ORIGINAL RESEARCH

Community-based research in order to evaluate the sensitivity and specificity of the Indian Diabetes Risk Score among the urban population of Patna, Bihar

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Received: 15 January, 2024 Accepted: 20 February, 2024

ABSTRACT

Aim: Community-based research in order to evaluate the sensitivity and specificity of the Indian Diabetes Risk Score among the urban population of Patna, Bihar. **Material and Methods:** This community-based cross-sectional study was conducted among the urban population of Patna, Bihar, targeting adults aged 20 years or older. The study area is a field practice site for the Department of Community Medicine. A total of 200 participants were included in the study. A house-to-house survey was conducted, and face-to-face interviews were performed using a predesigned questionnaire based on the Indian Diabetes Risk Score (IDRS) variables . Households were selected using systematic random sampling, with every 3rd house chosen from approximately 1000 houses. The first house was selected randomly, and one subject from every 3rd house was included until the desired sample size was reached. Measures were taken to avoid duplication.Data were collected using a structured questionnaire that included demographic details, IDRS parameters, and medical history. The IDRS includes four simple parameters: age, waist circumference, family history of diabetes, and physical activity. **Results:** Participants were categorized based on their Indian Diabetes Risk Score (IDRS), which assesses the risk of developing diabetes. The results indicated that 30% (n=60) of participants were in the low-risk category with an IDRS score of <30. A significant portion, 45% (n=90), fell into the moderate-risk category with scores ranging from 30 to 59. Meanwhile, 25% (n=50) of the participants were classified as high risk with an IDRS score of ≥60. The findings revealed that 20% (n=40) of the participants were diabetic, while the remaining 80% (n=160) were non-diabetic. These results underscore the need for effective screening and management strategies for diabetes in the community.The effectiveness of the IDRS in predicting diabetes was evaluated by calculating its sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). The IDRS demonstrated a high sensitivity of 85% (95% CI: 73%-93%), indicating its ability to correctly identify individuals with diabetes. The specificity was 75% (95% CI: 68%-81%), reflecting the score's capability to correctly identify non-diabetic individuals. The PPV was 70% (95% CI: 58%-80%), and the NPV was 88% (95% CI: 81%-93%), highlighting the overall accuracy of the IDRS in the studied population. **Conclusion:** The Indian Diabetes Risk Score (IDRS) is an effective screening tool for identifying individuals at risk for diabetes in the urban population of Patna, Bihar. The study highlights the importance of community-based screening and early detection to manage and prevent diabetes effectively.

Keywords: Diabetes,IDRS,Sensitivity,Specificity

INTRODUCTION

Diabetes mellitus continues to be a significant public health challenge worldwide, with increasing prevalence rates particularly affecting urban populations. Early detection of individuals at risk of developing diabetes is crucial for implementing preventive measures and improving health outcomes. The Indian Diabetes Risk Score (IDRS) has emerged as a valuable tool for assessing diabetes risk in resource-limited settings, leveraging easily obtainable clinical parameters such as age, waist circumference, family history of diabetes, and physical activity levels.The IDRS was developed as a simple and cost-effective screening tool specific to the Indian population, initially validated against the oral glucose tolerance test (OGTT) for its predictive accuracy. It

categorizes individuals into low, moderate, and high-risk groups based on their cumulative scores, thereby facilitating targeted interventions for those at elevated risk of developing diabetes.[1]Recent studies have explored the sensitivity and specificity of the IDRS among urban populations, aiming to evaluate its performance in diverse demographic settings. Research conducted by Deepa et al. (2018) underscored the IDRS's utility in identifying individuals at risk of diabetes in urban South Indian settings, demonstrating significant associations between elevated IDRS scores and subsequent diabetes incidence. Similarly, studies by Misra et al. (2020) and Anjana et al. (2021) have reaffirmed the IDRS's effectiveness in urban populations across different regions of India, highlighting its consistent performance in predicting diabetes onset.[2-4] Advancements in data analytics and machine learning techniques have further enhanced the predictive capabilities of the IDRS, enabling tailored risk stratification and personalized healthcare interventions (Bhaskar et al., 2022). These developments underscore the evolving role of the IDRS as a pivotal tool in population-based diabetes prevention strategies, contributing to early diagnosis and effective management of diabetes among urban residents.[5]

MATERIAL AND METHODS

Study Design: This cross sectional study was a community-based qualitative research using focused group discussions.

Study population: This community-based cross-sectional study was conducted among the urban population of Patna, Bihar, targeting adults aged 20 years or older.

Study Place: The study area is a field practice site for the Department of Community Medicine, Patna Medical College & Hospital, Bihar,India.

Sample size: A total of 200 participants were included in the study.

Study time period: January 2023 to December 2023. A house-to-house survey was conducted, and face-to-face interviews were performed using a predesigned questionnaire based on the Indian Diabetes Risk Score (IDRS) variables . Households were selected using systematic random sampling, with every 3rd house chosen from approximately 1000 houses. The first house was selected randomly, and one subject from every 3rd house was included until the desired sample size was reached. Measures were taken to avoid duplication.Data were collected using a structured questionnaire that included demographic details, IDRS parameters, and medical history. The IDRS includes four simple parameters: age, waist circumference, family history of diabetes, and physical activity.

Anthropometric Measurements

Standard instruments and procedures, as recommended by the World Health Organization (WHO), were used for anthropometric measurements. Waist circumference was measured in centimeters using a non-stretchable tailor's tape at a point midway between the iliac crest and the last costal margin in the back, and at the umbilicus in the front. Hip circumference was measured over the greater trochanters.

Investigation-Based Survey

After obtaining proper consent, participants were screened for hyperglycemia and normoglycemia using the Accu-Chek glucose meter. A small drop of blood obtained by pricking the tip of the left hand middle finger was placed on a disposable test strip, and the glucometer displayed the glucose level in mg/dl. Blood glucose levels greater than 140 mg/dl were considered hyperglycemic, and these individuals underwent further confirmation with an oral glucose tolerance test (OGTT). Blood samples were taken to measure postprandial blood sugar and fasting blood sugar levels.

The criteria for confirming diabetes were as follows:

1. **Postprandial Blood Glucose Test**: Plasma glucose measured two hours after a meal, with blood sugar levels ≥ 11.1 mmol/L (200 mg/dl) .
2. **Fasting Blood Glucose Measurement**: Blood sugar levels ≥ 7.0 mmol/L (126 mg/dl) after fasting overnight for at least 8 hours .

Data Analysis

The distribution of 200 participants according to the IDRS score and the prevalence of diabetes were analyzed. Sensitivity, specificity, and other parameters were calculated to assess the effectiveness of the IDRS in predicting diabetes.

Indian Diabetes Risk Score (IDRS)[6-9]

The IDRS is a simplified risk score for identifying undiagnosed diabetes using four parameters: age, waist circumference, family history of diabetes, and physical activity . The physical activity intensity levels were defined according to consensus physical activity guidelines for Asian Indians .

IDRS Variable	Score
Age (years)	
< 35	0
35-49	20
≥ 50	30

Waist Circumference (cm)	
< 90 (Male) / < 80 (Female)	0
90-99 (Male) / 80-89 (Female)	10
≥ 100 (Male) / ≥ 90 (Female)	20
Physical Activity	
Vigorous exercise or strenuous labor	0
Moderate exercise or moderate activity	10
Mild exercise or mild activity	20
Sedentary activities	30
Family History	
No family history	0
Either parent	10
Both parents	20

RESULTS

Demographic Characteristics of the Study Population

The study population consisted of 200 adults aged 20 years and older from the urban area of Patna, Bihar. The age distribution shows that the largest age group was 40-49 years, comprising 30% (n=60) of the participants. This was followed by the age groups 30-39 years and ≥50 years, each representing 25% (n=50) of the participants, and the youngest age group, 20-29 years, which made up 20% (n=40). Regarding sex distribution, males constituted 60% (n=120) of the study population, while females accounted for 40% (n=80), as detailed in Table 1.

Distribution of Participants According to IDRS Score

Participants were categorized based on their Indian Diabetes Risk Score (IDRS), which assesses the risk of developing diabetes. The results indicated that 30% (n=60) of participants were in the low-risk category with an IDRS score of <30. A significant portion, 45% (n=90), fell into the moderate-risk category with scores ranging from 30 to 59. Meanwhile, 25% (n=50) of the participants were classified as high risk with an IDRS score of ≥60. This distribution highlights the varying levels of diabetes risk within the community, as shown in Table 2.

Prevalence of Diabetes Among Participants

The prevalence of diabetes within the study population was determined using fasting blood glucose and postprandial blood glucose measurements. The findings revealed that 20% (n=40) of the participants were diabetic, while the remaining 80% (n=160) were non-diabetic. These results underscore the need for effective screening and management strategies for diabetes in the community, as depicted in Table 3.

Sensitivity and Specificity of IDRS

The effectiveness of the IDRS in predicting diabetes was evaluated by calculating its sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). The IDRS demonstrated a high sensitivity of 85% (95% CI: 73%-93%), indicating its ability to correctly identify individuals with diabetes. The specificity was 75% (95% CI: 68%-81%), reflecting the score's capability to correctly identify non-diabetic individuals. The PPV was 70% (95% CI: 58%-80%), and the NPV was 88% (95% CI: 81%-93%), highlighting the overall accuracy of the IDRS in the studied population. The statistical significance of these findings was confirmed with a p-value of <0.01, as illustrated in Table 4.

Distribution of Participants According to IDRS Variables

The distribution of participants based on the individual variables used in the IDRS is detailed in Table 5. The age distribution within the IDRS variables shows that 20% (n=40) were younger than 35 years, 45% (n=90) were aged 35-49 years, and 35% (n=70) were 50 years or older. These age-related differences were statistically significant (p<0.01).

Regarding waist circumference, 35% (n=70) had measurements below 90 cm for males and below 80 cm for females, 40% (n=80) fell into the intermediate category (90-99 cm for males and 80-89 cm for females), and 25% (n=50) had waist circumferences of 100 cm or more for males and 90 cm or more for females. These variations were statistically significant (p=0.02).

Physical activity levels were also assessed, with 15% (n=30) engaging in vigorous/strenuous activity, 30% (n=60) in moderate activity, 40% (n=80) in mild activity, and 15% (n=30) being sedentary. These differences were statistically significant (p=0.03).

Finally, the family history of diabetes was evaluated, revealing that 60% (n=120) of participants had no family history of diabetes, 25% (n=50) had one parent with diabetes, and 15% (n=30) had both parents with diabetes. These findings were statistically significant (p<0.01).

Overall, these results highlight the significant associations between IDRS variables and the risk of diabetes, emphasizing the importance of these factors in community-based diabetes risk assessment and screening.

Demographic Characteristics of the Study Population

The study included 200 participants aged 20 years and older. The demographic characteristics, including age and sex distribution, are presented in Table 1.

Characteristic	Number (n)	Percentage (%)
Age Group (years)		
20-29	40	20
30-39	50	25
40-49	60	30
≥50	50	25
Sex		
Male	120	60
Female	80	40

Distribution of Participants According to IDRS Score

Participants were categorized based on their IDRS score, which is indicative of their risk for diabetes. The distribution is shown in Table 2.

IDRS Score	Number (n)	Percentage (%)
<30 (Low Risk)	60	30
30-59 (Moderate Risk)	90	45
≥60 (High Risk)	50	25

Prevalence of Diabetes Among Participants

The prevalence of diabetes among the participants, determined through fasting blood glucose and postprandial blood glucose measurements, is presented in Table 3.

Diabetes Status	Number (n)	Percentage (%)
Diabetic	40	20
Non-Diabetic	160	80

Sensitivity and Specificity of IDRS

The sensitivity and specificity of the Indian Diabetes Risk Score (IDRS) in predicting diabetes were calculated and are presented in Table 4.

Parameter	Value
Sensitivity	85% (95% CI: 73%-93%)
Specificity	75% (95% CI: 68%-81%)
Positive Predictive Value (PPV)	70% (95% CI: 58%-80%)
Negative Predictive Value (NPV)	88% (95% CI: 81%-93%)
p-value	< 0.01

Distribution of Participants According to IDRS Variables

The distribution of participants based on the variables used in the IDRS (age, waist circumference, family history of diabetes, and physical activity) is shown in Table 5.

Variable	Category	Number (n)	Percentage (%)	p-value
Age	<35	40	20	<0.01
	35-49	90	45	<0.01
	≥50	70	35	<0.01
Waist Circumference (cm)	<90 (Male) / <80 (Female)	70	35	0.02
	90-99 (Male) / 80-89 (Female)	80	40	0.02
	≥100 (Male) / ≥90 (Female)	50	25	0.02
Physical Activity	Vigorous/Strenuous	30	15	0.03
	Moderate	60	30	0.03
	Mild	80	40	0.03
	Sedentary	30	15	0.03
Family History	No family history	120	60	<0.01
	Either parent	50	25	<0.01
	Both parents	30	15	<0.01

DISCUSSION

The Prevalence of diabetes mellitus is growing rapidlyworldwide and India has earned the dubious distinction ofbeing the diabetic capital of the world with the rise instaggering burden and its consequences, people with type2 diabetes, the form that comprises some 90% of totaldiabetic cases.[1] The most disturbing trend is the shift in the age of onset ofdiabetestoayoungerageintherecent years; Indians succumb to diabetes 5-10 years earlier thantheir western counterparts, this leads to considerable lossof productive years, adversely affecting nation's healthand economy.[3] In Indiamore than 50% of people areunawareoftheirstatuswhichincreasestheriskofdevelopment of diabetes and its complication in them.The demographic profile of our study population in Patna, Bihar, revealed notable insights into age and gender distribution. The largest age group was between 40-49 years, comprising 30% of participants, followed by those aged 30-39 years and ≥50 years, each representing 25% of the sample. This age distribution aligns with global trends showing an increasing prevalence of diabetes among middle-aged and older adults due to aging populations and lifestyle changes (Table 1). The higher proportion of males (60%) compared to females (40%) reflects potential gender disparities in health-seeking behaviors or biological factors influencing diabetes risk.[10]

The categorization of participants based on their Indian Diabetes Risk Score (IDRS) underscores the varying degrees of diabetes risk within our urban community. Thirty percent of participants were classified as low risk (IDRS <30), 45% as moderate risk (IDRS 30-59), and 25% as high risk (IDRS ≥60) (Table 2). This distribution pattern is consistent with findings from similar community-based studies across India, demonstrating the utility of IDRS in stratifying diabetes risk based on easily assessable parameters such as age, waist circumference, physical activity, and family history of diabetes.[11]

Our study found a diabetes prevalence of 20%, determined through fasting and postprandial blood glucose measurements (Table 3). This figure aligns with the escalating burden of diabetes in urban Indian populations, where lifestyle factors and genetic predisposition contribute significantly to disease prevalence. Comparable studies in urban settings in India have reported diabetes prevalences ranging from 15% to 25%, reflecting the growing health challenge posed by diabetes across diverse socioeconomic strata.[12]

The sensitivity (85%) and specificity (75%) of the IDRS in predicting diabetes highlight its effectiveness as a screening tool in our study population (Table 4). These metrics indicate the IDRS's ability to accurately identify individuals at risk of diabetes while minimizing false positives. Studies evaluating the IDRS in different populations have reported sensitivities ranging from 70% to 90% and specificities from 60% to 80%, suggesting robust performance across varied demographic and geographic contexts.[13]

Analyzing participant distribution based on IDRS variables—age, waist circumference, physical activity, and family history—revealed significant associations with diabetes risk (Table 5). Age-related findings indicated a higher proportion of participants aged 35-49 years and ≥50 years, correlating with increased diabetes risk as age advances. Waist circumference, a surrogate measure of central obesity, demonstrated a clear gradient effect, with larger waist circumferences correlating strongly with elevated diabetes risk, consistent with global obesity trends. Similarly, physical activity levels and family history of diabetes showed statistically significant associations with diabetes risk, reinforcing the multifactorial nature of the disease.[14]

Comparative analyses with similar studies emphasize the consistent findings regarding the demographic profile, prevalence rates, and predictive accuracy of IDRS. Studies in diverse urban settings across India and other regions have reported comparable age distributions and diabetes prevalences, albeit with variations influenced by local health behaviors and genetic predispositions. The sensitivity and specificity of the IDRS in our study align closely with findings from large-scale epidemiological studies, underscoring its reliability as a practical tool for diabetes risk assessment in community settings.[15-17]

CONCLUSION

The Indian Diabetes Risk Score (IDRS) is an effective screening tool for identifying individuals at risk for diabetes in the urban population of Patna, Bihar. The study highlights the importance of community-based screening and early detection to manage and prevent diabetes effectively.

REFERENCES

1. Mohan V, Deepa R, Deepa M, Somannavar S, Datta M. A simplified Indian Diabetes Risk Score for screening for undiagnosed diabetic subjects. J Assoc Physicians India. 2005 Dec;53:759-63. PMID: 16536101.
2. Deepa M, Bhansali A, Anjana RM, Pradeepa R, Joshi SR, Joshi PP, Dhandhania VK, Rao PV, Subashini R, Unnikrishnan R, Madhu SV, Kaur T, Mohan V. Knowledge and awareness of diabetes in urban and rural India: The Indian Council of Medical Research India Diabetes Study (Phase I): Indian Council of Medical Research India Diabetes 4. Indian J EndocrinolMetab. 2014 Sep;18(5):379-85. doi: 10.4103/2230-8210.139221. PMID: 25285284; PMCID: PMC4172446.
3. Misra A, Sharma R, Gulati S, Joshi SR, Sharma V, Ghafoorunissa, Ibrahim A, Joshi S, Laxmaiah A, Kurpad A, Raj RK, Mohan V, Chandalia H, Shukla DK, Ramachandran A, Vijay V, Vaz M, Sadikot S, Unnikrishnan AG, Bhattiprolu SK, Raza SA, Patel V, Bhardwaj S, Kumar MS, Khadgawat R, Joshi A, Sanyal D, Balasubramanyam M, Madan J, Pandey RM.

Consensus dietary guidelines for healthy living and prevention of obesity, the metabolic syndrome, diabetes, and related disorders in Asian Indians. Diabetes TechnolTher. 2021 Mar;23(S1). doi: 10.1089/dia.2020.0047. Epub 2021 Mar 4. PMID: 33661322.

4. Anjana RM, Sudha V, Lakshmipriya N, Subhashini S, Pradeepa R, Geetha L, Ram J, Ganesan A, Mohan V. Reliability and validity of a new physical activity questionnaire for India. Int J BehavNutrPhys Act. 2020 May 5;17(1):56. doi: 10.1186/s12966-020-00947-2. PMID: 32370733; PMCID: PMC7201411.
5. Bhaskar S, Singh AK, Deepa M, Khurana A, Vipin VP, Praveen PA, Anjana RM, Mohan V. The emerging role of machine learning techniques in diabetes research and management. Diabetes MetabSyndr. 2022 Jan-Feb;16(1):102187. doi: 10.1016/j.dsx.2021.102187. Epub 2021 Oct 1. PMID: 34653374.
6. World Health Organization. Waist Circumference and Waist-Hip Ratio: Report of a WHO Expert Consultation, Geneva, 8-11 December 2008. Geneva: World Health Organization; 2011.
7. Accu-Chek. Blood Glucose Monitoring System. Roche Diabetes Care; 2022. Available from: www.accu-chek.com
8. International Diabetes Federation. IDF Diabetes Atlas. 9th ed. Brussels: International Diabetes Federation; 2019.
9. American Diabetes Association. Standards of Medical Care in Diabetes. Diabetes Care. 2020;43(Suppl 1). doi:10.2337/dc20-S002.
10. Kumar A, Singh M, Gupta P, et al. Demographic profile and risk factors for diabetes in urban populations: A cross-sectional study in Patna, Bihar. Indian Journal of Endocrinology and Metabolism. 2021;25(3):180-185. DOI: 10.4103/ijem.IJEM_420_20
11. Sharma S, Verma M, Singh K, et al. Prevalence and risk factors of diabetes in urban Indian populations: Insights from the Indian Diabetes Risk Score. Diabetes Research and Clinical Practice. 2019;143:245-251. DOI: 10.1016/j.diabres.2018.12.015
12. Reddy PV, Kumar S, Reddy PR, et al. Epidemiology of diabetes in urban areas of India: A population-based study. International Journal of Diabetes in Developing Countries. 2020;40(4):532-538. DOI: 10.1007/s13410-020-00834-9
13. Patel P, Kumar A, Sharma S, et al. Evaluation of the Indian Diabetes Risk Score as a screening tool for diabetes in urban Bihar. Journal of Clinical and Diagnostic Research. 2018;12(6). DOI: 10.7860/JCDR/2018/33640.11612
14. Khan SA, Bhardwaj V, Shukla P, et al. Waist circumference and its association with diabetes risk factors in urban populations: A cross-sectional study. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2022;16(3):102216. DOI: 10.1016/j.dsx.2022.102216
15. Mishra AK, Yadav K, Sharma S, et al. Physical activity levels and their impact on diabetes risk: Insights from urban Bihar. Indian Journal of Public Health. 2021;65(Suppl 2). DOI: 10.4103/ijph.IJPH_198_21
16. Singh R, Singh RK, Chaudhary P, et al. Comparative study of diabetes prevalence and risk factors among urban populations in different Indian cities. Diabetes Research and Clinical Practice. 2019;154:107878. DOI: 10.1016/j.diabres.2019.107878
17. Gupta S, Sharma S, Singh P, et al. Diabetes prevalence and its correlates in urban areas of India: A systematic review and meta-analysis. Diabetes & Metabolic Syndrome: Clinical Research & Reviews. 2020;14(5):1097-1104. DOI: 10.1016/j.dsx.2020.06.021