# Original Research Paper

## Community Medicine

# A CROSS-SECTIONAL STUDY ON VALIDITY OF INDIAN DIABETES RISK SCORE FOR DIABETES MELLITUS AMONG THE POPULATION OF GWALIOR CITY

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**ABSTRACT**

**Background:** India is experiencing a rapid health transition with a rising burden of NCDs causing significant morbidity and mortality, with considerable loss in potentially productive years (age 35-64 years) of life.1 IDRS can act as a useful screening tool in early identification diabetes.4

**Objectives:** A. To find out sensitivity and specificity of INDIAN DIABETIC RISK SCORE (IDRS), and its validation in deciding to find out the magnitude of diabetes as a health problem in community of Gwalior City. B. To access and analyze the various component of IDRS – 1. Age of subjects -20 years and above, 2. Level of physical activity, 3. Waist circumference (in cm.), and 4. Family history of Diabetes in population and their contribution in deciding the risk of Type 2 Diabetes Mellitus as a whole. C. Application of Indian Diabetic Risk Score as a proxy marker in deciding the severity and management of Diabetes in population.

**Methods:** The study was community based cross sectional study. The sample size included in this study was 615 subjects.

**Results:** In this present study 28 % study participants have BMI ≥ 25, 13.3% were found to have diabetes in those subject, who were of low risk group and about 20.8% were found to have Type 2 DM of overweight subjects of high risk group.

**Conclusion:** By early indication would greatly help in favorable, alternation of the natural history of the disease, and also would help in reducing the global economic cost of diabetes.

**KEYWORDS :** Diabetes, Indian Diabetes Risk Score

## Introduction

Socioeconomic development, technological advancements and changes in lifestyles, behavioural patterns, demographic profile transition (aging population) lead to major health transition leading to rapid increase in burden of non-communicable diseases and their burden overweight the burden of communicable diseases.

India is experiencing a rapid health transition with a rising burden of NCDs causing significant morbidity and mortality, both in urban and rural population, with considerable loss in potentially productive years (age 35-64 years) of life.[1]

Chronic non-communicable diseases are assuming increasing importance among the adult population in both developed and developing countries. The life-styles and behavioural patterns of people are changing rapidly, these being favourable to the onset of chronic diseases like diabetes. The prevalence of chronic disease like diabetes is showing an upward trend in most countries. Developing countries are now warned to take appropriate steps to avoid the "epidemics" of non-communicable diseases likely to come with socio-economic and health developments.

The global prevalence of diabetes among adults over 18 years of age has risen from 4.7% in 1980 to 8.5% in 2014.[2]

As of 2014, an estimated 387 million people with prevalence of 8.3% have diabetes Worldwide, and the figure is expected to rise by 592 million by 2035.[3]

According to WHO, Globally, an estimated 422 million adults were living with diabetes in 2014, compared to 108 million in 1980.[2] This reflects an increase in associated risk factors such as being overweight or obese. Over the past decade, diabetes prevalence has risen faster in low- and middle-income countries than in high-income countries. Diabetes is a major cause of blindness, kidney failure, heart attacks, stroke and lower limb amputation.[2]

IDRS can act as a useful screening tool in early identification diabetes and would help in appropriate lifestyle intervention, prevention, and treatment of diabetes.[4]

Keeping this aspect in mind, a community based cross sectional observational study with prime objective to find out the sensitivity and specificity of Indian Diabetic Risk Score (IDRS) as screening tool done in Gwalior City which have population of 1069276.[5]

## Objectives

1. To find out sensitivity and specificity of INDIAN DIABETIC RISK SCORE (IDRS), and its validation in deciding to find out the magnitude of diabetes as a health problem in community of Gwalior City.

2. To access and analyze the various component of IDRS – 1. Age of subjects -20 years and above, 2. Level of physical activity, 3. Waist circumference (in cm.), and 4. Family history of Diabetes in population and their contribution in deciding the risk of Type 2 Diabetes Mellitus as a whole.

3. Application of Indian Diabetic Risk Score as a proxy marker in deciding the severity and management of Diabetes in population.

## Materials and Methods

The study was community based cross sectional study. It was conducted in the three wards numbered - 55,58 and 47. Those were randomly selected which includes, Amkho, Shivajinagar, Guda Gudi Ka Naka, and Lakkad Khana areas respectively in the catchment area of Department of Community Medicine , G. R. Medical College , Gwalior (M.P.). The sample size included in this study was 615 subjects.

The population of study area is 11200.[6] and the reference population consisted of age above 20 years . The proportion of population above 20 years of age is approximately 61%[7] of total population that was 6832.

The sample size is calculated by taking 9%[8] (of reference population above 20 years of age. The 9% sample size has been drawn from population above 20 years of age i.e. 6832, hence the approximate sample size came out to be approximate 614 and we were taken 615 in round figure.

House to house survey has been conducted and face to face interview has been done by predesigned questionnaire (schedule), which was based on IDRS variables study. The selection of households was done by proper sampling interval. The total approximate house was around 2000 and used sampling interval was every 3rd house. First house selected randomly and then one subject from each house, till the desired sample size was achieved. We took all the measure to avoid duplication in study.

## Study design:

The study was community based cross sectional study. It was conducted in the three wards numbered-55,58 and 47. Those were

randomly selected which includes, Amkho, Guda Gudi Ka Naka,and Lkkad Khana areas respectively in catchment area of Department of Community Medicine, G. R. Medical College, Gwalior (M.P.) because MBBS Final Proff. I students going there regularly under their community posting. The study period was 15 Months, March 2015-June 2016. The sample size included in the study was of 350 subjects.

**Duration of study:**
15 Months, March 2015- June 2016.

**Inclusion criteria:**
1. The subject included in study will be adult aged 20 years and above.
2. Who has given consent to take part in study.
3. Who is not a known diabetic case.
4. Who is not taking diabetic diet.
5. Who has not taken diabetic medication in their lifetime.

**Exclusion criteria:**
1. Known case of diabetes.
2. Who has not given consent.
3. Subject below 20 years of age.

**Data collection and measurement:**
There were three components of the study for the data collection and measurement.
1. Questionnaire based survey
2. Anthropometric measurement and physical examination
3. Investigation based survey

**Questionnaire based survey:**
Predesigned and pretested questionnaire was prepared for collecting data, By interviewing the study participants using these predesigned Questionnaire, which were based on IDRS variable. Questionnaire were contain all questions addressing detailed history of demographic data, anthropometric measurements, life style risk factors, food habits and physical activity.

**Anthropometric measurements and physical examination:**
Standard instruments and procedure were used for anthropometric measurements. Height, weight, waist circumference and blood pressure were measured after explaining the purpose of study, explaining the procedures and gaining their consent. By using appropriate and standard instruments, as per their protocols.

**Investigation based survey:** After obtaining proper consent from the participants, blood sample was taken to measure Post Prandial Blood Sugar and fasting blood sugar measurement.

Results found out through IDRS will be cross examined by blood glucose measurement.

1. Post prandial blood glucose test -plasma glucose is measured after two hour of meal. $\geq 11.1$ mmol/L (200mg/dl)[9] Fasting blood glucose measurement- done, if fasted overnight for at least 8 hours. $\geq 7.0$ mmol/L(126mg/dl)[9]

Institutional ethical committee of the Gajra Raja Medical College, Gwalior, has given the ethical approval for the study.

All the study subjects who came out to be positive for risk of diabetes on the basis of screening, were referred to Medicine Department of our hospital for further management.

**Parameters used:**
Age
Sex
Waist circumference
Height
Weight
BMI

**Statistical analysis**
Analysis will be done by tabulations of data with frequency distribution by percentage and proportions and applying statistics wherever necessary, using the software Epi-info 7.2.

**Socioeconomic status:**
For assessing the socioeconomic status of the participants, modified B.G. Prasad Classification was used.

**Table 1: IDRS and its variables**

| IDRS score | |
|---|---|
| Age (Years) | |
| <35 | 0 |
| 35-49 | 20 |
| ≥50 | 30 |
| Waist circumference (cm) | |
| < 80 cm ( 32 inch, female ) < 90 cm (36 inch, male ) | 0 |
| ≥ 80- 89 cm ( 32 inch -35 inch, female ) ≥ 90- 99 cm ( 36 inch -39 inch, male ) | 10 |
| ≥ 90 cm( 36 inch, female ) ≥ 100 cm( 40 inch, male ) | 20 |
| Physical activity | |
| Vigorous exercise [ regular] or sternuous [manual] labour at home/work | 0 |
| Moderate exercise[ regular] or moderate physical activity home/work | 10 |
| Mild exercise[ regular] or mild physical activity at home/work | 20 |
| No exercise and sedentary activities at home/work | 30 |
| Family history | |
| No family history | 0 |
| Either parents | 10 |
| Both parents | 20 |

| IDRS SCORE | RISK OF TYPE II DM |
|---|---|
| <30 | LOW RISK |
| >30-50 | MODERATE RISK |
| >60 | HIGH RISK FOR DIABETES AND CVD |

**Results**
**Table 2: Age and gender wise distribution of study participants**

| Age (Year) | Number of participants | Percentage (n=615) |
|---|---|---|
| <35 | 263 | 42.8 |
| 35-49 | 201 | 32.7 |
| ≥50 | 151 | 24.5 |
| Total | 615 | 100 |

| Gender | Number of participants | Percentage (n=615) |
|---|---|---|
| Female | 325 | 52.8% |
| Male | 290 | 47.1% |
| Total | 615 | 100 |

Most of the study participants were less than 35 years of age, reflecting that young adults constitute main proportion of Indian population in present time. The group at highest risk i.e. > 50 years constituted one-fourth of the study participants.

Table 2 shows that proportion of female participants were more (52.8%) than the male, because in morning hours, females were more available at their homes as compared to males.

In our study, most of the participants belonged to Hindu religion, reflecting that population of Gwalior city is mainly constituted by Hindu religion followers.

Majority of participants (i.e. 81%) are married and most of them were diabetic.

In this study, most of the participants were literate, majority of them being graduated and above. Percentage of Diabetic is highest (10.3%) among graduated and above followed by percentage of Diabetic among illiterates suggesting that the Diabetes is also common in lower and poorly educated groups of people, now days, as previously it was more prevalent in higher educational group. These finding reflects the literacy rate of Gwalior city according to census 2011.[10]

Our study sample had representation from all socioeconomic classes. Most (54%) of participants belonged to middle class(class II and III) and 23.6% in lower and lower middle class according to Modified B.G. Prasad Classification. Most of Diabetic were find in lower class (class-V) followed by upper class (class-I). This distribution also reflects the

urban setting of the study population and showing the shifting trends of diabetic in lower economic classes from higher economic classes.

**Table 3: Distribution of participants according to IDRS Score and percentage of diabetic among them:**

| Sr. no. | IDRS Score | Number of participants (%)[n=615] | Number of Diabetic(%) |
|---|---|---|---|
| 1 | ≤30 | 313(50.9) | 8(2.5) |
| 2 | 30-50 | 206(33.5) | 22(10.7) |
| 3 | ≥60 | 96(15.6) | 25(26.4) |
| | Total | 615 | 55 |

In this study about 93 % participants do not have family history of diabetes. This study brought out limited association with family history of diabetes. Information about family history is often not correctly available. Diabetes also often remains undiagnosed. A study with a larger sample size may show an association with family history.

In this study majority of females have waist circumference of 80-89 cm, and majority of males have <90 cm. 21% of females have > 90 cm waist circumference and 21 % of these were found to be diabetic, which is significantly higher than males i.e. 5 % have waist circumference >100 cm, of these only 15% were found to be diabetic. In females the proportion of Type 2 DM is increasing with increase in waist circumference, reflecting high waist circumference as a risk factor for Type 2 DM. According to others studies, among males waist circumference above 90 cm is also associated with diabetes but in present study it is not showing an increasing trend with increase in waist circumference.

In this present study about 47.5% of participants belonged to moderate physical activity level.

As the level of physical activity is increasing the proportion of diabetics is decreasing. Thus the finding in this table supports the well known protective role of physical activity in prevention of Type 2 DM

Most of participants 43% know that obesity is a risk factor of Type 2 DM. very few i.e. 29 % know that Type 2 DM is inherited from parents to their offsprings.

Following table shows that as the IDRS score is increasing the sensitivity is decreasing and specificity is increasing.

According to present study findings the sensitivity of IDRS score of ≥ 30 has been reported to be as high as 94.5% which is desired for any screening tool / test and the specificity of IDRS Score ≥ 30 has come out to be 33.7.

The present study shows that at IDRS score of ≥ 60, sensitivity is 45.5% and specificity is 88.0% respectively. As the cutoff of the Indian diabetic risk score (MDRF-IDRS) increases more than 50 the sensitivity decreases sharply for further increase of specificity with both FPG and PPPG. At cut off 10, the MDRF-IDRS is 100% sensitive but specificity is 11.8%. Similarly at 90 the MDRF-IDRS is 100% specific but 1.81% sensitive.

**Table 4: Showing sensitivity and specificity:**

| Net IDRS | Number of participants | Proportion of participants(n=615) | Number of diabetics | Sensitivity | Specificity | P value |
|---|---|---|---|---|---|---|
| ≥0 | 615 | 100 | 55 | 100 | 0 | |
| ≥10 | 549 | 89.26 | 55 | 100 | 11.8 | 0.004368 |
| ≥20 | 478 | 77.7 | 53 | 96.4 | 24.3 | 0.002682 |
| ≥30 | 425 | 69.10 | 52 | **94.5** | **33.7** | 0.000017 |
| ≥40 | 302 | 49.10 | 47 | 85.5 | 55.1 | 0.000000 |
| ≥50 | 227 | 36.91 | 41 | 74.5 | 67.6 | 0.000000 |
| ≥60 | 96 | 15.60 | 25 | 45.5 | 88.0 | 0.000001 |
| ≥70 | 32 | 05.20 | 8 | 14.5 | 96.84 | 0.000000 |
| ≥80 | 10 | 01.62 | 4 | 7.27 | 99.0 | 0.000331 |
| ≥90 | 1 | 00.16 | 1 | 1.81 | 100 | 0.218786 |
| Total | | | 55 | | | |

**Figure 1: ROC Curve**
The closer the ROC curve to left and top border the more valid is the test in terms of sensitivity and specificity. The maximum possible area in the curve (AUC) is 1.0, and the actual area in the curve measure the test validity in the sense of its ability to correctly classify those known with and without the disease. It is considered excellent, if the area under the curve is 0.90 or more, and good if the area under curve is between 0.70- 0.89. The area 0.50 corresponds to the diagonal and indicates that the test is absolutely not helpful.

In the present study, the area under the ROC curve (Fig 1) was 0.775 and this represents the category of good diagnostic accuracy. In urban area this diagnostic accuracy was more or less same with other studies.

IDRS score a screening method also has high negative predictivity, means it is safe to assume in these cases, the diabetes is absent. In addition, IDRS screening test is durable to with stand constant use and considerable abuse because it tends to be used on a large number of subjects.

The goal of IDRS screening test diagnosis is to ferret out pre diabetic and diabetic cases while keeping false positives to a negligible level because false positivity can create an unmanageable backlog of cases that actually does not require medical attention. This can lead to organization fatigue and staff may wear out causing loss of alertness. Thus IDRS screening test is good, it has high positive predictivity. Scoring is good to confirm diabetes.



Diagonal segments are produced by ties.
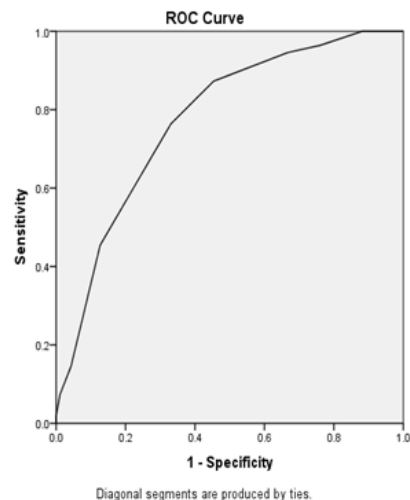
**Discussion**
In the present study most (42.8%) of the study participants were below 35 years of age[table 2], reflecting that young adults constitute main proportion of Indian population in present time. The group at highest risk i.e. > 50 years constituted one-fourth of the study participants.

In a study conducted by Gupta S.K. et al[11] 50% participants were below 35 years of age, but in the study conducted by Mani G. et al[12] Only 14% of the participants were less than 35 year of age. This difference may be due to that our study has been done in city population, whereas study by Gupta S.K. et al[11] and Mani G. et al[12] were done in Rural area of Tamil Nadu.

In our study proportion of female participants was more than the males i.e. 52.8%, this result was similar with result of study conducted by Gupta S.K. et al[11] where 60.27% were females and 39.73% were males, Gupta N. et.al[13] and Mani G. et.al.[12] Our finding were not similar to the study conducted by Gupta R.K. et al.[14]

In the present study, about 88% of the participants belonged to Hindu religion, reflecting that population of Gwalior city is mainly constituted by Hindu religion followers. These finding were similar with the results of study conducted by Gupta S.K. et. al where, 62.50% were Hindus and study conducted by Mani G. et al

In this present study, most (46.5%) of participants were having IDRS≤ 30 (i.e. low risk group),whereas one fourth were belonged to moderate risk group and little more than one fourth were found to have IDRS Score ≥60.

These finding were not similar with results of study conducted by Arun A. etal[15], where 67.7% of subjects were in moderate risk IDRS category while 17.4% were in low risk and only 14.9% were in high risk IDRS category.

In an another study conducted by Nandeshwar et al[16],2.8% participants were belonged to low risk ,28.40% to moderate risk and 68.5% to high risk of these, 8.40 % diabetic were in moderate risk group, and 51.16 % diabetic were belonged to high risk group.

In this present study 28 % study participants have BMI $\geq$ 25, 13.3% were found to have diabetes in those subject, who were of low risk group and about 20.8% were found to have Type 2 DM of overweight subjects of high risk group.

These finding were similar with the finding of study conducted by Gupta S. et al[11]. These finding reflect that chances of Type 2 DM increase with the increase in IDRS in persons having BMI $\geq$ 25(i.e. in overweight).

## Conclusion
After doing in-depth analysis of the data collected for the study, we can reach at the following conclusion
1. In modern era, Socioeconomic development, technological advancements and changes in lifestyles, behavioral patterns, demographic profile transition (aging population) lead to major health transition leading to rapid increase in burden of non-communicable diseases like diabetes and their burden overweight the burden of communicable diseases.
2. The most disturbing trend is the shift in the age of onset of diabetes to a younger age in the recent years; Indians succumb to diabetes 5-10 years earlier than their western counterparts, during their most productive years.
3. In India more than 50 % of people are unaware of their status of diabetes in them [submerged portion of the iceberg represents the hidden mass of disease (e.g., sub clinical cases, carriers, and undiagnosed cases)]. which increases the risk of development of diabetes and its complication in them.
4. This hidden part of the iceberg (mass of unrecognized disease in the community), and its detection and control is a challenge to modern techniques in preventive medicine[17] IDRS – A simple two minutes Indian diabetic risk test has good sensitivity and specificity on the basis of our study and many more previous studies and can be used for mass screening and high risk screening for early identification of diabetes in communities.
5. By early indication and taking appropriate and proper intervention would greatly help in favorable, alternation of the natural history of the disease, preventing or postponing the onset and burden of Diabetes and its complications, and also would help in reducing the global economic cost of diabetes.

## Limitations of the Study
Due to limitation and small sample size of study we found less AOC, But with study with more sample size and with relaxation of limitation, we could be able to get more AOC curve with very good or excellent diagnostic accuracy with IDRS score for diagnosis of diabetic cases during screening.

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