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## ORIGINAL RESEARCH

# Analysis of Indian diabetic risk score and its association with body mass index and HBA1C levels in Western U.P.

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**Abstract**

**Aim**: 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.

**Material and methods**:The present prospective study was conducted in the department of Medicine at Autonomous State Medical College & SNM Hospital, Firozabad (U.P.)from September 2021 to June 2022. The study group was consisted of 500 patients, aged between 25 and 70 years. HbA1c was also measured as one the diagnostic parameter for the confirmation of diabetes.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.

**Results**: High, moderate and low diabetes risk score was found among 52.2% (261), 42.4% (212) and 5.4% (27) of the subjects respectively. Most of the obese, overweight and normal subjects belonged to high risk, moderate risk and no risk diabetes category with statistically significant difference as $p<0.01$.Significant association was found between subjects with higher risk score and HbA1c.

**Conclusion**: Our study fully supports the validity of IDRS as it can be used as a cost‑effective tool for mass screening of diabetes. This scoring system can be used for strict monitoring for diabetes and obesity so that timely intervention can be done to reduce the early development of diabetes complications and severe obesity comorbidities.

**Keywords**: IDRS, Diabetes, BMI, HbA1c

## Introduction

Obesity is a complex condition, one with serious social and psychological dimensions that affects virtually all age and socioeconomic groups and threatens to overwhelm both developed and developing countries. As in developed societies, the risk for obesity in developing countries like India is also strongly influenced by diet and lifestyle, which are changing dramatically as a result of the economic and nutrition transition. According to WHO global estimates, about 13% of the world's adult population (11% of men and 15% of women) were obese in 2014[1]. The prevalence 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[2].

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The epidemiological survey used BMI as a measure of general obesity, and waist circumference (WC) and waist‐hip ratio (WHR) as measures of central/abdominal obesity (AO). Cutoff value of BMI is different for Asian Indians because they tend to develop diabetes at a significantly lower BMI and WC. Logue et al. confirmed that patients with T2DM have U‐shaped association of BMI with mortality and previously it was also reported that the higher BMI is associated with increased risk of coronary heart disease and cardiovascular mortality among people with T2DM. These studies indicate that measuring BMI is important and cost‐effective parameter for early screening of obesity and prevalence of T2DM as well as monitoring and managing the T2DM patients also[3].

So, early identification of the high risk individuals would help in taking appropriate intervention in the form of dietary changes and increasing physical activity, thus helping to prevent, or at least delay, the onset of diabetes. This means that identification of at risk individuals is extremely important if we are to prevent diabetes in India.

Recently, risk scores based on simple anthropometric and demographic variables have been devised to detect high risk individuals named Indian Diabetes Risk Score (IDRS) which was devised by the Madras Diabetes Research Foundation (MDRF) in the year 2005. This IDRS is a simple and efficient screening tool which can be used by the community health worker to screen the high risk population[4].

The Indian Diabetic Risk Score (IDRS) is a simple, low cost, feasible tool for mass screening programme at the community level. IDRS uses two modifiable risk factors (waist circumference and physical inactivity) and two non-modifiable risk factors (age and family history of diabetes), providing a clear message that if modifiable risk factors are altered, the risk score can be considerably reduced. Subjects with high IDRS regardless of their blood sugar status, are ideal candidates for life style modification as these are risk factors for not only diabetes but also for cardiovascular disease[5].

Various other studies has been conducted to find out the validity of this screening tool like in 2012, Bharti et al conducted a study at Sewangi and find out 97.5% sensitivity and 87.9% specificity of IDRS score whereas another research conducted at Lucknow in 2015 found 81.4% sensitivity and 72.0% specificity. Although, this tool is 13 year old, but still, it has not become so much popular among health personnel, even most of them have no knowledge of it[6]. Most prevalence studies in India have come from large metropolitan cities and some from rural areas but none of the study had assessed it at rural as well as urban level. Hence the present study was conducted 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.

## Material and methods

The present prospective study was conducted in the department of Medicine at Autonomous State Medical College & SNM Hospital, Firozabad (U.P.)from September 2021 to June 2022. The study group was consisted of 500 patients, aged between 25 and 70 years. HbA1c was also measured as one the diagnostic parameter for the confirmation of diabetes. Patients were enrolled in the study after obtaining written informed consent and approval from Institutional Ethical Committee.

### Inclusion criteria

Age more than 25 years.

a. Un-diagnosed diabetic subjects.

### Exclusion criteria

Subjects with following characteristics were excluded from the study:

a. Ischemic heart disease, angina, myocardial infarction (MI),

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b. Electrocardiogram abnormalities,
c. Those with other concurrent sickness such as chronic liver disease, hypothyroidism or those on drugs such as diuretics and women using oral contraceptives or pregnant.

The data was collected by a preformed structured interviewer-administered questionnaire that was pretested with modifications made prior to its use in the study. 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.

**Definition**

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. IDRS analysis was done with the help of all four parameters. If age <35 years score is = 0, if 35-49 years score is=20, if >50 years score= 30, waist circumference <80 cm for female and <90cm for male score = 0, >80-89 cm for female and >90-99 cm male score=10, >90 cm for female and >100 cm for male score=20, physical activities vigorous exercise or strenuous work score=0, moderate exercise work-home=10, mild exercise work/ home = 20, no exercise and sedentary work-home =30, family history of diabetes, no family history = 0, family history present either parent = 10, both parents =20. After adding all four parameters, if risk score (>60 very high risk, 30-50 moderate risk, <30 low risk). 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

**Laboratory investigations**

Two‑milliliter 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 so collected was tabulated in an excel sheet, under the guidance of statistician. The means and standard deviations of the measurements per group were used for statistical analysis (SPSS 22.00 for windows; SPSS inc, Chicago, USA). For each assessment point, data were statistically analyzed using factorial ANOVA. Difference between two groups was determined using chi square test and the level of significance was set at $p < 0.05$.

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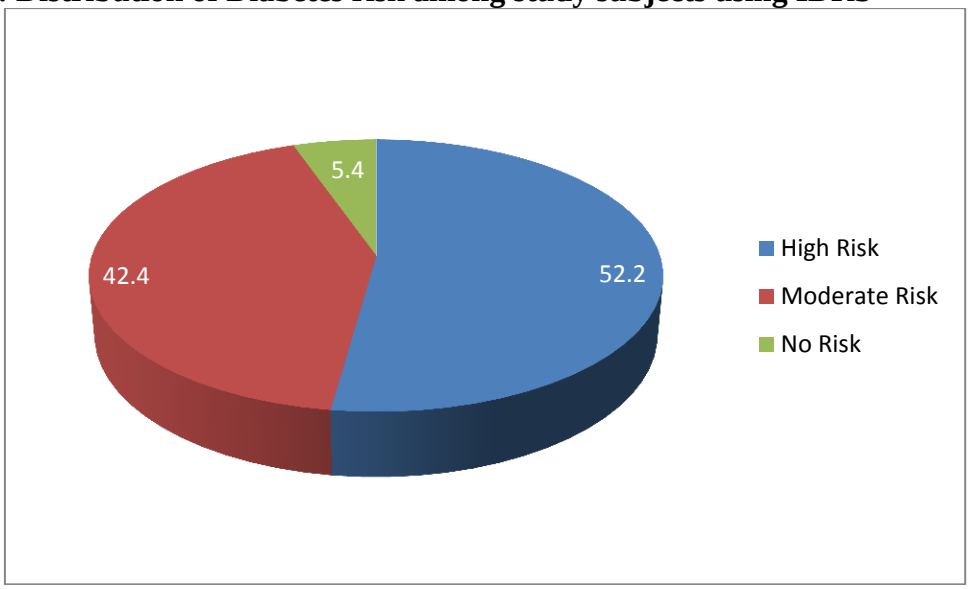
**Results**

HbA1c was also measured as one the diagnostic parameter for the confirmation of diabetes. High, moderate and low diabetes risk score was found among 52.2% (261), 42.4% (212) and 5.4% (27) of the subjects respectively (graph 1).

**Graph 1: Distribution of Diabetes risk among study subjects using IDRS**




Out of 500 subjects, 377 (75.4%) and 123 (24.6%) were females and males 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 $p<0.05$ as shown in table 1.

**Table 1: Distribution of Diabetes risk in relation to age using IDRS**

| Diabetes risk | Mean Age (in years) | SD | Anova Test | p value |
|---|---|---|---|---|
| High Risk | 44.31 | 8.696 | 6.97 | 0.04* |
| Moderate Risk | 40.67 | 9.225 | | |
| No Risk | 35.44 | 9.537 | | |
| Total | 39.47 | 8.953 | | |

*: statistically significant

High diabetes risk was found among 35.6%, 12.6% and 51.7% of the illiterate, primary and secondary passed subjects. No diabetes risk was reported among 81.5% of the secondary passed subjects. When diabetes risk among subjects was compared in relation to education, it was found to be statistically significant as $p<0.05$ (table 2).

**Table 2: Distribution of Diabetes risk in relation to education using IDRS**

| Diabetes risk | | Education | | |
|---|---|---|---|---|
| | | Illiterate | Primary | Secondary |
| High Risk (N=261) | N | 93 | 33 | 135 |
| | % | 35.6% | 12.6% | 51.7% |
| Moderate Risk (N=212) | N | 56 | 23 | 133 |
| | % | 26.4% | 10.8% | 62.7% |
| No Risk (N=27) | N | 2 | 3 | 22 |
| | % | 7.4% | 11.1% | 81.5% |
| Total (N=500) | N | 151 | 59 | 290 |
| | % | 30.2% | 11.8% | 58.0% |
| Chi Square | | 13.69 | | |

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| | | |
|---|---|---|
| p value | | 0.008* |

*: statistically significant

Table 3 shows the distribution of diabetes risk in relation to BMI (kg/m2) using IDRS. Most of the 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 3: Distribution of Diabetes risk in relation to BMI (kg/m$^2$) using IDRS**

| **Diabetes risk** | | **BMI (kg/m$^2$)** | | |
|---|---|---|---|---|
| | | **Normal** | **Obese** | **Overweight** |
| High Risk (N=261) | N | 210 | 28 | 23 |
| | % | 51.47% | 62.22% | 48.94% |
| Moderate Risk (N=212) | N | 174 | 16 | 22 |
| | % | 42.65% | 35.56% | 46.81% |
| No Risk (N=27) | N | 24 | 1 | 2 |
| | % | 5.88% | 2.22% | 4.25% |
| Chi Square | | 20.39 | | |
| p value | | <0.01* | | |

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).

**Table 4: Distribution of Diabetes risk in relation to blood pressure using IDRS**

| **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 |

*: statistically significant

When HbA1c level was analyzed, 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 (Table 5].

**Table 5: Association of Indian Diabetes Risk Score with glycatedhaemoglobin**

| **Diabetes risk** | | **HbA1c (%)** | | |
|---|---|---|---|---|
| | | **Normal (<5.7)** | **Prediabetic (5.7‑ 6.4)** | **Diabetic (≥6.5)** |
| High Risk (N=261) | N | 38 | 23 | 200 |

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| | | | | |
|---|---|---|---|---|
| | % | 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* | | |

**Discussion**

Although, IDRS tool is 13 year old, but still, it has not become so much popular among health personnel, even most of them have no knowledge of it. Most prevalence studies in India have come from large metropolitan cities and some from rural areas but none of the study had assessed it in rural as well as at urban level. Hence the present study was conducted 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.

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[7] 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[8] and in Puducherry and Tamil Nadu by Gupta et al[9]. 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[8]. conducted their study in Chennai and Gupta et al. conducted their study in rural and urban areas of South India. Gutch et al[10] reported that North Indians are becoming more prone for diabetes and obesity‐related diseases such as dyslipidemia because of rapid westernization in lifestyles and diet and continuous migration from small towns and rural areas to metropolitan cities for employment.

The result also shows that a large number (moderate and high risk) of the study subjects had some kind of risk of developing diabetes in future. This is the group where active interventions in the form of health education, counselling and further work up is urgently required. The earlier the interventions are started the later will be the onset of disease and its subsequent complications.

In our study, there was no statistically significant difference among males and females in relation to diabetes risk score. Similar results were reported by Acharyaet al[11]. Our finding do not corroborate with those of study by GarimaNamdevet al[12]. According to by GarimaNamdevet al[12], females have more predilection of higher risk of diabetes. It may be due to more tendency of fat accumulation among females. There was significant association found between religion and IDRS score due to the fact that majority of study subjects were Hindus in their study. The reason may be change in the place of study setting.

In our study, 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. Shobha et al[13] assessed the risk of developing T2DM using IDRS in 216 subjects having age between 20-40 years reported that risk of T2DM development increases with age in all risk score groups. GarimaNamdevet al[12] in their study reported significant association between IDRS and age.

In our study 70.6% and 29.4% of the subjects belonged to Hindu and Muslim religion respectively. Statistically no significant difference was found among Hindu and Muslim subjects in relation to diabetes risk. Similar results were reported by Acharyaet al[11]. Our

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finding do not corroborate with those of study by GarimaNamdevet al[12]. There was significant association found between religion and IDRS score due to the fact that majority of study subjects were Hindus in their study. The reason may be change in the place of study setting[16].

Though home makers, unemployed or unskilled workers were at higher risk, but there was no significant association between diabetes risk and occupation. Similar results were found by other authors suggesting that occupation has no role in developing diabetes risk[10-12].

In our study, when diabetes risk among subjects was compared in relation to SES, it was found to be statistically insignificant as $p>0.05$, though diabetes risk was more in subjects with upper lower SES. GarimaNamdevet al[12] in their study reported that as SES increased, the risk of having diabetes also increased.

High risk diabetes score was reported among 66.67% of current smokers. When smoking status was compared statistically according to diabetes risk, it was found to be statistically significant in our study. Anita Shankar Acharyaet al[11] too revealed similar finding. The findings were in agreement with the studies done in Puducherry a nationwide cross sectional survey but differ from studies done in southern India where significant association was seen between smoking and diabetes[9].

There was no statistically significant association between tobacco intake and IDRS in our study which corroborate with findings of Bharathiet al1[4]. However, tobacco use showed a statistically significant association with diabetes ($p<0.00$) in studies done by Valliyot B et al[15].

In our study, 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. Various studies including that of Ravikumar P[16], Valliyot B[15] reported similar findings. It was also seen that as the DBP increases the risk of having diabetes also increases, but it was not found to be statistically significant. Hence for reducing blood pressure, physical activity needs to be increased which would subsequently lower Diabetes risk.

Both general and central obesity have been associated with a number of metabolic abnormalities including prediabetes, type 2 diabetes (T2DM), HTN, metabolic syndrome, and CVDs. The obesity and HTN have become the causes for developing diabetes. Similarly, in a study by Mandal[17], reported that the prevalence of T2DM and HTN increases with increasing weight (overweight/obese) of individuals. Another study also reported that patients with type 2 diabetes (T2DM) demonstrated highest co‐prevalence for the combination of overweight/obesity and HTN (66.0%), overweight/obesity and CKD (19.1%), and overweight/obesity and CVD (17.0%)[18]. 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[7].

Assessment of HbA1c with diabetes risk is also essential tool to identify the diabetes patients because HbA1c reduction in type 2 diabetes is associated with increased insulin sensitivity. Assessment of HbA1c with diabetes risk score also helps to identify developing diabetes complications. Because HbA1c has a strong association with prevalent CVD risk factors in Asian‐Indian subjects with normal glucose tolerance (NGT). A study reported that the prevalence of CAD is nearly 1.5 times higher among subjects with IGT compared with NGT. HbA1c is also useful to reduce the risk of CVD and MI. For each 1% increase in the level of HbA1c, the relative risk of CVD increases by 1.18%, whereas each 1% decrease in HbA1c levels is associated with a 37% reduction in microvascular complications and a 14%

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reduction in MI[6]. 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.

The limitation of present study was its cross sectional design. 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. In rural areas, a great number of diabetic cases remain left behind due to lack of investigation facilities. Therefore, all of those could be detected very easily by applying this score.

## Conclusion

The results of the present study found significant association between Indian diabetic risk score with 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 can be used as a cost‐effective tool for mass screening of diabetes. This scoring system can be used for strict monitoring for diabetes and obesity so that timely intervention can be done to reduce the early development of diabetes complications and severe obesity comorbidities

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