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Research Article

PREVALENCE AND PREDICTORS OF DIABETES AMONG ADULTS IN RURAL DHARWAD, INDIA: A CROSS-SECTIONAL STUDY

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ABSTRACT

Objective: Diabetes is a long life chronic non-communicable disease and emerging fast as one of the most serious health problems in developed and developing countries, also influences the risk of developing macrovascular complication including heart disease and stroke which are the leading causes of global death. This study aims to find the potential risk factors associated to diabetes among different community (Government, Private employees, and Businessmen) of adults 20 years and above.

Methods: A cross-sectional study followed and conducted door-to-door survey using World Health Organization STEP Surveillance (WHO STEPS) questionnaire to collect the information of sociodemographic, anthropometric and behavioral characteristics. Multiple logistic regression is used to determine the risk factors of diabetes among study population. Data was pre-processed and used Chi-square test and t-test to find the comparison between the attributes.

Results: Overall prevalence of diabetes is found to be 49.1% in which prevalence more in females with 51.7% than in males with 46.8%, the education, health examination, and waist circumference were found to be the potential risk factors. The total study subjects include 1083 in which male is 611 and female is 472.

Conclusion: The current study reflects the importance of Diabetes disease among the study population in rural Dharwad and this study can be utilized to control and prevent diabetes. It's an early call for the females of the study population to take care and practice healthy food in day today life and the outcome of the study says that the education should be given prime importance in everyone's life.

Keywords: Diabetes, Prevalence, Risk factors, Pre-Diabetes, Sociodemographic, Anthropometric.

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INTRODUCTION

According to the International Diabetes Federation, the global population of 415 million adults have diabetes in 2015, and it is expected to rise 642 million by 2040. It is estimated that one in 11 adults has diabetes in 2015 and expected that one in 10 adults will have diabetes in 2040. In financial relations, the global burden of diabetes is immense, the annual expenditure of 673 billion US dollars in 2015, which constituted 12% of global health expending for that year. As in urban areas of low- and middle-income countries, the recent prevalence suggests that diabetes an increasing problem and well recognized as public health priority among urban and rural population [1].

India is the second largest diabetes adult population after China and children population with type 1 diabetes next to USA, also the World Health Organization (WHO) has anticipated the supreme growth in the world diabetes in India [2]. According to the International Diabetes Federation, there are 40.9 million people are subjected to diabetes and it is likely to rise to 69.9 million by the year 2025. India being the second largest individuals living with diabetes, spent <3% of the World's total expenditure on diabetes comparing to other top ten diabetes populated countries. It is believed that the Indians have greater degree of insulin resistance and a solid genetic tendency to diabetes, due to swift changes in culture, socioeconomic development, high-tech improvements, and transformation in lifestyle due the Western Culture adoption, behavioral pattern, environmental factors like obesity, physical inactivity, diet (saturated fat and unsaturated fat) and aging population leads to prominent health changeover which is responsible for developing diabetes.

Dasappa *et al.* has set up a cross-sectional study to determine the "prevalence of diabetes and assessments of their risk factors associated with diabetes and Pre-diabetes in urban slums of Bangalore". The study was conducted among adults of 35 years and above in four urban slums of Bangalore, in which only the selected people were considered, who are residing for past 2 years in the slums. The author did house-to-house survey for gathering data of the eligible people, and, they collected the details such as sociodemographic factors, morbidity profile, and anthropometric measurements. The collected data were entered into Microsoft Excel 2007, and they used Statistical Package for Social Sciences (SPSS) version 19.0 for statistical analysis, they analyzed the data using descriptive statistics for sociodemographic variables, morbidity profile, and risk factor data. In this study, Chi-square test of association or Fisher's exact probability test was used for finding the association between diabetes and associated variables. The variables which have statistically potential association were entered into multiple logistic regression model. This study got the result that, prevalence of diabetes was 12.33% and of prediabetes was 11.57% and they showed statistically significant association with prevalence of diabetes and prediabetes factors such as increasing age, over weight and obesity, sedentary lifestyle, tobacco consumption, and diet habits [3].

Okwechime *et al.* conducted a study to estimate the "prevalence and predictors of pre-diabetes and diabetes among adults 18 years or older in Florida: A multinomial logistic modelling approach". Author collected the data between the period of January and December 2013, were taken from Florida's Behavioral Risk Factor Surveillance System. They performed descriptive analyses to estimate the prevalence of prediabetes and diabetes. Author examined the predictors of prediabetes and diabetes using multinomial logistic regression model. Model goodness-of-fit was gauged using both the multinomial goodness-of-fit test. In this study, author found that based on the final multivariable multinomial model, only being overweight, obese, hypertensive, hypercholesterolemic, and arthritic had significant associations with prediabetes. According to this study outcome, determined the risk of diabetes increased with increasing age, lower income, in males, and with physical inactivity [4].

Akter *et al*., "prevalence of diabetes and prediabetes and their risk factors among Bangladeshi adults: a nationwide survey". Author collected the data samples from the 2011 Bangladesh Demographic and Health Survey using a stratified, multistage, cluster sampling design. Risk factors for diabetes and prediabetes were identified using multilevel logistic regression models, with adjustment for clustering within households and communities. Among the participants, 56.0% of diabetics were not aware that, they had the condition and only 39.5% we are taking treatment regularly. The study found that the chance of diabetics between the age 55 and 59 years is nearly double that in those aged 35–39 years, also between richest households and poorest. According to this study, the probability of diabetes was notably associated with educational level, body weight, and the presence of hypertension and almost one in ten adults in Bangladesh was found to have diabetes [5].

Tripathy *et al*. "prevalence and risk factors of diabetes in a large community-based study In North India: Results from a steps survey in Punjab, India". This study reports on the prevalence of diabetes and prediabetes and data collected by household NCD steps survey and the information like anthropometric and blood pressure measurements were collected using the WHO steps questionnaire. Author performed the statistical analysis such as, Chi-square test was used for comparison of proportions across groups and ANOVA test for comparison of means across groups. Univariate and multiple logistic regression analysis was done to determine the predictors of diabetes. This study results, age group (45–69 years), marital status, hypertension, obesity, and family history of diabetes were found to be the risk factors significantly associated with diabetes [6].

Akhtar and Dhillon "Prevalence of diagnosed diabetes and associated risk factors: Evidence from the large-scale surveys in India." This paper estimates the diabetes prevalence in states and districts of India and inspects the associated risk factors with newly diagnosed and self-reported diabetes. Author collected the information from clinical, anthropometric, and biochemical data from District Level Household and Facility Survey (2012–2013) and Annual Health Survey (2014). Based on the collected information, on glucose level of the blood sample and defines diabetes as per the WHO (1999) criteria. They performed multinomial logistic regression to identify the risk factors of diabetes. The study outcome of their work estimates 7% adults with diabetes in India and urban have the more diabetes than the rural. Widowed, older persons, and persons with high blood pressure have very high risk of both diagnosed and self-reported diabetes. Author found that Hindus, Muslims, and Christians have higher, and Sikhs have less risk of diabetes and could not find the association of diabetes with some of the key factors such as physical activity levels, dietary habits, occupation status, expenditure on treatments, and family history as information was not available in the data [7].

Considering the background, the diabetes is increasing rapidly and according to the statistics it is predicted to be a significant difference in the population that leads to a problem in economic as well as in the development of the nation, so the changing epidemiology of diabetes in India is required. It is essential to consider the present conditions and analyze, to battle in guiding against the current scenario. Hence, the present study is conducted to determine the prevalence and finding the risk factors associated with diabetes among the government, private employees, and businessmen. The outcomes of this study will be important to know the health conditions among the government, private employees, and businessmen, and for informing public health program decisions.

METHODS

Materials

The data are collected through house-to house survey with help of WHO STEPS questionnaire in this area, out of total population our examination considered just for the residents who are living for past 2 years and who has current occupation as government, private workers, and individuals having their businesses. These residents considered to be as qualified participants and three visits made to each of the houses, if in the last visit the participants were not available and refused to take part in the examination, they are considered to be non-responder, also in our study pregnant women are ignored in the total study population.

Methods

Study design

This study is a cross-sectional, community-based among adults whose age is 20 years and above who were residents of Kelgeri, Dharwad district, Karnataka state, India, total study population accounts 1083 in which male is 611 and female is 472 according to the census of 2011 [8].

Study instrument

The data gathered by means of the WHO STEPS questionnaire [9] was used with minor alterations. The questionnaire was created in English language and was figured out how to regulate in Kannada (the local language) to the participants, the questionnaire was designed to gather information like sociodemography attributes, medical related inquiries, measurements, and behavioral information on smoke and alcohol use, fruit and vegetable intake, physical activity (exercise), family history of diabetes conditions, health examination and physical measurements such as height, weight, blood pressure, and waist circumference. Biochemical tests conducted to measure fasting blood glucose were collected in WHO steps strategy. During the collection of information through WHO steps questionnaire, the eligible residents were completely informed with respect to the reason for the examination so that the participants trust and confidently gave their details for our study.

Data were gathered with the help of a two-membered team (1 researcher, 1 medical investigator). The participants were considered as tobacco user if they smoke cigarettes (1 or more in 3 days) and as alcohol consumer if they consume then, marked in terms of consumption period such as daily, weekly, and monthly. In case of vegetable and fruit consumptions, the intake of fruit might be either raw or juice, then the consumption measured into two categories (Every day, twice a week) and about the physical activity information it is based on the time spent on exercise or work done in either work time or leisure time of 30 min daily then the person considered to be active. If the participant's family members such as aunt, uncle, parents, brother, sister, grandparents, and first cousin then considered as the positive family history of the diabetes.

The blood glucose was measured using the blood glucose measurement device (Freestyle Optimum H Glucometer) and diabetic participants were ignored in this test and considered as positive. Blood pressure was measured in a sitting position with the help of the standard measuring instrument. Twice blood pressure has been measured with the interval of 5 min the mean of both the measurements is taken into consideration for the study. Health examination which is recorded based on the health check-up related to blood sugar, blood pressure, and other for past 1 year. Height was verified using the measuring tape in centimeters, participants were informed before measuring to stand straight, without shoes with their back against the wall, heels together and looking forward. Weight is measured using the standard digital weighing scale, and weight value is recorded in kilograms.

Waist circumference is measured using the non-stretchable measuring tape; the value is recorded in centimeters. Body mass index (BMI) was calculated using the formula, weight (kg)/height (m^2), participants considered to be obese if BMI ≥25 kg/m^2 and overweight when BMI ≥23 kg/m^2, abdominal obesity was considered to be present when waist circumference ≥90 cm in males and ≥80 cm in females. Education of the participants are recorded based on their qualification (Undergraduate, Postgraduate, 12th, 10th), and age is verified using the date of birth of the participants. After the entire examination process, an overview of the

diabetes disease, complication, symptoms, and treatment process were conveyed to the participants.

Statistical methods

Collected data were manually entered in Microsoft Excel 2016 and statistical analysis was done in SPSS version 21.0. The categorical attributes are reviewed using the proportions and the continuous attributes with the mean or median, whichever is appropriate, with 95% confidence intervals. The relationship between these attributes proportions is computed using Chi-square test for across groups and t-test for comparison of means across group. To determine the potential predictors of diabetes, univariate and multiple logistic regression analysis performed. In the univariate analysis, the attributes inputted into multiple regression models were chosen based on significance ($p<0.05$).

RESULTS

Out of the total study population of 1083 residents, the male and female participants were 299 (males=156 and females=143), some of them were not eligible and non-responders. The sociodemography and behavioral information characteristics of the study participants are as shown in Table 1. Most of the respondents lies in the age group (40–59) with 47.8%, and overall male participants were more in numbers (52.2%). Of total study population, 43.1% were primary educated and 36.5% were private employees, also non-smokers and non-alcoholic were 70.2% and 68.9%. Participants who do daily exercise and consume vegetable and fruits were 53.5% and 56.5%, and participants with obesity and hypertension were 59.6% and 16.7%, as of occupation government, private employee, and businessmen were 36.1%, 36.5%, and 27.4.

Table 2 outlines, the total prevalence of diabetes among the study respondents was found to be 49.1% (95% CI 0.433–0.545) which was higher among the private employee 49.5% (95%, CI 0.398–0.593) compared to other occupations. Male participants with 46.8% (95%, CI 0.388–0.549) were found to have diabetes compared to female with 51.7% (95%, CI 0.432–0.602), similarly the age group of 40–59 with 55.2% (95%, CI 0.467–0.636) has the highest prevalence of diabetes among the other age group. In the family history of diabetes comparing to other family member's brother and sister has highest prevalence of diabetes with 60.0% (95%, CI 0.452–0.736) and as of the vegetables and fruit intake, participants consume every day with a prevalence of 59.9% (95%, CI 0.431–0.586) and as of obesity with 50.0% (95%, CI 0.410–0.590). With 50.0% (95%, CI 0.430–0.570) were non-smoker and non-alcoholic were 50.5% (95%, CI 0.435–0.575).

Table 3 describes the predictors of the diabetes, on using binary logistic regression, the prevalence of diabetes shown the highest significant among those who are completed their education till primary and secondary, also those who are positively marked in health examination and the participants whose has waist circumference above normal. There was no statistical significant among the other characteristics in the study such as age, gender, bmi, alcohol, smoke, vegetable and fruit intake, family history of diabetes, hypertension, occupation and daily exercise but education, health examination, and waist circumference found to statistically significant ($p<0.05$)

Table 1: Sociodemography and behavioral information characteristics of adults in rural Dharwad, India

S. No.	Characteristics	n=299 (%)
1	Age	
	20–39	129 (43.1)
	40–59	143 (47.8)
	60+	27 (9.1)
2	Gender	
	Male	156 (52.2)
	Female	143 (47.2)
3	Education	
	Primary	129 (43.1)
	Secondary	110 (36.8)
	Higher	60 (20.1)
4	Occupation	
	Government employee	108 (36.1)
	Private employee	109 (36.5)
	Own business	82 (27.4)
5	Health examination	
	Yes	65 (21.7)
	No	234 (78.3)
6	Family history of diabetes	
	No	139 (46.5)
	Parents	53 (17.7)
	Brother and sister	50 (16.7)
	Grandparents	16 (5.4)
	Other	41 (13.7)
7	Daily exercise (30 min)	
	Yes	160 (53.5)
	No	139 (46.5)
8	Vegetable and fruit intake	
	Everyday	169 (56.5)
	Weekly	50 (16.7)
	Twice a week	80 (26.8)
9	Smoke	
	Yes	89 (29.8)
	No	210 (70.2)
10	Alcohol	
	No	206 (68.9)
	Daily	23 (7.7)
	Weekly	49 (16.7)
	Monthly	21 (7.0)
11	BMI	
	<25 (Normal)	126 (40.4)
	>25 (Obesity)	173 (59.6)
12	Waist circumference	
	<31inch and<34 inch (normal)	121 (40.4)
	<31inch and<34 inch (obesity)	178 (59.6)
13	Hypertension*	
	Yes	50 (16.7)
	No	249 (83.3)

*Systolic blood pressure>140 and diastolic blood pressure>90, BMI: Body Mass Index (Kilogram/metre^2)

DISCUSSION

This study found 49.1% overall prevalence rate of diabetes, which is higher when compared to few other similar studies on the prevalence of diabetes. Females participants has the highest prevalence than the male participants [10,11] whereas in other studies, male subjects have the higher prevalence rate [12,13] and considering the prevalence rate of diabetes among the study participants who fall in age group 20–39 has less chance of getting diabetes than whose age is above 40 years, which is like some other studies [14,15].

This study considered only private, government employees, and businessmen as the occupation in which among these businessmen has the high prevalence rate but in others work occupation is considered in different dimensions such as housewife, farmer, and teacher, so on [16]. In a study from A. Ramachandran *et al*. diabetes in India, the family history of diabetes has the high prevalence rate when it is considered as positive [17], whereas in our study the positive output is framed in terms of distinct categories such as parents, grandparents, brother, and sister and other, similar to their study even we got the high prevalence rate among the study participants who is positive in the family history of diabetes.

When it comes to the characteristics such as smoke and alcohol our study shows the high prevalence rate in alcoholics and non-smoker, similarly in others works they found that non-smoker have the high prevalence. The current study we found the participants who has BMI >25 (obesity) and hypertension has the high prevalence rate when compared to other

Table 2: Prevalence of diabetes in rural Dharwad, India, 2016–2017. N=299.

S. No.	Characteristics	N	Prevalence (%)	CI (95%)
1	Age			
	20–39	59	45.7	0.369–0.547
	40–59	79	55.2	0.467–0.636
	60+	9	33.3	0.165–0.540
2	Gender			
	Male	73	46.8	0.388–0.549
	Female	74	51.7	0.432–0.602
3	Education			
	Primary	77	59.7	0.507–0.682
	Secondary	48	43.6	0.342–0.534
	Higher	22	36.7	0.246–0.501
4	Occupation			
	Government Employee	53	49.1	0.393–0.589
	Private Employee	54	49.5	0.398–0.593
	Own Business	40	48.8	0.376–0.601
5	Health Examination			
	Yes	40	61.5	0.486–0.733
	No	107	45.7	0.392–0.523
6	Family history of diabetes			
	No	70	50.4	0.418–0.589
	Parents	20	37.7	0.248–0.521
	Brother and sister	30	60.0	0.452–0.736
	Grandparents	6	37.5	0.152–0.646
	Other	21	51.2	0.351–0.621
7	Daily exercise (30 min)			
	Yes	82	51.2	0.432–0.592
	No	65	46.8	0.383–0.554
8	Vegetable and fruit intake			
	Everyday	86	50.9	0.431–0.586
	Weekly	22	44.0	0.300–0.587
	Twice a week	39	48.7	0.374–0.602
9	Smoke			
	Yes	42	47.2	0.365–0.581
	No	105	50.0	0.430–0.570
10	Alcohol			
	No	104	50.5	0.435–0.575
	Daily	13	56.5	0.345–0.768
	Weekly	20	40.8	0.270–0.558
	Monthly	10	47.6	0.257–0.702
11	BMI			
	<25 (normal)	84	48.6	0.409–0.563
	>25 (obesity)	63	50.0	0.410–0.590
12	Hypertension*			
	Yes	25	50.0	0.355–0.645
	No	122	49.0	0.426–0.554

Diabetes is defined as individuals diagnosed those who had fasting blood glucose≥126 mg/dl (≥7 mmol/l). *Systolic Blood Pressure>140 and Diastolic Blood Pressure>90, CI: Confidence Interval, BMI: Body Mass Index (Kg/m^2)

normal participants in the study, similarly in some studies positive hypertension and BMI >25 (obesity) are considered high prevalence rate of diabetes [18]. This study found education, health examination, and waist circumference as the potential predictors of the diabetes in rural Dharwad, India whereas likely potential characteristics such as BMI, daily exercise (30 min), age, and family history of diabetes where not statistically significant in this study outcome.

Tripathy *et al*. in a large community-based study in North-Punjab, they found Age group (45–69 years), marital status, hypertension, obesity, and family history of diabetes mellitus as their risk factors of diabetes and in our study majority participants were educated primary and secondary, but less participants who completed higher education, primary educated participants have the higher prevalence rate among the other two but in another study shown that secondary educated subjects have more prevalence rate [6]. In another work from, Khwaja Mir Islam Saeed *et al*. a study among Kabul, Afghanistan, they found education as the statistical significant, which is one of the risk factors of diabetes among the Kabul citizens [19]. The present study we determined an interesting statistical significant risk factor of diabetes that is health examination which is recorded based on the health check-up of blood sugar and blood pressure for past 1 year.

In this study, due to the high waist circumference, the participants are considered to have obesity and of also it influences to get affected by the diabetes disease, as well as it is the potential risk factor the diabetes, similarly several other studies have reported that waist circumference as the potential risk factor in their work [20]. Meng *et al*. in which three data mining models have been applied and reported education as the potential risk factor along with other risk factors in their study [21], similarly in the current study, we found primary and secondary level education were highly statistical significant risk factor of diabetes among all other characteristics.

One of the major surveillances of our study is the risk factors of diabetes only those who has the occupation as government, private employees, and businessmen, so that the awareness of the diabetes among these are reached and examining all other factors of the participants it is an early call to avoid the diabetes. The strength of the study is, the data collected using the STEPS questionnaire, and limitation of the study is the measurement of blood glucose was done using glucometer instead

Table 3: Binary logistic regression to explore the predictors of diabetes among adults in rural Dharwad, India.

S. No.	Characteristics	Total	Diabetes	Odd Ratio	CI (95%)	p value
1	Age			1.083	0.692–1.697	0.726
	20–39	129	59 (45.7)	-	-	-
	40–59	143	79 (55.2)	-	-	-
	60+	27	9 (33.3)	-	-	-
2	Gender			0.709	0.394–1.275	0.251
	Male	156	73 (46.8)	-	-	-
	Female	143	74 (51.7)	-	-	-
3	Education					
	Primary	129	77 (59.7)	2.667	1.432–4.969	0.002*
	Secondary	110	48 (43.6)	4.323	1.988–9.400	0.000 *
	Higher	60	22 (36.7)	-	-	-
4	Occupation					
	Government Employee	108	53 (49.1)	0.686	0.365–1.288	0.241
	Private Employee	109	54 (49.5)	1.039	0.541–1.993	0.909
	Own Business	82	40 (48.8)	-	-	-
5	Health Examination					
	Yes	65	40 (61.5)	1.878	1.001–3.524	0.050 *
	No	234	107 (45.7)	-	-	-
6	Family history of diabetes					
	No	139	70 (50.4)	1.870	0.902–3.875	0.092
	Parents	53	20 (37.7)	0.660	0.323–1.346	0.253
	Brother and sister	50	30 (60.0)	1.937	0.613–6.123	0.260
	Grandparents	16	6 (37.5)	0.936	0.442–1.983	0.863
	Other	41	21 (51.2)	-	-	-
7	Daily Exercise (30 min)					
	Yes	160	82 (51.2)	1.547	0.861–2.780	0.145
	No	139	65 (46.8)	-	-	-
8	Vegetable and Fruit Intake					
	Everyday	169	86 (50.9)	1.537	0.759–3.112	0.232
	Weekly	50	22 (44.0)	1.387	0.757–2.538	0.289
	Twice a week	80	39 (48.7)	-	-	-
9	Smoke					
	Yes	89	42 (47.2)	0.728	0.387–1.369	0.324
	No	210	105 (50.0)			
10	Alcohol					
	No	206	104 (50.5)	0.688	0.262–1.806	0.447
	Daily	23	13 (56.5)	1.022	0.477–2.190	0.956
	Weekly	49	20 (40.8)	1.265	0.442–3.619	0.661
	Monthly	21	10 (47.6)	-	-	-
11	BMI					
	<25 (normal)	126	84 (48.6)	0.963	0.581–1.597	0.884
	>25 (obesity)	173	63 (50.0)	-	-	-
12	Hypertension **					
	Yes	50	25 (50.0)	0.656	0.322–1.338	0.247
	No	249	122 (49.0)	-	-	-
13	Waist circumference***					
	<31 inch and<34 inch	49	19 (38.7)	-	-	-
	<31 inch and<34 inch	250	128 (51.2)	2,166	1.076–4.360	0.030*

*p value<0.05 is considered as statistically significant, **systolic blood pressure>140 and diastolic blood pressure>90, ***≥34 inch for males and≥31 inch for females, CI: Confidence interval, BMI: Body Mass index (Kg/m^2)

of venous blood glucose estimation, also was unable to collect large data of above 60-year age group and information about the smoke and alcohol participants were hesitated to give frank answers.

CONCLUSION

The current study reflects the importance of diabetes disease among the study population in rural Dharwad, India, and it is an alarm for the government, private employees, and businessmen to stay away from the diabetes disease. Among the overall study population, 49.1% was found to have prevalence of diabetes which requires a critical consideration. At last, this study can be utilized to figure well-being approaches and procedures for suitable control and prevention of diabetes in rural Dharwad population.

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