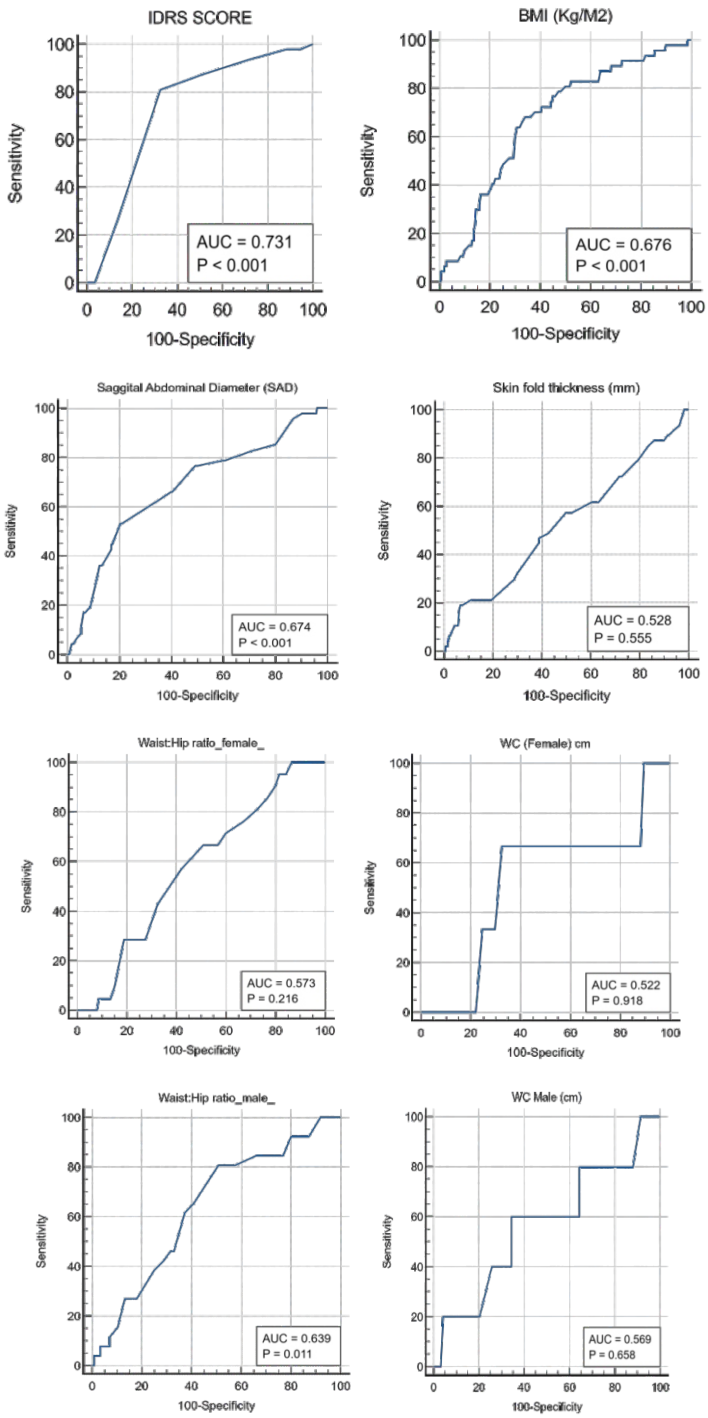
Among 444 participants, 206 (46.4%) were female, and 238 (53.6%) were male. The study participants' average age was 45.3±13.7 years. 47 (10%) individuals were diabetic, while 397 (89.4%) were non diabetic. Table 1 shows that participants with diabetes (n = 47) had significantly higher Indian Diabetes Risk Scores, compared with those without diabetes (n = 397). The diabetic group's mean was 58.29 ± 12.21, while the non-diabetic group's was 45.5±17.42 (p<0.001). The diabetes group had a substantially higher (28.07±4.48 kg/m2) than the non-diabetic group (25.50±4.52 kg/m2; p < 0.001), and a similar pattern was seen in the sagittal abdominal diameter (28.70±4.83 vs 25.80±4.83 cm; p< 0.001).Waist circumference showed a modest but statistically significant increase among those with diabetes (93.88 ± 10.78 vs. 88.49 ± 13.77 cm; p = 0.010). The waist-to-height ratio differed significantly between groups (0.0315 ± 0.0207 vs 0.0447±0.0319 p = 0.006), indicating greater central obesity in the diabetes cohort. In contrast, waist-to-hip ratio (0.969 ± 0.0899 vs. 0.961 ± 0.4580; p = 0.908), skin-fold thickness (24.81 ± 10.70 vs. 23.37 ± 9.20 mm; p = 0.319), and percentage body fat (35.12 ± 5.82% vs. 34.00 ± 6.28%; p = 0.247) did not differ significantly between groups. These findings highlight the reliable discrimination of IDRS, BMI, sagittal abdominal diameter, waist circumference, and waist to height ration for identifying individual with diabetes, whereas general adiposity measures such as skin fold thickness and percent body fat add little discrimination in the population Table 2 demonstrate how receiver operating characteristic (ROC) analysis was used to evaluate the diagnostic performance of different anthropometric and risk-score factors. With an area under the curve (AUC) of 0.731 (standard error [SE] = 0.0334;95% confidence interval [CI]:0.687-0.772; p< 0.001), the Indian diabetic risk score (IDRS) showed the best discriminative capacity. IDRS attained a sensitivity of 80.85% and specificity of 67.45% at an ideal cut-off of > 50 (as indicated by the Youden Index of (0.4830). Other parameters showed varied performance. The Body Mass Index (BMI) had an AUC of 0.676 (SE= 0.039; 95% CI: 0.630-0.71(P< 0.001) with a cut-off of >26 yielding 68.09% sensitivity and 65.99% specificity (Youden index=0.3408). The sagittal abdominal diameter (SAD) recorded an AUC of 0.674[SE= 0.0440; 95% CI 0.628-0.711; P<0.001) with 53.19% sensitivity and 79.60% specificity at a cut-off of > 28.5(Youden index = 0.3279). Waist circumference in males showed a relatively low performance with AUC of 0.573 (SE=0.0590; 95% CI 0.502- 0.642; P=0.2157) sensitivity of 66.67% and specificity of 49.19% at >0.91 (Youden index 0.1586). At a threshold of >0.95(Youden index = 0.2839), the waist circumference of males showed a somewhat improved AUC of 0.639 (SE= 0,0549; 95% CI:0.574-0.700; P=0.01), sensitivity of 80.77% and specificity of 49.19%. Females (WHR) had an AUC of 0.632 (SE= 0.0584; 95% CI:0.562-0.698; P=0.216) with 66.67% sensitivity and 49.19% specificity at > 0.91(Youden index=1.238) for weight-hip-parameter, while females (WHR) had an AUC of 0.573 (SE = 0.502- 0.642; P= 0.216) with 66.67% sensitivity and 49.19% specificity at >0.91.At an associated criteria of ≤0.03 (Youden index = 0.3610), the waist-to-height ratio (WHtR) showed an AUC of 0.695 (SE= 0.0337; 95% CI: 0.695-0.737: P= 0.001), sensitivity of 82.23% , and specificity of 48.87%. The percentage of body fat and skinfold thickness, on the other hand, offered little discrimination. At a threshold of >34 (Youden index = 0.1235), skinfold thickness had an AUC of 0,528 (SE=0.0477; 95% CI:0.480-0.575; P= 0.5553) with high specificity (93.20%) and low sensitivity (19.15%).

At a cut-off >36 (Youden index = 0.1681), the % body fat parameter had an AUC of 0.0551 (SE = 0.0451; 95% CI: 0.503-0.598; P = 0.2610), 51.06% sensitivity, and 65.74% specificity, Together, these result shows that IDRS, BMI, sagittal abdominal diameter, waist circumference, and waist-to-height ratio are valid screening methods for identifying people with diabetes, while general measures of adiposity, such as skin-fold thickness and body-fat percentage, showed poor discriminatory power and might be less helpful in this context.



Discussion

The Indian Diabetes Risk Score (IDRS) was determined to be the most effective screening cut-off for type 2 diabetes Mellitus in our population. The IDRS's sensitivity was 80'85%, its specificity was 67.45%, and its area under the curve (AUC) was 0.731. This demonstrates that the IDRS was superior to other metrics like body mass index (BMI) and sagittal abdominal diameter (SAD), which had moderate AUCs of 0.676 and 0.674.

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The current results align with research by Doddamani et al. [10] and Ramachandran et al. [6], who reported similar AUC values for the IDRS, ranging from 0.70 to 0.75, thereby highlighting its reliability across the Indian population. Similarly, Halder et al. [11] found that urban females had moderate predictive ability, albeit with somewhat lower AUCs, perhaps due to gender-restricted composition m;] and narrower age ranges of their samples. The inclusion of both sexes and a wider age distribution in the current study may have contributed to the higher AUC observed, thereby enhancing the findings' applicability and reliability across Indian populations.

Trends were similar; for instance, Swetha H., et al. (12). mentioned the IDRS as a useful diabetes risk assessment tool, with sensitivity and specificity comparable despite slightly lower AUCs. A study by Halder et al. [11] among urban females had an AUC of around 0.60. Our higher AUC and sensitivity may be due to the wider age range and mixed gender representation, and thus the need for population-specific research in determining screening cut-offs.

Sagittal Abdominal Diameter (AUC = 0.674) and Body Mass Index (AUC = 0.676) were the two anthropometric measures that showed the most discriminatory power, confirming their use as secondary screening instruments. These results are consistent with earlier meta-analyses showing the value of central obesity indices in determining metabolic risk, especially the waist-to-height ratio and waist circumference. However, due to their accuracy limitations and inter-observer variability in field settings, the waist-to-hip and skin-fold thickness were less predictive. In Indian adults, where central obesity and visceral fat distribution are major factors, generalised adiposity alone does not accurately reflect metabolic risk, as evidenced by the particularly poor performance of percentage body fat in predicting diabetes risk.

Other anthropometric measures, such as waist circumference (WC) and weight-to-hip ratios, differed by sex. Our data revealed a WC of 0.573 in male participants and an unexpectedly elevated weight-to-hip ratio in female participants, differences that warrant further exploration. These findings are consistent with evidence attributing effects of variables such as fat distribution and measurement error to anthropometric estimates. A comparative assessment of the ADA, IDRS, and FINDRISC models indicates that although valuable, single-parameter anthropometry can misclassify subjects, supporting the utility of parametric methods such as IDRS.

Our research concluded that body composition measurements, such as skin fold thickness and % body fat, performed badly, with an AUC for % body fat of 0.0551. The other evidence also indicates body fat estimation does not necessarily correlate with Type 2 Diabetes Mellitus's metabolic hazards. Hence, we require supplementary indicators of risk in the form of lifestyle and genetics for a better predictive index.

In conclusion, these results validate the use of composite risk scores such as the IDRS in combination with some anthropometric measures to improve diabetes screening. Comparison with other journals shows that although the IDRS is promising, differences in performance arise from population-specific characteristics and techniques. Future studies should aim to integrate biochemical markers, lifestyle, and better anthropometric measures for better Type 2 Diabetes Mellitus screening.

RECOMMENDATION & CONCLUSION

The Indian Diabetes Risk Score (IDRS) demonstrated superior discriminative power and can serve as the primary screening tool for diabetes in the north Indian population. Implementing a two-step strategy- initial IDRS assessment followed by targeted measurement (BMI OR Sagittal Abdominal Diameter) and, if required, point-of-care glucose testing optimizes resource use in low-resource settings. Applying sex-specific waist-based cut-offs enhances risk stratification, whereas routine evaluation of skinfold thickness and Body-fat percentage may be omitted given their poor diagnostic value. Digitizing the IDRS for mobile health platforms to streamline community screening. Training community health workers on gender-tailored thresholds. Conducting cost-effectiveness analysis of the two-tier model in rural versus urban settings. Integrating point-of-care HbA1C or glucose strips in tier 2 to further refine risk stratification.

THE STUDY'S LIMITATIONS

Recall bias may have affected the data obtained on participants' memories.

THE STUDY'S RELEVANCE

Similar studies have been done in other parts of India and globally,but have not been done in Kanpur.

AUTHOR'S PARTICIPATION

Each author has made an equal contribution.

FINANCIAL ASSISTANCE AND SUPPORT

Nothing

CONFLICT OF INTEREST

Nothing

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