Original Research Article

Prevalence of the risk and cases of Type -2 diabetes mellitus among the residents in a rural area of a coastal district of Andhra Pradesh - A cross-sectional study

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Received: 28-11-2021 / Revised: 27-12-2021 / Accepted: 01-01-2022

Abstract

Introduction: Diabetes is a major cause of blindness, kidney failure, heart attacks, stroke and lower limb amputation. Approximately 537 million adults are living with diabetes in the world. 3 in 4 adults with diabetes live in low- and middle-income countries. India is set to be diabetic capital of world with 74.19 million diabetics and 39.39 million undiagnosed diabetics. **Objective:** To estimate the prevalence of high risk for developing Type 2 Diabetes in adults aged 30 years and above using the Indian Diabetic Research Score (IDRS) in the study population and determine their association with various modifiable, non-modifiable risk factors (age, waist circumference, family history of diabetes, physical activity) and other socio-demographic variables. To estimate the prevalence of Type 2 Diabetes Mellitus in the study population. **Methodology:** A community based cross-sectional study was conducted among 207 eligible, sampled residents of the field practice area ≥ 30 years of Rural Health and Training Centre of a private medical college in Visakhapatnam, Andhra Pradesh.. The data was collected from the study subjects by a using a pre-designed, pretested questionnaire. Statistical analysis was done by using Chi-square to determine the association of risk factors and socio-demographical variables of the study subjects with the status of risk of diabetes in them. **Results:** After excluding the 35 existing diabetics in the study, the data of rest of 172 research subjects was collected, The data of 2 research subjects was missing and was excluded. Maximum 43.5% of the study subjects were in the age group of 35-49 years. Proportion (71.8%) of females was higher than males. As per IDRS, 32 (18.8%) participants were at low risk,102 (60%) participants were at moderate risk and 36 (21.2%) participants were at high risk of diabetes. 4 out of 36 high risk research subjects had Random Capillary Blood Glucose (RCBG) of more than 140 mg/100 ml of blood and were further confirmed by Oral Glucose Tolerance Test (OGTT) to be diabetic. The association of variables like age, literacy, family history of Diabetes, physical activity, waist circumference with categories of risk of development of Diabetes Mellitus was found to be statistically significant. The prevalence of Type 2 Diabetes Mellitus (existing diabetics=35 and new diabetics=4) was found to be 18.8%, out of the total study sample (n=207). **Conclusion:** A considerable proportion of the study population were in moderate and high categories of risk of development of Diabetes. A healthy diet, regular physical activity, maintaining a normal body weight and avoiding tobacco use are ways to prevent or delay the onset of type 2diabetes. Diabetes can be treated and its consequences avoided or delayed with diet, physical activity, medication and regular screening and treatment for complications

Keywords: Diabetes, Indian Diabetes Risk Score, Prevalence, Rural

Introduction

Diabetes is a major cause of blindness, kidney failure, heart attacks, stroke and lower limb amputation[1].

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Approximately 537 million adults are living with diabetes in the world. The total number of people living with diabetes is projected to rise to 643 million by 2030 and 783 million by 2045. 3 in 4 adults with diabetes live in low- and middle-income countries[2]. India is set to be diabetic capital of world with 74.19 million diabetics and 39.39 million undiagnosed diabetics[3]. The factors responsible for existence of this epidemic are due epidemiological transition associated with changes in dietary patterns and decreased physical activity[4]. Moreover, lack of knowledge about healthy diet and nutrition and role of exercise compounds their susceptibility.

Globalization and Urbanization has led to increase in consumption of High Fat, Salt and Sugar (HFSS) foods[5,6]. Diabetes is one of the contender diseases for which the community can be screened as it qualifies criteria of having a long latent asymptomatic stage that may be present for up to seven years before diagnosis, is treatable, and testing is acceptable to patients[7]. Early treatment of diabetes improves micro as well as macro-vascular outcomes in the long run. In communities, size-able percentage of people with Type 2 Diabetes remain undiagnosed. As per the International Diabetes Federation (IDF), more than half (66%) of Indians are unaware of their diabetic status as compared to 50% in Europe and 33% in USA[8]. Approximately 44 lakh Indians are not aware that they are diabetic and hence are at increased risk of complications. Khan et al. in their study have defined that screening for diabetes can actually increase in quality of life-years gained by the patients over a period of time[9]. Thus the present priority is to screen high risk population in the community, diagnose and then treat them in the community. It has been acknowledged that diabetic screening can add quality of life years. The battle against diabetes epidemic needs to be fought at all levels of prevention put into action simultaneously. Screening for undetected diabetes primarily addresses the role of secondary prevention in diabetes. Type 2 Diabetes can be screened for by using risk assessment questionnaires, laboratory tests and combinations of the two. It is imperative that the risk assessment tool used in diabetes screening is 'population specific'. Such tools are effective in unmasking the real burden of disease. Madras Diabetes Research Foundation (MDRS) gave the countrymen the Indian Diabetes Risk Score (IDRS) which effectively screens for those at high risk of developing diabetes. This score is based on an extremely large population base study on Diabetes in India 'CURES'. This screening score has a sensitivity of 72.5% and specificity of 60.1% in the Indian community[10]. This technique will enable the family physicians to stratify the risk for Diabetes and will aid the proper management to deliver appropriate health care services at primary care level to the targeted populations in a cost-effective manner. The advantages of this tool encompasses is- no cost, non- invasive, simple, and easy applicability by the target population during mass screening programs. Hence, the present study was done using IDRS as screening tool for diabetes and determine the prevalence of undiagnosed diabetics in a Rural population.

Aim and objectives

To estimate the prevalence of high risk for developing Type 2 Diabetes in adults aged 30 years and above in the study population using the Indian Diabetic Research Score (IDRS) and to determine their association with risk factors and other socio-demographic variables. To estimate the prevalence of Type 2 Diabetes Mellitus in the study population.

Materials and Methods

Study type

Community based observational study, descriptive type.

Study design

A cross-sectional study was conducted among the residents of the field practice area.

Study setting

This study was conducted in the Field practice area of Rural Health Training Centre (RHTC), BantuPallivari Kallalu of Gayatri Vidya Parishad Institute of Health Care and Medical Technology, Visakhapatnam.

Study duration

Two months (28th February to 27th April).

Study population

The residents of the field practice area $\geq$ 30 years of RHTC, BantuPallivari Kallalu.

Sample size

The sample size was determined by using the formula: $n \geq Z^2_{1-\alpha} p q/d^2$ where n= sample size, Z = 1.96, (p) = 36.6 % [10], q = 63.4 %, d = 20 % of p. Taking into consideration a non-response rate of 20%, the sample size was estimated to be 199.7 and rounded off to 200. The sample population collected in the field in the stipulated timeframe was 207.

Inclusion criteria

All the adults residents in the field practice area of RHTC $\geq$ 30 years and who gave informed consent to participate in the study.

Exclusion criteria

Adults not cooperative, who are morbidly sick and pregnant and lactating women up to 12 weeks post-partum.

Study procedure and Data Collection

Approval was taken from Institutional Research Committee and Institutional Human Ethics Committee before the start of the study. After getting the approval, the households in the field practice area of RHTC were enumerated and from the list, 207 households were selected using simple random sampling technique Among the households selected eligible adults present in the house were enumerated and using inclusion and exclusion criteria and simple random sampling technique 1 adult per household was selected. The data was collected by interviewing the study subjects using a pre-designed, pre-tested study instrument after explaining it, taking informed consent and ensuring strict confidentiality to them. The questionnaire enquired if the study subject was a diabetic. If the answer was positive further data was not collected and the questionnaire was administered to next sampled study subject. If the next subject was not a diabetic then the entire questionnaire was asked and the relevant data was collected. The questionnaire dealt with socio-demographic and economic details, family history of diabetes, physical activities or exercise and anthropometric measurements like waist circumference. The study subjects were screened for the risk of developing Diabetes Mellitus by using IDRS[10]. The maximum score is 100 and the minimum score is 0. IDRS was developed using four simple parameters namely age, abdominal obesity, family history of diabetes, and physical activity Subjects with an IDRS of <30 was categorized as low risk, 30-50 as medium risk and those with > 60 as high risk for diabetes. The study subjects who were found to be at high risk of developing diabetes (IDRS >60) were subjected to biochemical testing i.e. Random Capillary Blood Glucose (RCBG) using a standardized digital glucometer (Accu-Check, Roche Diagnostics, Germany). The RCBG more than 143mg/dl was taken into consideration for considering a subject to be diabetic. Those whose RBCG was more than 143 mg/dl were further subjected to Oral Glucose Tolerance Test (OGTT) to confirm diabetes. Those having a Fasting Plasma Glucose (FPG) $\geq$ 126mg/dl and or 2 hr plasma glucose $\geq$ 200 mg/dl were further confirmed to be having diabetes[11].

Data entry and analysis

The data was collected using google forms, entered into MS Excel spreadsheet and was analysed by using SPSS ver.22 and descriptive statistics like proportions, confidence limits, mean, standard deviation and inferential statistics like Chi-square tests was done to test the association between sociodemographic variables and risk factors with IDRS.

Ethical approval

Approval from Institutional Ethics Committee was obtained prior to the start of the study.

Consent

Written informed consent was obtained from the research subjects in the Informed Consent Document before the commencement of the study.

Results

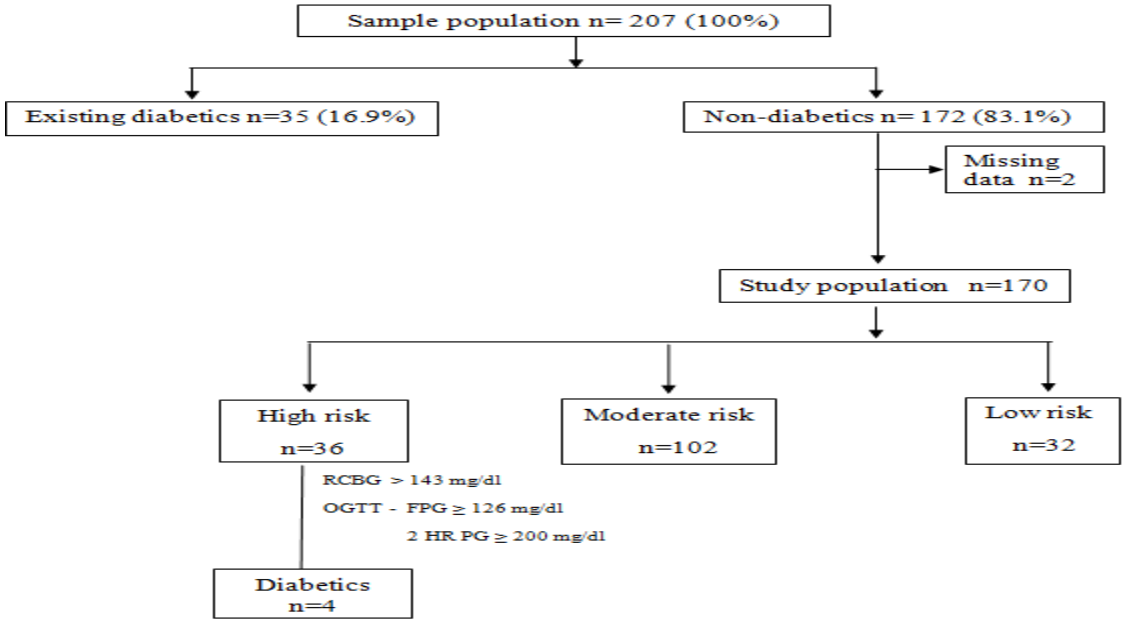

Figure 1: Flow diagram of the results of the study

Out of 207 participants, 35 (16.9%) were already diagnosed as having diabetes. Of the rest 172 participants, the data of the 2 research subjects was incomplete or missing. The data of the 170 subjects is as follows. Majority (43.5%) of the study participants were between 35-49 years age group, followed by 38.8% participants who were ≥50 years and 17.6% participants who were between 30-34 years. Females (71.8%) outnumbered the males (28.2%). Most (68.2%) of the study participants were illiterates. Maximum (38.8%) of the participants belonged to lower middle class or class IV socio-economic status (SES) as per modified B.G.Prasad's classification of SES. A sizeable proportion (31.8%) of the participants were housewives. Only11.8% participants had a family history of diabetes. About 52.4% participants had sedentary to mild while 47.6% had moderate to vigorous physical activity respectively. 54.1% participants had high waist circumference (Men≥90cm / Women≥80 cms). **[vide Table 1]**

Table-1: Baseline characteristics of the study population (n=170)

Variable	Category	Total	
		Frequency	Percentage
Age in years	30-34	30	17.6
	35-49	74	43.5
	≥50	66	38.8
Sex	Male	48	28.2
	Female	122	71.8
Education	Illiterate	116	68.2
	Primary (upto 5th class)	15	8.8
	Secondary (6th class to 10th class)	27	15.9
	Higher secondary and above (>10th class)	12	7.1
SES as per modified B.G.Prasad's Classification of SES	Class I: Rs.8224 and above	4	2.4
	Class II: Rs.4112-Rs.8223	18	10.6
	Class III: Rs.2467-Rs.4111	40	23.5
	Class IV: Rs.1234-Rs.2466	66	38.8
	Class V: Rs.1233	42	24.7
Occupation	Business	5	2.9
	House wife	54	31.8
	Household worker	5	2.9
	Labourer	32	18.8
	Retired	4	2.4
	Service	9	5.3
	Other	61	35.9
Family History of Diabetes	Yes	20	11.8
	No	150	88.2
Physical Activity	Sedentary to mild	89	52.4
	Moderate to vigorous	81	47.6
Waist Circumference	Men≥90 / Women≥80	92	54.1

In cm	Men<90 / Women<80	78	45.9

Of the 170 study subjects as per IDRS categorisation of risk of development of Diabetes, majority (60%)(15 – 27.3 95% CI) participants were at moderate risk, 21.2% (52.6 – 67.4 95% CI) participants were at high risk and 18.8%(12.9 – 24.7 95% CI) participants were at low risk of diabetes. **[vide Table 2, Figure 2]**

Table-2: Classification of study participants according to categories of risk of Diabetes as per IDRS (n=170)

Categories of Risk of Diabetes (IDRS)	Frequency	Percentage	95% Confidence limits
High (≥60)	36	21.2	15 – 27.3
Moderate (30-50)	102	60.0	52.6 – 67.4
Low (<30)	32	18.8	12.9 – 24.7
Total	170	100.0	-

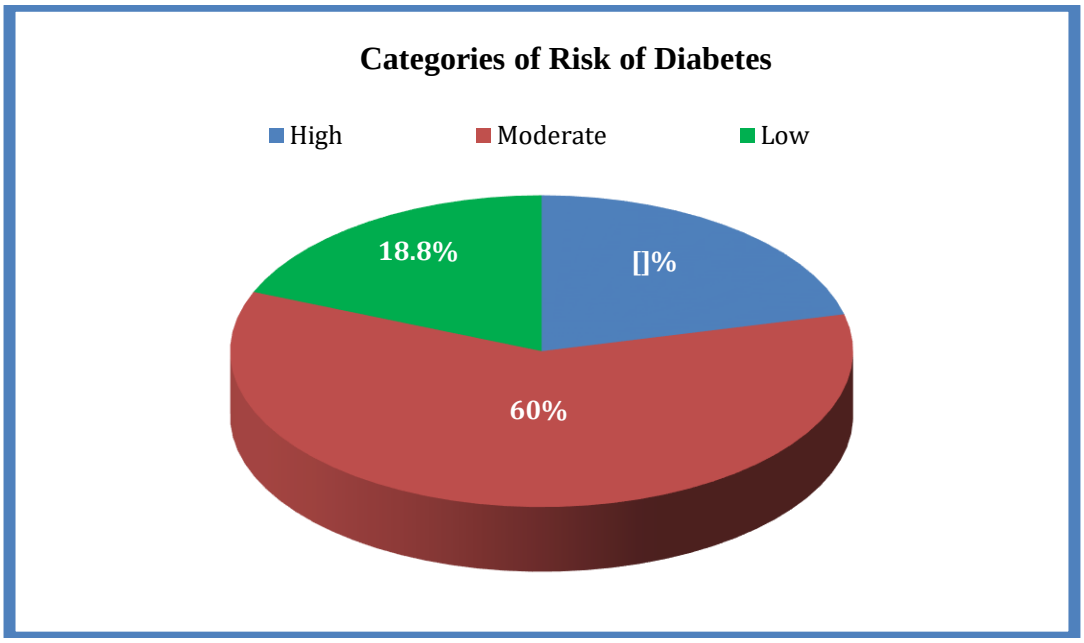

Figure 2: Distribution of study population as per categories of risk of diabetes

None (0%) of the participants in the age group of 30-34 years , 20.3% of the participants in the age group of 35-49 years and 31.8% of them in age group ≥ 50 years were in high risk group. It was seen that as age increases the risk of development of diabetes also increases. The association of age of the study subjects and categories of risk of diabetes was found to be statistically significant. (p<0.001).23% of females were in high risk of diabetes compared to 16.7% of males. The association of gender of the study population with categories of risk was not statistically significant. (p=0.363). In the category of high risk of diabetes, illiterates constituted the maximum (26.7%) compared to other categories of education. It was seen that as category of education increases the risk of diabetes also falls. The association of education of the study subjects with categories of risk of diabetes was found to be statistically significant. (p<0.001). Maximum proportion (27.3%) of high risk of diabetes was found in participants belonging to Class IV or Lower middle class. The association of socio-economic status of the participants and categories of risk of diabetes was not found to be statistically significant. (p=0.27). 100 % of the research subjects who were retired were seen in the category of high risk of diabetes compared to nil in household workers and 12.5 % in labourers in the same category. This shows sedentary nature of occupation can be a cause for risk of diabetes. The association of occupation of the participants with categories of risk of diabetes was found to be statistically significant. (p<0.001). 40% of the participants having a family history of diabetes were seen in high-risk category compared to 18.7% who had no family history of diabetes. The association of family history of diabetes in the participants with categories of risk of diabetes was found to be statistically significant. (p<0.045). 40.4% of the study subjects who were doing sedentary to mild physical activity or exercise were seen in high-risk category of diabetes compared to none (0%) of the participants doing moderate to vigorous activity. The association of physical activity of the participants with categories of risk of diabetes was found to be statistically significant. (p<0.001). 33.7% of the participants who had a higher waist circumference were under high risk compared to none (0%) of the participants who were to have normal or lesser waist circumference. The association of waist circumference of the study subjects with that of the categories of risk of diabetes was found to be statistically significant. (p<0.001). **[vide Table 3]**

Table 3: Association of socio-demographic and risk factors with the categories of risk of diabetes among the study population

Variable	Category	Risk						p-value
		High		Moderate		Low		
		Frequency	Percentage	Frequency	Percentage	Frequency	Percentage	
Age	30-34	0	0	11	36.70	19	63.30	**<0.001**
	35-49	15	20.30	46	62.20	13	17.60	
	≥50	21	31.80	45	68.20	0	0	
Gender	Male	8	16.70	28	58.30	12	25.00	0.363

	Female	28	23.00	74	60.70	20	16.40	
Education	Illiterate	31	26.70	74	63.80	11	9.50	**<0.001**
	Primary (up to 5th class)	0	0	9	60.00	6	40.00	
	Secondary (6th class to 10th class)	3	11.10	12	44.40	12	44.40	
	Higher secondary and above (>10th class)	2	16.70	7	58.30	3	25.00	
SES	Class I: 8224 and above	0	0	2	50.00	2	50.00	0.27
	Class II: 4112-8223	2	11.10	12	66.70	4	22.20	
	Class III: 2467-4111	9	22.50	20	50.00	11	27.50	
	Class IV: 1234-2466	18	27.30	39	59.10	9	13.60	
	Class V: 1233	7	16.70	29	69.00	6	14.30	
Occupation	Business	3	60.00	2	40.00	0	0	**<0.001**
	House wife	18	33.30	30	55.60	6	11.10	
	Household worker	0	0	3	60.00	2	40.00	
	Labourer	4	12.50	23	71.90	5	15.60	
	Retired	4	100.00	0	0	0	0%	
	Service	2	22.20	5	55.60	2	22.20	
	Other	5	8.20	39	63.90	17	27.90	
Family History of DM	Yes	8	40.00	11	55.00	1	5.00	**0.045**
	No	28	18.70	91	60.70	31	20.70	
Physical Activity	Sedentary to mild	36	40.40	43	48.30	10	11.20	**<0.001**
	Moderate to vigorous	0	0	59	72.80	22	27.20	
Waist Circumference	Men≥90 / Women≥80	31	33.70	55	59.80	6	6.50	**<0.001**
	Men<90 / Women<80	5	6.40	47	60.30	26	33.30	

The existing or old cases of diabetes found in the study were 35 (16.9%) out of the total sample of 207 study participants. New or incident cases of diabetes were 4(1.9%). The prevalence of diabetes in the study was thus found to be 39 cases (18.8%) in the study population. **[vide Table 4, Figure 3]**

Table 4: Status of cases of Diabetes in the study population

Diabetes cases	Frequency	Percentage
Existing	35	16.9
New	4	1.9
Total	39	18.8

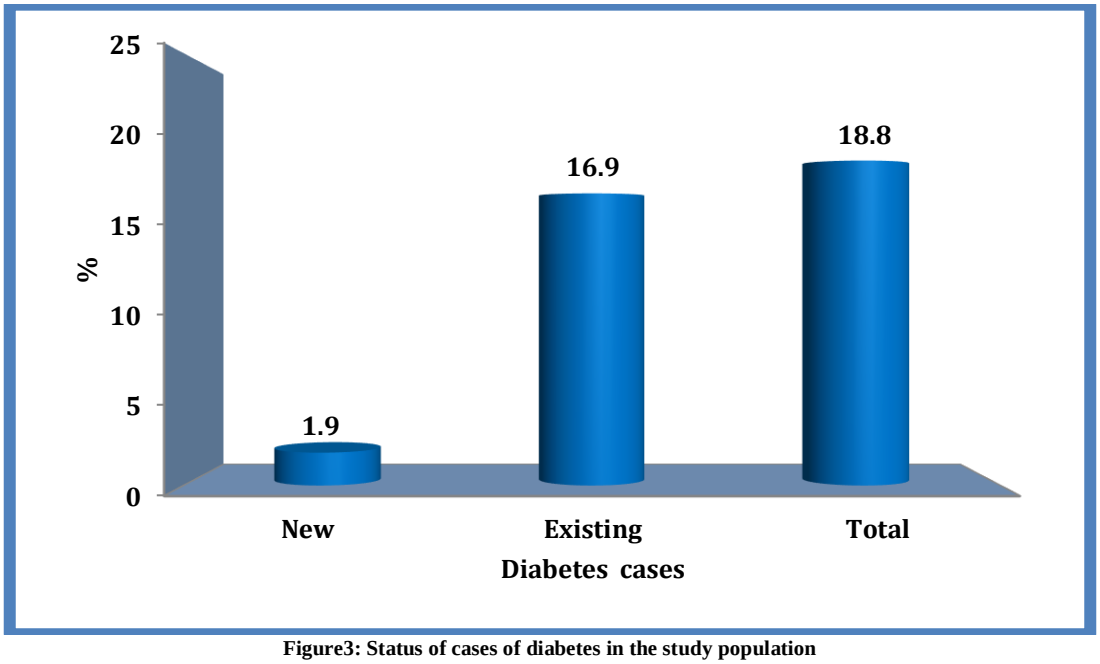

Figure3: Status of cases of diabetes in the study population

Discussion

In the present study out of 207 participants, 35 (16.9%) were already diagnosed as having diabetes. A study by Patil RS et al[10]. reported that out of 425 participants 42 (9.88%) were diagnosed as having diabetes. Maximum proportion (43.5%) of participants were found in this study in the age group of 35-49 years. Similar observation was noted in the study by Patil RS et al[10]. which was 48.3% and also Sarada V et al[13]. which was 48%. In the study by Nittoori S et al[14]. 39.7% were seen in the above age group. Females (71.8%) outnumbered the males (28.2%) in the present study. Similar

observations were made in the study by RS et al[10]. and Nittoori S et al[14]. This was in contrast to the observation in the study Sarada V et al[13]. where the males were 64.3% and females were 35.7%. Majority of the study population were illiterate (68.2%) which differed with the observations by Patil RS et al[10],Vallepalli C et al[12], Sarada V et al[13]. and Nittoori S et al[14]. A major proportion (38.8%) of the research subjects were in the Class IV SES. This was found to be similar to the findings in the study by Vallepalli C et al[12]. and differed with the observations in studies by Patil RS et al[10], Sarada V et al[13]. and Nittoori S et al[14]. Among the occupations in the present study majority were housewives(31.8%) which was similar to that of the study by Patil RS et al[10]. In the present study the proportion of study population with a family history of diabetes was 11.8% which is similar to the finding in the study by Patil RS et al[10]. and Nittoori S et al[14].Sedentary to mild physical activity was seen in majority (52.4%) of study subjects which is similar to the finding in the study by Patil RS et al[10] . Majority in the present study had a high waist circumference. Similar observation was seen in the study by Patil RS et al[10] and Sarada V et al[13].

In the present study the proportion of individuals at high risk of development of diabetes as per IDRS was 21.2%. It differs from the observations in studies made by RS et al[10] (36.6%), Vallepalli C et al[12] (35.8%), Sarada V et al[13] (49.7%) and Nittoori S et al[14]. (74.2%) who reported high risk scores. The difference in the prevalence of risk in the present study to that of others may be due to differences in socio-demographic profiles and lifestyles of the study population. It was seen in the current study that 60% of the study subjects had moderate risk and 18.8% had low risk. This was in contrast to Patil RS et al[10] who reported in their study, 54.6% and 8.9% participants had moderate and low risks respectively. The study by Sarada V et al[13] noted 41% of the study population had moderate risk and 9.3% had low risk. A study by Nittoori S et al[14] also differed by reporting 23.5% participants were at moderate risk and 2.2% had low risk. Similar observations to the present study were noted in a study by Vallepalli C et al[12]where 57.6% and 6.6% of the participants had moderate and low risks respectively.

It was noted in the present study that as age increases the risk of development of diabetes also increases. The association of age of the study subjects and categories of risk of diabetes was found to be statistically significant. ($p<0.001$). Similar findings were reported by RS et al[10], Vallepalli C et al[12] and Nittoori S et al[14]. 23% of females were in high risk of diabetes compared to 16.7% of males. The association of gender of the study population with categories of risk was not statistically significant. ($p=0.363$). Similar observations were seen in the studies by Vallepalli C et al[12] and Nittoori S et al[14] where the association between gender and risk was not significant. However a study by RS et al[10] reported significant statistical association between gender and risk. In the present study in the category of high risk of diabetes, illiterates constituted the maximum (26.7%) compared to other grades of education. The association of education of the study subjects with categories of risk of diabetes was found to be statistically significant. ($p<0.001$).This could be due to awareness of types of foods consumed, exercise and healthy lifestyle in the literate persons. Similar findings were noted in the study by RS et al[10] where it was seen that the statistical association between low educational status with high risk status was highly significant. A study by Vallepalli C et al[12] also had similar observation. However a study by Nittoori S et al[14] revealed that the association between educational status and risk of diabetes. Maximum proportion (27.3%) of high risk of diabetes was found in participants belonging to Class IV or Lower middle class. This may be due to changes in lifestyle and standards of living which in turn is due to influence of television, newspaper and social media The association of socio-economic status of the participants and categories of risk of diabetes was not found to be statistically significant. ($p= 0.27$). Nittoori S et al[14] in their study had similar finding . In contrast the studies by RS et al[10] and Vallepalli C et al[12] observed a significant statistical association between SES and risk of diabetes. 100 % of the research subjects who were retired were seen in the category of high risk of diabetes compared to nil in household workers and 12.5 % in labourers in the same category. This shows sedentary nature of occupation can be a cause for risk of diabetes. The association of occupation of the participants with categories of risk of diabetes was found to be statistically significant. ($p<0.001$). Study by Nittoori S et al[14] also noted a statistical significant association between occupation and risk of diabetes. However study by RS et al[10] differed in this regard. 40% of the participants having a family history of diabetes were seen in high-risk category compared to 18.7% who had no family history of diabetes. The association of family history of diabetes in the participants with categories of risk of diabetes was found to be statistically significant. ($p<0.045$). The role of family history of diabetes in the screening of diabetes in populations is very important. Studies by RS et al[10] and Vallepalli C et al[12] also reported similar observation. The findings in a study by Nittoori S et al[14] contradicted to that of the present study. 40.4% of the participants who were doing sedentary to mild physical activity or exercise were seen in high-risk compared to none (0%) doing moderate to vigorous activity. The association of physical activity of the participants with categories of risk of diabetes was found to be statistically significant. ($p<0.001$). RS et al[10] and Vallepalli C et al[12] in their studies had similar observations. 33.7% of the participants both males and females who had a higher waist circumference were under high risk compared to none (0%) of the participants who were to have normal or lesser waist circumference. The association of waist circumference and risk of diabetes was found to be statistically significant. ($p<0.001$). Waist circumference is a potent indicator of subsequent risk of diabetes[15] Studies by RS et al[10], Vallepalli C et al.[12], Nittoori S et al[14], Bener A et al[15] and Satman et al[16] also reported similar observation. The prevalence of diabetes in the present study was found to be 39 cases (18.8%) in the study population. RS et al[10] however observed that the prevalence of diabetes in their study was 11.52%.

Conclusion

This study was conducted to assess the risk of Type-2 Diabetes Mellitus using Indian Diabetes Risk Score in a rural population. It was found in this study that non-modifiable factors like advancing age, family history of diabetes, and modifiable factors like low education, sedentary nature of occupation, low physical activity and high waist circumference indicating abdominal obesity were found associated with the high risk of diabetes.

Recommendations

A healthy diet, regular physical activity, maintaining a normal body weight, avoiding tobacco use and micronutrient poor, energy dense foods are ways to prevent or delay the onset of type 2 diabetes. Diabetes can be treated and its consequences avoided or delayed with the above- mentioned interventions coupled with proper, timely medication, regular screening and treatment for complications. Primordial, primary and secondary levels of prevention strategies, creating awareness among the lay public about the national programme on diabetes and drawing attention of the policy makers and bureaucracy by observing World Diabetes Day will go in a long way to control diabetes in the population effectively.

Strengths of the study

The study design being a cross-sectional one was helpful to get a large amount of information in a very short time and also by using IDRS a large section of the population could be screened for diabetes. New cases of diabetes were also found in the present study

Limitations

As it was a cross-sectional study a causal association between the factors identified and risk of diabetes couldn't me made out. As only 1 person per household was chosen, there could be a chance of missing out other potential diabetics in the family.

Relevance of the study

The study brings out the need for a regular screening programme for diabetes in the high-risk group in population and the also use of IDRS, a user friendly, simple, fast and cost-effective screening tool which helps to detect the unexposed part of the 'iceberg' of undiagnosed high risk diabetics in the population who would never seek the services of a health care facility or are too late before they become diabetics.

Acknowledgement
The authors would like to acknowledge the medical and the field staff of the Rural Health Training Centre, B.P.Kallalu of the Dept. of Community Medicine, GVPIHC & MT (Gayatri Medical College) for the cooperation in conducting the survey in the rural population for the project.

Source of support
Nil

Conflict of interest
Nil

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