



Prevalence and Risk Factors for Type 2 Diabetes and Effectiveness of Health Education in Reducing Blood Sugars among Diabetics in Coastal Karnataka-An Intervention Study

Usha Rani S Padmanabha¹, Rashmi Kundapur², Udayakiran Nalam³, Sanjeev Badiger⁴

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Author's Affiliation:

¹Assistant Professor, Dept. of Community & Medicine, Sapthagiri Institute of Medical sciences and research centre, Bangalore; ²Professor, Dept. of Community & Medicine, K.S.Hegde Medical Academy, Nitte University, Mangalore; ³Professor, Dept. of Community & Medicine, Mahavir Institute of Medical Sciences, Vikarabad; ⁴Professor and Head, Dept. of Community & Medicine, K.S.Hegde Medical Academy, Nitte University, Mangalore

Correspondence

Usha Rani S.P
ushaspadmanabh@gmail

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ABSTRACT

Introduction: Diabetes contribute to 1.5 million of global deaths with an additional 2.2 million deaths due to uncontrolled blood sugars leading to increased risk for cardiovascular and other disorders. Diabetes is a progressive disease which requires tremendous medical and self-care to prevent acute and long term complications. Lifestyle interventions plays an effective role in maintaining metabolic control. This study was done to assess the prevalence and risk factors for type 2 Diabetes Mellitus and effectiveness of health education as an intervention in reducing blood sugar levels among diabetics in rural population of coastal Karnataka.

Methodology: A Community based intervention study done in rural population among subjects aged 18 years and above. Based on the prevalence rate of 10%, a minimum sample size was 160, with 10% as non-respondents, totally 172 subjects were enrolled. Health education as an intervention was done in one among the two villages. Random blood sugars and HbA1c assessment was done before and after intervention.

Results: Among the 172 participants, 87 were from Kuthar and 84 belonged to Manjanady village. The overall prevalence of type 2 DM was 29.1%. Middle aged group, obesity, physical inactivity, positive genetic history and hypertension was found to be major risk factors. Health education as an intervention showed significant reduction in mean blood sugars in Kuthar (test arm) post intervention in comparison with Manjanady (control arm).

Conclusion: A Community based intervention in the form of health education showed a significant reduction in mean RBS among diabetics of Kuthar village than compared with the controls from Manjanady who received only pharmacotherapy without any lifestyle interventions.

Key words: Health education, intervention, prevalence, risk factors, type 2 diabetes

INTRODUCTION

WHO Global status report states that, NCDs are responsible for the demise of approximately 38 million people each year, contributing to majority of deaths in low and middle-income nations. Yearly, around 16 million of deaths occurs pre-

turely due to NCDs. Among the NCDs, 1.5 million of global deaths are attributed to diabetes.^{1,2} As an example for "Iceberg disease", currently 422 million individuals are living with diabetes which is likely to peak 642 million by 2040.³ The epidemic of diabetes has reached its peak in parallel with rapid urbanization, nutrition transition, sedentary life-

styles and physical inactivity along with increase in prevalence of obesity. The economy of the developing nations is being threatened by type 2 diabetes mellitus leading to public health crisis globally.⁴

Diabetes an emerging epidemic of the 21st Century, would threaten to overwhelm the health care system in the coming years. The majority of the people with diabetes fall in the age group of 45 to 64 years in the low economic countries. This productive group are expected to drive the economic engine of the country to achieve the required international development goals. Along with the reduced productivity, diabetes tends to further impose a high economic burden on nation in terms of health care expenditure, loss of productivity with inevitable economic progress.⁵

Increased ageing, urbanization and population growth estimates that India and China will remain as the two nations with the highest numbers of individuals being the victims of diabetes accounting to 79.4 million and 42.3 million cases by the year 2030 followed by other countries like Indonesia, Pakistan, Bangladesh and Philippines.⁶ National Urban Diabetes Survey (NUDS) was carried out in six large cities of India in 2001 which showed an age standardized frequency of type 2 DM of 12.1%. Highest Prevalence was reported in Hyderabad around 16.6%, followed by Chennai; 13.5%, Bangalore showing total of 12.4%, Kolkata with 11.7%, New Delhi and Mumbai with 11.6% and 9.3% respectively.⁷

Diabetes is a progressive disorder that requires tremendous medical and self care to prevent its acute and long term complications involving coronary, cerebrovascular, retinal, renal and neurological disorders. A structured lifestyle interventions in the form of health education plays a very important role in achieving and maintaining metabolic control⁸.

In view of rapid epidemiological transition occurring in the rural population of Karnataka, this study was conducted with an objective to assess the prevalence and risk factors for type 2 diabetes mellitus and also to evaluate the effectiveness of health education as an intervention in the form of increased physical activity, reduced intake of saturated fats, high intake of dietary fibers and abstinence from smoking and alcohol use so as to bring a improvement in the glycemic status of individuals with diabetes.

METHODS

The present study was a community based interventional study conducted over a period of 18

months from May 2015-October 2016 in two villages namely Kuthar and Manjanady which are the rural field practice areas of the department of Community Medicine, K.S.Hegde Medical Academy, Mangalore. Health education as an intervention was done in one of the villages(Kuthar).The study participants included participants aged 18 years and above who were permanent residents residing in field practice areas of the villages ; individuals with Gestational diabetes, psychiatric disorders and type 1 diabetes were excluded from the study. Taking the prevalence rate of diabetes as 10% from pilot study done in our field practice area in 2015, the minimum sample size estimated was around 144, with 10% as non respondents the sample size came up to 160 and finally 172 participants were enrolled in this study. The formula used to calculate the sample size was $n = \frac{4 P q}{d^2}$ where P taken as 10%, $q = (100 - P)$ and $d = 5\%$ (absolute precision), 50% of the total sample was obtained from Manjanady and remaining 50% from Kuthar. Universal sampling of 200 adopted households was done to obtain the desired sample size where one individual in each household was selected randomly. If the house was found to be locked during the interview or there was a non-respondents in the house the immediate next house was selected for the study. A pilot study was done initially to check for the feasibility of the study tool. Selected subjects were interviewed by administering a pretested questionnaire after obtaining a written informed consent.

House to house interview was done to collect information on socio demographic characteristics, assessment of risk factors, anthropometric measurements. Random blood sugars were checked on blood obtained by finger prick method using automated glucometer and sterile surgical lancets, whole blood samples for HbA1c was collected in the field with the help of Medical Lab technicians after obtaining a written informed consent. Regular monitoring of diabetic subjects was done through HbA1C test done once in 6 months and totally 2 HbA1C were done during the study period one before and one after the intervention. Blood glucose estimation (RBS) was done on all 172 subjects and two HbA1c tests were done on all diabetics. RBS measuring $\geq 200\text{mg/dl}$ was taken as diabetic and blood glucose values in the range of $\geq 140 - < 200\text{mg/dl}$ was taken as prediabetic (WHO diagnostic criteria)⁹.

Intervention

After the initial data collection (that is during the first four months of the study period), followed by an intervention in the following next 10 months; which contained a new formulated health education material consisting of some stickers, pamphlets, videos and counselling was conducted every 2

months for the diabetic patients to reinforce on better diet, good physical activity (at least 30 minutes a day), regular check-ups and regular drug intake, cessation of smoking and reduction of alcohol consumption which was used in Kuthar village whereas Manjanady received only Pharmacotherapy without any lifestyle interventions.

At the end of 14 months, RBS was repeated again on study subjects and was seen for the reduction of sugars. HbA1c estimation was done on all diabetics to look for the long term blood glucose control in both the groups. The reliability of the tool was checked and the calculated Cronbach alpha value was 0.871.

Statistical Analysis

The collected information was summarized using frequency, percentages, mean and standard deviation. The inferential statistics used was chi-square. Logistic regression model was used to estimate the adjusted odds ratio for independent variables with dependent variable being dichotomous. Paired 't' test was done before and after intervention. Unpaired 't' test was done between the two groups.

The "p" value of < 0.05 was considered as significant. The data was analyzed using SPSS version 20 (SPSS Inc., Chicago, IL, USA). The study was approved by Institutional Ethics committee, Nitte University (INST.EC/EC/026/2015-16).

RESULTS

The findings of the current study is related to 172 study participants from both Manjanady and Kuthar villages which are the field practice areas of the department of Community Medicine. Out of 172 study subjects, 87 were from Kuthar and 84 belonged to Manjanady. Among them, 119 (69.2%) were found to be females and the remaining 53 (30.8%) were males. The mean age of the participants was found to be 54.01 (±11.1 years). Majority were Muslims by religion 104 (60.5%) and majority had completed their primary schooling (52.3%). Among the females, 64 (53.8%) were homemakers and among the males, 17 (32.1%) were unemployed. Majority belonged to Lower middle class, 57 (33.1%). (Table.1)

Table.1. Sociodemographic details of the study participants.

Socio demographic variables	GENDER N(%)		TOTAL 172(100%)
	Male=53	Female=119	
Age group(years)			
31-40	6 (11.3)	17(14.2)	23(13.4)
41-50	12(22.6)	40(33.6)	52(30.2)
51-60	14(26.4)	30(25.2)	44(25.6)
>61	21(39.7)	32(26.9)	53(30.8)
Mean age ± SD(yrs)			54.01years(±11.1years)
Marital status			
Unmarried	2(3.8)	2(1.7)	4(2.3)
Married	51(96.2)	106(89.1)	157(91.3)
Widow/widower	-	11(9.2)	11(6.4)
Religion			
Hindu	13(24.5)	45(37.8)	58(33.7)
Muslims	37(69.8)	67(56.3)	104(60.5)
Christians	3(5.7)	7(5.9)	10(5.8)
Educational status			
Illiterate	7(13.2)	55(46.2)	62(36)
Primary school	41(77.4)	49(41.2)	90(52.3)
High school	4(7.5)	12(10.1)	16(9.3)
Higher secondary(PUC)	1(1.9)	1(0.8)	2(1.2)
Graduate	-	2(1.7)	2(1.2)
Occupation			
Skilled	9(17)	-	9(5.2)
Semi skilled	12(22.6)	37(31.1)	49(28.5)
Laborer	15(28.3)	6(5)	21(12.2)
Homemaker	-	64(53.8)	64(37.2)
Unemployed	17(32.1)	12(10.1)	29(16.9)
Socio economic status (Total per capita income)			
Class I	4(7.5)	4(3.4)	8(4.7)
Class II	10(18.9)	17(14.3)	27(15.7)
Class III	15(28.3)	32(26.9)	47(27.3)
Class IV	18(34)	39(32.8)	57(33.1)
Class V	6(11.3)	27(22.7)	33(19.2)

Table.2.Association of various risk factors and Type 2 Diabetes Mellitus.

Risk factors	Disease status N(%)		Total 172(100%)	Chi square P value
	Diabetic (N=50)	Non diabetic (N=122)		
Age group(years)				
31-40	2(4)	21(17.2)	23(13.4)	0.003
41-50	9(18)	43(35.2)	52(30.2)	
51-60	19(38)	25(20.5)	44(25.6)	
>61	20(40)	33(27.0)	53(30.5)	
BMI(kg/mt²)				
Underweight	1(2)	21(17.2)	22(12.8)	0.027
Normal	19(38)	42(34.4)	61(35.5)	
Overweight	9(18)	28(23)	37(21.5)	
Preobese	17(34)	22(18)	39(22.7)	
Obese	4(8)	9(7.4)	13(7.6)	
WHR-male				
central obesity	11(73.3)	9(23.7)	20(37.7)	0.001
Normal	4(26.7)	29(76.3)	33(62.3)	
WHR-female				
central obesity	34(97.1)	78(92.9)	112(94.1)	0.672
Normal	1(2.9)	6(71.)	7(5.9)	
Physical activity				
Sedentary	47(94)	70(57.4)	117(68)	<0.001
Moderate	2(4)	48(39.3)	50(29.1)	
Heavy	1(2)	4(3.3)	5(2.9)	
Family history				
Present	21(55.3)	17(44.7)	38(100)	<0.001
Absent	29(21.6)	105(78.4)	134(100)	
*Note(parenthesis indicates % of row total)				
Hypertension				
Present	33(66)	35(28.7)	68(39.5)	<0.001
Absent	17(34)	87(71.3)	104(60.5)	
Socio economic status				
Class I	1(2)	7(5.7)	8(4.7)	0.751
Class II	8(16)	19(15.6)	27(15.7)	
Class III	14(28)	33(27)	47(27.3)	
Class IV	15(30)	42(34.4)	57(33.1)	
Class V	12(24)	21(17.2)	33(19.2)	

Table.3: Multiple binary logistic regression analysis to see the association of Independent risk factors and Diabetes.

Independent risk factors	B	S.E.	Wald	P value	aOR*	95.0% C.I .for OR
BMI (Asian classification)-Obese			6.188	0.186		
Underweight	-1.267	1.431	.784	0.376	.282	0.017 to 4.656
Normal	.707	1.024	.477	0.490	2.029	0.273 to 15.095
Overweight	.857	1.087	.622	0.430	2.357	0.280 to 19.840
Preobese	1.355	1.027	1.740	0.187	3.878	0.518 to 29.053
WHR male(Normal)			3.562	0.059	.405	0.159 to 1.035
Age-31 to 40 yrs			5.071	0.167		
41 to 50 yrs	.911	1.041	.766	0.381	2.487	0.323 to19.121
51 to 60 yrs	1.932	1.031	3.512	0.061	6.900	0.915 to52.022
>61 yrs	1.524	1.060	2.069	0.150	4.591	0.576 to 36.629
Normotensive			8.332	0.004	0.260	0.104 to 0.649
Family h/o DM-absent			13.379	0.000	0.117	0.037 to 0.370
Physical inactivity			13.333	0.000	15.805	3.592 to 69.546

*Adjusted Odds ratio

Table.4: Difference in mean RBS and HbA1c in Kuthar village before and after intervention.

Variables	N	Time of collection		Correlation	P value	Mean diff	t statistic	P value
		Before (m±sd)*	After (m±sd)*					
RBS	21	252.10±72.672	213.19±58.096	0.496	0.022	38.905	2.668	0.015
HbA1c	21	6.48±1.405	6.28±2.243	0.604	0.004	0.208	0.533	0.600

*mean±standard deviation

Table.5: Difference in mean RBS and HbA1c in Manjanady village before and after intervention.

Variable	N	Time of collection		Correlation	P value	Mean diff	t statistic	P value
		Before (m±sd)*	After without intervention (m±sd)*					
RBS	22	273.68±55.238	282.09±77.747	0.497	0.018	-8.409	-0.568	0.576
HbA1c	22	6.31±1.718	6.90±1.586	-0.062	0.785	-0.587	-1.142	0.266

Table.6: To see the differences in mean RBS and Hba1c in Kuthar and Manjanady villages after the intervention.

Locality	N	Postintervention RBC		t statistic	P value
		Mean	Std. Deviation		
Kuthar	21	213.19	58.096	-3.279	0.002
Manjanady	22	282.09	77.747		
Kuthar	21	6.23	2.238	-1.131	0.265

The overall prevalence of type 2 DM in the study population was found to be 50 (29.1%); out of which 15(30%) were male and 35(70%) were female; among them 6(3.4%) were found to be newly detected cases and the rest 44(25.6%) were known diabetic. Overall 12.2% of them were prediabetic. Majority of them had mixed dietary practices (99.4%). Overall, 20.3% were tobacco users. Among the males 43.4% smoked cigarettes or beedi's and 10.1% of females were tobacco chewers and 11.3% of males had history of alcohol use. Sedentary lifestyle was seen in 68% of the study subjects, 39% of them were obese, central adiposity was seen among 94.1% of females and 37.7% of males. Overall 22.1% of subjects had a positive genetic history and prevalence of hypertension in the study subjects was 39.5%. In univariate analysis subjects aged 50 years and above, physical inactivity, obesity, positive family history and hypertension proved to be significant risk factors for diabetes (p < 0.05) but factors like occupation, history of substance use, socio economic status, dietary habits, religion, literacy did not show any association with diabetes. (Table.2).

In multiple logistic regression analysis after adjusting for other socio demographic variables, physical inactivity showed 15.8 times increase in risk of diabetes and individuals being normotensive (Odds of 0.26) and negative family history (Odds of 0.117) were found to be protective factors (p < 0.05) (Table.3).

Health education as an intervention done in Kuthar village showed a significant reduction in RBS by 38.9mg/dl (p < 0.015 by paired 't' test) and there was a reduction in HbA1c level post intervention (0.20%), however there is no much difference in HbA1c level before and after intervention (p = 0.600). Random blood sugar levels and HbA1c levels without health education (in the control arm) but with only drug therapy in Manjanady village had increased mean RBS levels in patients

(+8.5mg/dl) and HbA1c by 0.58% (Table.4 and Table.5).

The test arm being Kuthar and Manjanady village being Control, the Independent sample 't' test showed differences in RBS and HbA1c levels post intervention; there was a significant reduction in mean Random blood sugars in Kuthar village (P = 0.002) post intervention, however there was no much significant reduction in HbA1c levels in Kuthar (Table.6).

DISCUSSION

Among the 172 study participants, majority were found to be female (69.2%) in comparison with males (30.8%). Similar findings have been reported in the study by Veena et al¹⁰ where the proportion of male was 35% and females was 65%. Rahman et al also showed a similar results with male constituting 31% and females around 63%¹¹. The disproportionate distribution of male respondents in the current study was due to males working overseas and majority being daily wage workers; so they were not available during the time of interview. Majority of the subjects were aged above 60 years (30.8%) followed by 41 to 50 years of age group (30.2%). Similar observations were seen in study conducted by Vijayakumar et al where majority of the participants (28.2%) were aged above 60 years¹².

The overall prevalence of type 2 DM in the study population was 29.1% and 12.2% of them were found to be prediabetic. The prevalence of diabetes among the males was found to be 15(30%) and among the females 35(70%). Dasappa and Farah et al in their community based survey conducted among the individuals aged 35yrs and above showed an overall prevalence of diabetes of 12.3% and among them majority (60.54%) were females and 39.5% were males and 11.6% was found to be prediabetic¹³. In our study majority of females

were homemakers with a sedentary lifestyles and this could be the reason for increased prevalence among them.

The current study showed increased prevalence among subjects aged above 50years(38%) and its association with diabetes was significant statistically and this reflected the findings of study by Hemavathi et al where majority of diabetics were aged 45yrs and above¹³. The overall prevalence of obesity was 30.2% and among the diabetics it was 42% (p=0.027). Similar findings were reflected in study by Vijayakumar and Rao et al where prevalence of obesity was 38.6% and 28% respectively and among the diabetics it was 21.4% with 1.8 times increased risk of developing diabetes^{10,12}. The overall prevalence of central adiposity was found to be 77% and among the diabetics it was 90% which was similar to study by Hemavathi and Chythra et al where the prevalence was 73% and 56.2% with a significant association with diabetes^{10, 13}.

Physical inactivity was noticed in majority of our study subjects; 117(68%). Sedentary lifestyle had a significant association with occurrence of diabetes (p<0.001). Javid et al in his study conducted in the semi urban area of Kashmir also reported that more than half of the subjects (52.7%) were sedentary workers and among the diabetics it was 63%¹⁴. A positive family history of diabetes was seen in 22.1% of the participants and among them 55.3% were found to be diabetic (p<0.001). Bharati et al in their study also showed a similar result where 21.2% of the participants had a genetic history with an Odds of 2.5¹⁵. The overall prevalence of hypertension was 39.5% and among them majority were diabetic, 66% (P<0.001). Similarly Shrivastava et al reported the prevalence of hypertension among the diabetics around 46.5% with 3.6 times increased risk of developing diabetes¹⁶.

RBS levels (by +8.9mg/dl) and there was a reduction in HbA1c level post intervention in Kuthar(intervention group) by 0.2% but there was an increase in HbA1c levels by 0.5% in Manjanady(control group). Similarly, Zareban and Niknami et al in their study conducted to assess the self efficacy of health education program on reducing blood sugar level showed that intervention done on 138 diabetic subjects divided into test and control group(n=69 each) with test group receiving health intervention in the form of educational CDs and pamphlets at the end of 3 and 6 months of intervention showed a drop in HbA1c and FBS levels by 1.5% and 40 mg/dl in the test group with no changes in the glucose levels in control group and this difference was found to be statistically significant(p<0.001)¹⁷.

A limited sample size of 172 has limited us to see the association of other socio demographic variables and substance usage with diabetes but however as the study population was homogenous in terms of literacy, dietary habits and socio economic status the findings can be extrapolated to the rest of the population.

CONCLUSION

The present study showed an overall prevalence of type 2 diabetes and prediabetes of 29.1% and 12.2% respectively. Subjects aged 50 years and above, physical inactivity, obesity, genetic history and hypertension proved to be significant risk factors. Health education as an interventional method showed a significant reduction in the mean random blood sugars in diabetic participants of Kuthar village by 39mg/dl than compared with the controls from Manjanady who received only pharmacotherapy without any lifestyle interventions.

Recommendations

Primary preventive strategies in the form of health education modules on lifestyle interventions can be implemented and reinforced in the community in the form of stickers, posters, videos and charts by Health care providers which would help in the reduction of burden of diabetes and improvement in the glycemic status of diabetics.

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