Original Research

RISK ASSESSMENT FOR TYPE2 DIABETES AND PRE-DIABETES AMONG POPULATION OF RURAL FIELD PRACTICE AREA, TERTIARY CARE HOSPITAL, TIRUPATHI

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ABSTRACT

Background: Pre diabetes is a state where the glycaemic parameters above normal but below diabetes thresholds. Nearly 70% of Prediabetic adults are prone for Diabetics and associated with increased risk of diabetes, cardiovascular events, and mortality. Lifestyle changes are the first line treatment.

Objectives:

1. To assess the risk of Type 2 diabetes mellitus and Pre-diabetes of the participants by using Indian diabetic risk score.
2. To determine the association between identified risk factors and the presence of risk diabetes among study participants.

Materials and Methods: A Community based Cross –sectional study was conducted for two months among 351 participants of aged 30 years and above 30 years, who were not a known diabetics and residing in the field practice area of Chandragiri. Indian Diabetes Risk Score is a tool used to classify risk group. Ethical clearance was obtained from the Institutional Ethical Committee and informed consent was taken from the participant. Collected data was coded and entered into a Microsoft excel and analyzed using statistical package for the social sciences (SPSS) software version 26.

Results: Among 351 participants 50.4% of the study subjects were in moderate risk followed by 38.2% were in high risk while 11.4% were in low risk according to IDRS. Among study participants, 20% had a family history of Diabetes mellitus, 25% were diagnosed with Pre -diabetics, 4% were newly diagnosed as diabetics. Family history, larger waist circumference and lack of physical activity were found to be significantly associated with risk of diabetes.

Conclusions: Among 351 patients, nearly one fourth were identified as Pre diabetics and 4% as diabetics. Current study revealed that the early identification of high-risk individuals and planning for appropriate measures to delay the onset of pre-diabetes and diabetes, so that we can reduce the burden of diabetes in India.

Keywords: Type 2 Diabetes Mellitus, Pre-Diabetes, Indian Diabetes Risk Score, Risk Assessment, Family History of Diabetes.

INTRODUCTION

Diabetes mellitus is a major Public health problem which affects all age groups.

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It is the leading cause of adult blindness and amputation and a major cause of renal failure, nerve damage, heart attacks and strokes. Type 2 diabetes mellitus accounts for approximately 90-95% of all diagnosed cases of Diabetes mellitus. The estimates in 2022 showed that 74 million individuals had diabetes in India, which is expected to rise to over 124 million by 2045[1].The incidence and prevalence of T2D is increasing because of aging and change in

lifestyles. Approximately 57% of individuals remain doesn't know their diabetic state. [2]

Prediabetes describes a state between diabetes mellitus and normality. The normal values of Fasting blood glucose level are between 70 mg/dL to 99 mg/dL. In prediabetics, Fasting blood glucose levels elevated between 110 mg/dL to - 125 mg/dL. These levels do not meet the required criteria for a diagnosis of diabetes mellitus. For this reason, many people are not aware that they are living with prediabetes. **[3], [4]**

People with prediabetes are on the road towards developing type 2 diabetes, without intervention it is likely to become Type 2 diabetes within 7 years **[1]**. Prediabetes is also at increased risk for other serious health problems such as stroke and heart disease. With early diagnosis, prediabetes can often be reversed with a change in life style behavior. A CDC-recognized lifestyle change program is an evidence-based solution that can reduce a person's risk of developing type 2 diabetes by more than half. Participants who lost 5-7% of their body weight and added 150 minutes of exercise per week cut their risk of developing type 2 diabetes by up to 58% in general and 71% for people over 60 years old. **[5]**

As there are no clear symptoms of pre-diabetes, screening and testing are especially important parts of its prevention. With this background, Present study is thus formulated with the aim to assess the risk for type 2 diabetes and pre-diabetes among population of rural field practice area.**[6]**

Objectives

1. To assess the risk of Type 2 diabetes mellitus and Pre-diabetes of the participants by using Indian diabetic risk score
2. To determine the association between identified risk factors and the presence of risk diabetes among study participants

METHODOLOGY

Study Design: It is a Community based Cross – Sectional study.

Study Period: Study was conducted for two months from October 2022 - November 2022.

Study Area: The study was carried out in the Rural Health Training Center (RHTC), Chandragiri, affiliated with the Tertiary care center (S. V Medical college), Tirupati, Andhra Pradesh. The RHTC covers a population of approximately 40,226 across three sub-centers. (Dornacambala, Narsingapuram and Chandragiri). Under Dornacambala 3 sachivalayams with 20 villages (2651 houses with 11315 population), Narasingapuram had 4 sachivalayams with 13 villages (2446 houses with 10068 population) and Chandragiri had 3 sachivalayams with 10 villages (4789 houses with 18843population).

Study Population

Target Population: Residents of the RHTC Chandragiri area (3 subcenters) women and men of aged 30 years and above residing in the field practice area of S. V Medical College, Tirupati.

Inclusion Criteria:

1. Individuals aged 30 years and above who did not know their diabetic status.
2. Those who have given the written informed consent

Exclusion Criteria:

1. Population of field practice area who were known diabetics were excluded.
2. All Pregnant and lactating women.
3. Adults who were severely ill or cognitive impairment preventing participation
4. Temporary visitors.

Sample size: A study conducted by Pradeepa [2] found that proportion of undiagnosed diabetics was taken as 57%. Sample size was calculated by using, (z value of 1.96 as the degree of accuracy at 95% confidence interval, p=57% [2] **,** relative error of 10% of Prevalence). Based on this, the sample size was calculated to be 290 with 10% non-response rate the sample size is 319. In the present study 351 participants were included.

Sampling Technique: A multistage stratified random sampling method was used.

Stage 1: Stratification by sub-center (Dornacambala, Narasingapuram, Chandragiri)

Stage 2: Random selection of 2villages from each sub-center.

Stage 3: Simple random sampling method for selection of house within selected villages and systemic random method for selection of houses for data collection.

Stage 4: all adults aged 30 and above willing to participate was interviewed.

Data Collection Method:

Rural Health Training Center Chandragiri had nearly 40226 population with 3 Sub centers (Dornacambala, Narsingapuram and Chandragiri). Under Dornacambala 20 villages with 3 sachivalayams, Narasingapuram had 13 villages with 4 sachivalayams and chandragiri had10 villages with 3 sachivalayams. Two villages from each sub center were selected by simple random sampling method and Proportionate of the sample was taken from each sub center.

From each village, the household was selected by taking random number of the last digit of the available currency note and every fifth house was selected for data collection using systemic random method. If the proportionate sample in the first village is not achieved, data was collected in the second village till the proportion of sample for the first sub center achieved. Like that the 351 samples were collected. 117 in the Dornacambala, 117 in the Narsingapuram and 117 in the Chandragiri subcenters.

In the selected house, data was collected from all the individuals aged 30 years and above who were not a known diabetic and willing to participate in the

study. The participants were fully informed about the purpose of the study and written informed consent was obtained. Data was collected by House -to-house visits. Each interview began with a general discussion to build rapport with the participants and gain their confidence. A predesigned, semi structured questionnaire was used to collect the data from the study participants. The questionnaire was designed to collect information on the following aspects:

1. Socio-demographic information including gender, age, religion, education, occupation, Socio economic status.
2. Information on risk of diabetes and life style factors: Family history of diabetes, physical activity, H/o hypertension, H/o gestational DM, PCOD in female
3. Measurements included blood pressure, height, weight, waist circumference were done using standard methods and recorded for all study participants.
4. Biochemical testing, i.e. Random capillary blood glucose is tested with standardized digital Glucometer (Accu-Check,)

Random capillary blood glucose was done for all the participants. In a healthy person, these levels tend to be less than 140 mg/dL. A reading between 140 mg/dL and 199 mg/dL indicates prediabetes and reading above 200 mg/dL suggest diabetes. This test helps to evaluate roughly if an individual is Pre diabetic, likely to have diabetes or normal. Working Definition- Indian Diabetes Risk Score (IDRS) was developed by V Mohan and his colleagues and is considered to be one of the strongest predictor of diabetes incident in India. It is a simplified risk score for identifying undiagnosed diabetic subjects taking into account two modifiable risk factors (waist circumference and physical inactivity) and two non-modifiable risk factors (age and family history of diabetes), which may be amenable to intervention. The individuals were classified as having high risk (score >60), moderate risk (score 30 - 50) and low risk (score <30) out of a total score of 100.

IDRS SCORE derived from CURES

Risk Criteria	Details	Scores
Age (years)	<35	0
	35 – 49	20
	≥50 years	30
Abdominal obesity	Waist < 80cm (female) < 90cm (male)	0
	Waist < 80 – 89cm(female) < 90- 99cms(male)	10
	Waist ≥ 90cm (female)>_100cm(male)	20
Physical activity	Vigorous exercise or strenuous work	0
	Moderate exercise work/home	10
	Mild exercise work/home	20
	No exercise and sedentary work /home	30
Family history	No family history	0
	One parent	10
	Either parent	20
Score	Maximum	100
	Minimum	0

Statistical Analysis:
Data was entered in Microsoft excel sheet and analyzed by using SPSS software, version 26. Risk score was calculated by using IDRS. A descriptive data was expressed in terms of frequency, percentages, mean and SD. Chi-square test was used to know the association between two categorical variables, and P-value <0.05 was considered as statistically significant.

Ethical Issues: Ethical clearance was obtained from Institutional ethical committee of Sri Venkateswara Medical College (IEC number Lr.No.74/2022.) before starting the study proper (19.09.2022). During the study, the purpose of the study was explained to all the participants and written informed consent was taken.

OBSERVATIONS AND RESULTS

Table 1: Socio-demographic characteristic distributions of study participants

Characteristics	Number	Percentage (%)
Age (years)		

< 35 years	63	18.0%
35 to 49 years	142	40.5%
≥50 years	146	41.5%
Gender		
Female	263	74.9%
Male	88	25.1%
Religion		
Hindu	328	93.4%
Muslim	15	4.3%
Christian	8	2.3%
Education		
Post graduate	18	5.1%
Degree	23	6.6%
Inter	14	3.9%
High school	36	10.3%
Mid school	64	18.2%
Primary school	55	15.7%
Illiterate	141	40.2%
Occupation		
Professional	4	1.1%
Semi-Professional	7	1.2%
Skilled	78	22.2%
Semi-skilled	37	10.5%
Unskilled	104	29.6%
Un employed	121	34.4%
Occupation		
Type of Family		
Nuclear	234	66.7%
Joint	7	2.0%
3 generation	88	25.1%
Broken	22	6.2%
Socio Economic Status		
Upper	51	14.5%
Upper middle	65	18.5%
Middle	130	37.1%
Lower middle	88	25.1%
Lower	17	4.8%

A total of 351subjects were enrolled in the present study. Table1 shows demographic characteristics of participants; females represented 75% (263). The participants were ranged from 30 - 70 years. 41.5% (146) belonged to 50 years and above. Majority of the study participants were Hindus 93.4 % (328). Around 40 % (141) of the study subjects were illiterates. Nearly two third of the participants were unemployed 34.4% (121) followed by unskilled 29.6% (104). Most of the study participants belonged to middle class according to modified BG Prasad's classification. Nearly 67% (234) belonging to nuclear family.

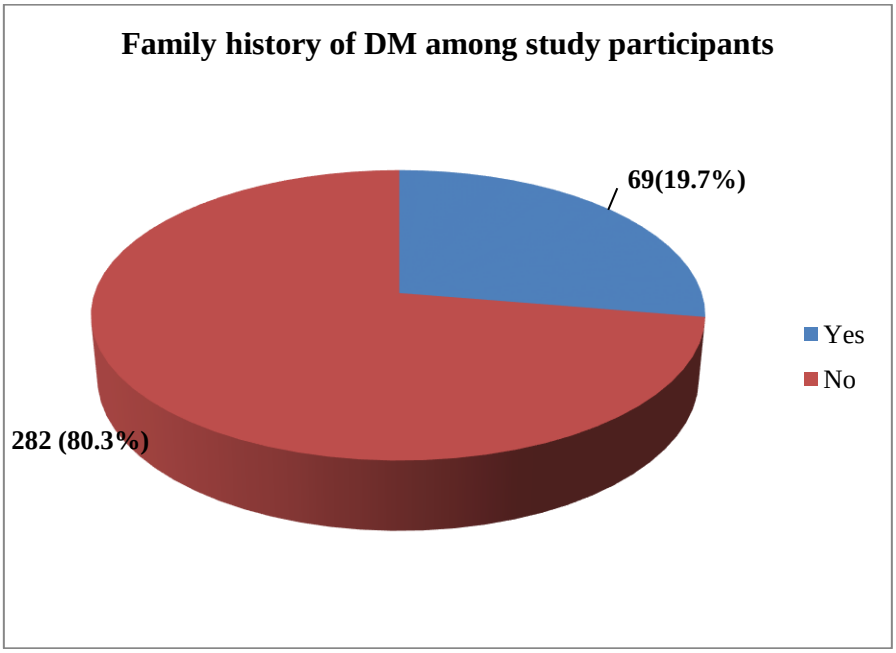

Figure 1: Family history of Diabetes mellitus among study subjects. Among 351 study subjects nearly 20% (69) had a family history of Diabetes mellitus.

Table 2: IDRS components of study subjects (n=351)

IDRS components	No. of subjects	Percentage (%)
Waist circumference (cm)		
≤80 (female)	37	10.5%
≤90 (male)	32	9.1%
≥81-89 (female)	110	31.3%
≥91-99 (male)	41	11.7%
≥90 (female)	116	33.1%
≥100 (male)	15	4.3%
Physical activity		
Regular vigorous exercise or strenuous (manual) activities	39	11.1%
Regular moderate exercise or moderate physical activities	124	35.3%
Mild exercise /mild physical activity at home or work	74	21.0%
No exercise and/or sedentary activities	114	32.4%
Family history of diabetes		
No diabetes in parents	282	80.3%
One parent is diabetic	59	16.8%
Both parents are diabetic	10	2.9%

IDRS=Indian Diabetes Risk Score

Table 2 shows the Risk score components of the study subjects. The waist Circumference in females less than or equals to 80 cm, 81-89 cm and more than 90cm were 10.5% (37), 31.3% (110), 33.1% (116) respectively. Waist circumference in males less than or equals to 90cm, 91-99cm, above 100cm were 9.1% (32), 11.7% (41), 4.3% (15) respectively.

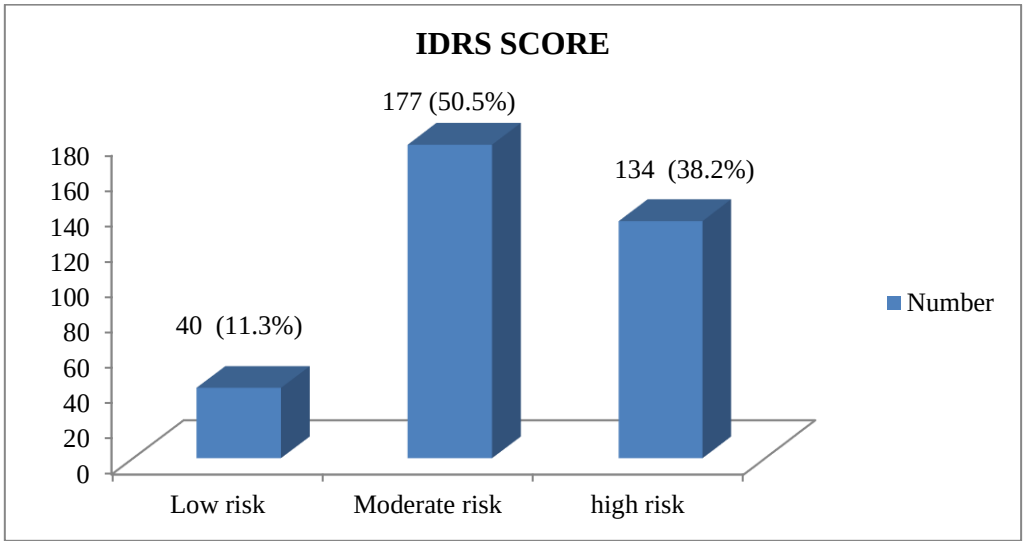

Figure 2: Indian Diabetic Risk Score among Study Participants

Figure 2 shows the Indian diabetic risk score among study participants. Based on IDRS scoring 50.4% (177) of subjects were in moderate risk, 38.2% (134) were in high risk while 11.4% (40) were in low risk.

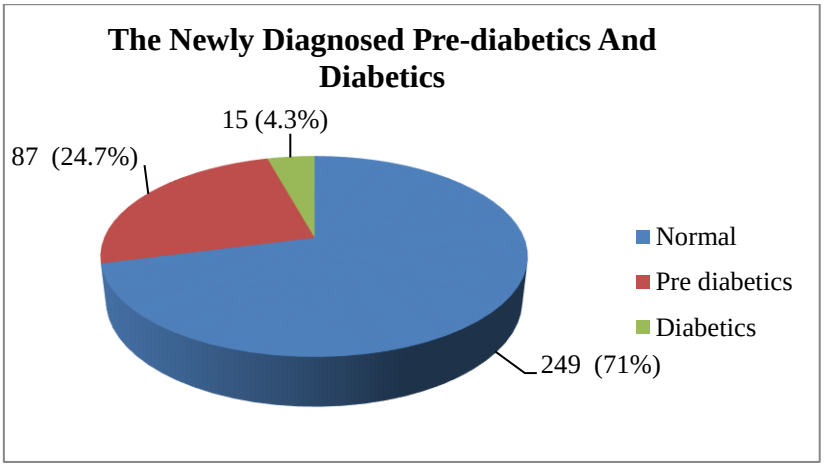

Figure 3: The newly diagnosed Pre diabetics and Diabetics among study participants.

Figure 3 shows nearly 25% (87) were diagnosed with Pre -diabetics, 4 % (15) were newly diagnosed as diabetics who were unaware of their diabetic status previously and are asymptomatic and nearly 71% (249) were in normal range based on RBS values.

Table 3: Association of Diabetes Risk with Socio-Demographic Profile of the Study participants

IDRS components	Low (40)	Moderate (177)	High risk (134)	Total (N= 351)	χ2 Value p-value
Gender					
Female	35 (13.3%)	118 (44.8%)	110 (41.9%)	263	χ2: 13.454 p-value :*0.00
Male	5 (5.6%)	59 (67%)	24 (27.4%)	88	
Age group					
<35 years	29 (46%)	30 (47.7%)	4 (6.3%)	63	χ2*: 126.947
35-50 years	11 (7.7%)	92 (64.8%)	39 (27.5%)	142	
>50 years	0	55 (37.7%)	91 (62.3%)	146(41.5%)	P value: 0.00
Religion					
Hindu	37(11.3%)	163(49.7%)	128(39%)	328(93.4%)	χ2*: 5.450
Muslim	3(20%)	10(66.7%)	2(13.3%)	15(4.2%)	P: 0.196
Christian	0	4(50%)	4(50%)	8(2.2%)	
Education status					

Illiterate	11(7.8%)	58(41.2%)	72(51%)	141(40.1%)	χ2: 16.96
Literate	29(13.8%)	119(56.6%)	62(29.5%)	210(56%)	P value: 0.00
Occupation					
Professional	0	1(25%)	3(75%)	4(1.1%)	
Semi-professional	0	6(85.7%)	1(14.3%)	7(2%)	χ2*: 33.943
Skilled	13(16.7%)	45(57.7%)	20(25.6%)	78(22.2%)	P: 0.00
Semi-Skilled	3(8.1%)	27(73%)	7(18.9%)	37(10.5%)	
Un skilled	8(7.7%)	55(52.8%)	41(39.4%)	104(29.6%)	
Un employed	16(13.2%)	43(35.3%)	62(51.5%)	121(34.5%)	
SES					
Upper	10(19.6%)	21(41.2%)	20(39.2%)	51	
Upper middle	1(1.5%)	35(53.8%)	29(44.6%)	65	χ2: 23.29
Middle	9(6.9%)	69(53.1%)	52(40%)	130	p-value :*0.00
Lower middle	15(17.1%)	44(50%)	29(33.9%)	88	
Lower	5(29.4%)	8(47.1%)	4(23.5%)	17	

P value*: Significance χ2: chi-square value χ2*: chi-square with yates' correction.

Table 3 describe the association of diabetes risk with the socio-demographic profile showed that increasing age, females, illiterates, Unemployed, Middle class were found to be significantly associated with risk of diabetes. Risk of diabetes was not having any significant association with Religion.

Table 4: Association of Diabetes risk among study subjects as per IDRS

IDRS components	**Low (40)**	**Moderate (177)**	**High risk (134)**	**Total**	**χ2 Value p-value**
Family history of diabetes					
No diabetes in parents	38(13.5%)	137(48.5%)	107(38%)	282(80.3%)	χ2*: 10.392
One parent is diabetic	2(3.5%)	37 (62.7%)	20(33.8%)	59(16.8%)	P: 0.02
Both parents are diabetic	0	3(30%)	7(70%)	10(2.9%)	
Waist circumference (cm)					
≤80 (female) ≤90 (male)	20(28.9%)	41(59.6%)	8(11.5%)	69	χ2: 56.981
≥81-89 (female) ≥91-99 (male)	14(9.3%)	86(56.9%)	51(33.8%)	151	P : 0.00
≥90 (female) ≥100 (male)	6(4.6%)	50(38.2%)	75(57.2%)	131	
Physical activity					
Sedentary /mild	3(1.6%)	53(28.2%)	132(70.2%)	188()	X2: 182.64
Moderate & vigorous	37(22.7%)	124(76.1%)	2(1.2%)	163	0.00
Body Mass Index					
Underweight (<18.5)	3(20%)	9(60%)	3(20%)	15	χ2*: 7.517 P: 0.261
Normal (18.5-23)	9(16.7%)	26(48.1%)	19(35.2%)	54	
Overweight (23-27.5)	13(9.6%)	75(55.1%)	48(35.3%)	136	
Obese (≥27.5)	15(10.3%)	67(45.9%)	64(43.8%)	146	

P < 0.05 S: Significance χ2: chi-square value χ2*: Chi-square with Yates' correction.

Table 4 shows that the positive family history, larger waist circumference and sedentary lifestyle with lack of physical activity were found to be significantly associated with risk of diabetes.

Table 5: Association between Random blood sugar values and IDRS

RBS values	Low risk	Moderate	High risk	χ2 Value p-value

<140 mg/dl (249)	30(12%)	138(55.4%)	81(32.6%)	$\chi 2$: 13.329 p-value: 0.00
140-199 mg/dl (87)	9(10.3%)	35(40.2%)	43(49.5%)	
≥200 mg/dl (15)	1(6.7%)	4(26.7%)	10(66.6%)	
Total	40	177	134	

Table 5 shows about the association between the Random blood glucose levels and IDRS. The newly detected Diabetes 4.3% (15) and Pre diabetics were 24.8% (87). Among diabetics 66.6% (10) were high risk and among pre diabetics 49.4% (43) were high risk. The association between RBS values and the IRDS is highly significant with p - value (0.00)

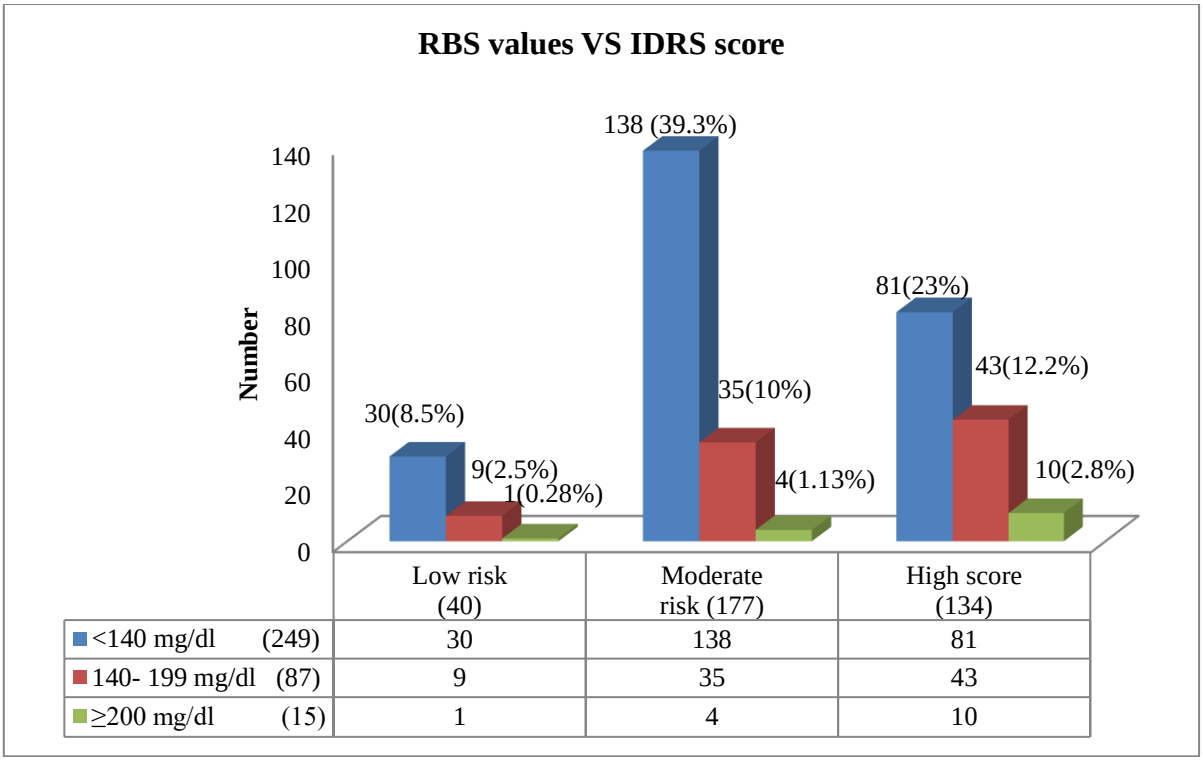

Figure 4: RBS values VS IDRS score

Figure 4 shows that based on random blood glucose levels Diabetes detected in 4.3% (15) and Pre diabetics were 24.8% (87). Among diabetics 66.6% were high risk and among pre diabetics 49.4% were high risk.

DISCUSSION

Indian diabetes risk score: The Present study revealed that among 351 participants, half of the study subjects were in moderate risk followed by 38% were in high risk and 11% were in low risk according to IDRS. Similar findings observed by Anand K et al.[7] revealed that out of 503 subjects, nearly half (49.7%) were in moderate risk followed by high risk group(33.4%) and low risk category(16.9%) as per the IDRS. Studies done by Arun et al (8) in Lucknow and Choudhary et al (9) Jaipur also showed the similar reports. Slightly different results were obtained by Agarwal et al study (10) where although majority (53.5%) were having moderate risk but only 15.6% were having high IDRS risk and 30.9% had low risk.

Age: In Present study almost equal number is present in 35-50 yrs and above 50 years. Study done by Sanjeevaiah et al (11) in rural area of Warangal (2019), it was found that majority (32.4%) were in age group of 25 - 34 years followed by 15 - 24years age group 31.6%.

In the present study the Diabetes Risk was assessed in different age group which reveals that as the age of the person increasing the risk of prediabetes and diabetes is also increased. Nearly two thirds (62.3%) of those belonging to age group 50 years and above were at high risk and more than two third (64.8%) of the participants with age group 30-50 years were at moderate risk as per IDRS. The association between age group with risk for pre diabetes and diabetes was statistically significant. This finding was also supported by the study done by Anita S Acharya et al [6]. Anand K et.al [7] and Patil RS, et al [12]

All the above studies showed that risk of diabetes as predicted by the IDRS, increases significantly with age.

Gender: In present study nearly three fourth (75%) of the study participants were females. Study done by Dasappa H [13], Singh MM [14] also observed that most of the study subjects were females. Most of the studies conducted in India observed that majority of the study subjects were females. This might be due to the timings during which the studies were conducted coincides with working hours .So females subjects were available for survey. Present study reported that nearly 42% females were at high risk of having diabetes as compared to males 27.4% and the difference between males and females with high risk found to be statistically significant ($p<0.05$). The findings were consistent with that of the studies conducted by Namdev et al[15], Prabhakar et al[16] and Anand K et.al[7] (2022) where females had more predilection of higher risk of diabetes and had a significant association of moderate to high risk of developing future diabetes.

Education: Present study reported that two fifth of the study participants were illiterates. It was observed that high diabetes risk was seen in illiterates (51%) compared to literates (29%). 56.6% (119) literates have moderate risk. The association between low education statuses with high risk status was highly significant. ($P = 0.001$). Garima Namdev et al (15) and Acharya et al (6) reported illiterates in their study were 58.1%, and 67.8%. Comparatively more literacy rate in studies conducted by Anand k et.al (7) 92.2% and Bala et al (17) (86%). Patil and Gothankar JS. Et al (12 also showed that more than half (56.5%) of illiterate were at high risk which is nearly similar to the findings of the present study. Illiterates were mostly unaware of the signs and symptoms of disease and were not having any regular checkups to know their diabetic status.

Waist Circumference

Present study reported that above two fifth (44%) of the female participants had waist circumference above 90cm followed by 41% between 81-89 cm and 14% had less than 80 cm. Nearly 47% of the male subjects were having waist circumference 91-99cm followed by less than 90(36.4%) and above 100 by 17%. Patil & Gothankar [12] (2016) also reported the nearly similar findings. Study by acharya as et al (6) observed that more than half (52%) of the males had high waist circumference of ≥90-99 cm and ≥100 cm (22%). Similarly, majority of females had high waist circumference of ≥80-89 cm (25%) and ≥90 cm (61%). Waist circumference which corresponds to central obesity, is a simple, non-invasive and accurate predictor of the risk of type 2 diabetes. In the present study, central obesity was found to be highly prevalent among both male and female study subjects. The association between waist circumference and risk status was highly significant statistically ($P < 0.001$).

Family history: Current study shows that 20 % (69) were having family history of diabetes, among them 8% in high risk and 11% had moderate risk. Study done by Acharya et al, (6) revealed that family history was not significantly associated with risk of diabetes ($p=0.865$) which is similar to the study done by Dasappa et al (13). Ramesh et al (18). Some factors that increase the risk of diabetes are hereditary from parents or close biological relatives.

Physical activity: Present study shows one third of the participants were sedentary having higher risk of having diabetes in near feature. Similar results shown by Anand et al (7) that 40% of participants with vigorous exercise were in low risk and 60% were having moderate risk of having diabetes in near future. While among those who were sedentary 84% having high risk of chance becoming diabetics. This association of Diabetes risk with the physical inactivity was found to be statistically significant ($p<0.05$).

Study conducted by Vishnu et al (19) showed that lack of physical activity is a major concern which increases the future risk of developing type 2 DM. Dugg p(20) also revealed the similar reports. This could be attributed to the fact that rapid urbanization in rural areas leads to a shift from manual work to less physically active jobs, leading to lifestyle changes and obesity. Lack of physical activity in younger individuals and fond of eating junk food may contribute risk of central obesity and risk for Type 2 DM.

RBS and IRDS: In the present study based on random blood glucose levels, 4% have ≥ 200 mg/dl and 25% were Pre diabetics (140-199mg/dl). Among diabetics 67% were high risk and among pre diabetics 49% were high risk. The association between RBS values and the IRDS risk score is highly significant. Study by Dugg p A (20) found that there is a significant association between high RBS value (≥140 mg/dl) and high IDRS. Measurement of RBS has an advantage in that it is convenient, does not require a venepuncture, and can even be performed by a layperson. Therefore, RBS may be used as a good screening modality for adults aged >30 years wherever fasting blood glucose is not feasible at field level.

CONCLUSIONS

Among 351 patients that 25% were identified as Pre diabetics and 4% as diabetics. Current study revealed that the early identification of high-risk individuals and planning for appropriate measures to delay the onset of pre-diabetes and diabetes, so that we can reduce the burden of diabetes in India. IDRS is an effective tool in identifying high risk individuals for pre-diabetics and diabetes in the community.

Recommendation

- Increasing awareness regarding risk factors and importance of knowing once own diabetic and pre diabetic state in an individual would help for early intervention to prevent or to delay the onset of diabetes mellitus and its complications.

- Early detection of risk of diabetes by periodic screening and appropriate lifestyle changes for adopting a healthy lifestyle needed to prevent the future risk of pre diabetes and diabetes in community.
- More awareness campaigns along with diagnostic facilities are needed to know the diabetic state of the individuals.

Limitations of the Study

- Random blood glucose was the only glycemic variable checked.
- Most of the study participants were females.

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