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Original Research Article

Analytical Study of Associated Risk Factors of Type 2 Diabetes Mellitus among the Population in Batticaloa District, Sri Lanka

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ABSTRACT

The aim of the study was to assess the risk factors associated with type 2 diabetes mellitus (T2DM) in Batticaloa District, Sri Lanka. This study was conducted at different places of Batticaloa district such as Kattankudy, Kallady, Kaluwanchikudy, Batticaloa Town, Eravur and Valaichenai. A number of 287 cases were randomly selected in the clinics of different hospitals. A questionnaire that contained sociodemographic characteristics and risk factors was used for data collection. ANOVA was performed to find the significance of more than two means. Simple binary logistic regression and multiple binary logistic regression were performed to find the crude and adjusted odds ratio (OR) and 95% confidence interval (CI) was calculated to find the significance of the observed OR. A p value considered statistically significant. Study results showed those above 50 years of age to have five times more chance to get diabetes when compared with those in the 20-30 age group. Gender and religion did not show any statistically significant association with diabetes. Physical activity was observed as a protective factor for the development of DM. Hypertension, especially systolic hypertension, emerged as a strong risk factor for T2DM in this study. Subjects with systolic hypertension had 4.6-fold chance to develop T2DM, making it mandatory to screen all patients with hypertension above 25 years of age for T2DM irrespective of the presence of other risk factors. In conclusion, results of the present study will be of use in planning primordial, primary and secondary measures of prevention at the community level.

Key words: diabetes mellitus, risk factors, rural population, Batticaloa.

INTRODUCTION

Type 2 diabetes mellitus is one of the greatest public health threats of the 21st century. Changes in human behavior and lifestyle associated with globalization have resulted in a dramatic increase in its prevalence and incidence worldwide. Diabetes mellitus type 2 is a metabolic disorder of multiple etiologies due to disturbances of carbohydrate, fat, and protein metabolism. It is characterized by chronic hyperglycemia, and it is associated with cardiovascular and renal complications. [1] These complications result in diminished quality of life and reduced life expectancy. In addition, the disease places a considerable economic burden on worldwide healthcare resources. [2] The estimated number of deaths due to diabetes is similar to the combined number of deaths from several infectious diseases such as human immunodeficiency virus (HIV) /AIDS, malaria, and tuberculosis. [3]

Type 2 diabetes mellitus is the commonest form of diabetes affecting more than 90% of the diabetic population

worldwide. There is a rapid upsurge in the number of diabetic patients and this explosive growth is noted in both urban and rural area. The estimated number of type 2 diabetes patients in the year 2000 at 174 million and predicted to increase to 336 million in 2030. [4] The majority of the patients with diabetes in developed countries are above age 64. It is predicted that by 2030, the number of people aged above 64 with diabetes will be around 82million, of which about 48 million in developing countries. Several surveys on risk factors conducted across South Asian countries have shown high and rising rates of overweight, central obesity, high blood glucose levels and high blood pressure in urban populations. Such trends also exist in rural populations but are lower in magnitude and less steep in the slope of change. [5]

Sri Lanka is a middle income country with a population of 20.7 million people [6] and the population comprises of two broadly different socio-demographic groups, namely urban and rural. The urban population has higher income and leads a more westernized lifestyle compared to the rural population, where the majority is engaged in agriculture and related occupations, with lower income levels and a more physically active lifestyle. According to the WHO criteria, the prevalence of known diabetes was 5.6% and 2.7% among urban and rural areas respectively. [7] Studies in rural areas have shown an increase in the prevalence of diabetes from 2.5% in 1990 to 8.5% in 2000. [8] In the sub-urban populations, the prevalence has been reported as 5.0% in 1994 and 6.6% in 2002. [9] In a mixed urban and rural population, the prevalence was reported as 5.8% in 2004. In 2005, a study carried out in adults between 35 and 65 year of age in four provinces (North, Central, Uva and Western,) in Sri Lanka reported that diabetes prevalence of 14.2% in men and 13.5% in women. [10]

Several investigators have estimated the prevalence of Diabetes Mellitus (DM) in Sri Lanka over the past 15 years. [11] The criteria used to diagnose Diabetes Mellitus were different between studies. Fasting blood sugar was used in some studies, and the oral glucose tolerance test in others. The Sri Lanka Diabetes and Cardiovascular Study (SLDCS) were carried out in 2005 to bridge the gap of data and have previously reported that national prevalence of Diabetes Mellitus in Sri Lanka as 10.3%. According to the 2008 World Health Organization estimations and projections on diabetes prevalence of its member countries for the years 1995, 2000, and 2025 the estimated and projected figures for Sri Lanka were 2.5%, 2.6% and 3.5% respectively. The available studies show a definite upward trend in the prevalence of Diabetes Mellitus in Sri Lanka.

Adequate baseline information about the prevalence and awareness regarding diabetes activities is not available in Batticaloa district, Sri Lanka. Hence, this study was taken up to assess the level of the diabetic awareness, knowledge about diabetic complications and alternative treatment practices through investigative and assessor research in Batticaloa district. Such data are tremendously important to an understanding of the level of public awareness and helpful to health educators to plan for national diabetic control program.

MATERIALS AND METHODS

This study was conducted at different places of Batticaloa district such as Kattankudy, Kallady, Kaluwanchikudy, Batticaloa Town, Eravur and Valaichenai. 287 cases were randomly selected in the clinics of different hospitals.

Recruitment of participants: Eligible patients meeting study criteria who consented to participate were recruited. Participants who withdrew from the

interview and /or pregnant women were excluded from the study.

Data Collection Techniques and Tools: A face-to-face interview was administered to all the participants using a pretested designed questionnaire that was adapted from the World Health Organization STEP wise approach to chronic disease risk factor surveillance (STEPS). [12] The questionnaire contained data pertaining to sociodemographic characteristics and various risk factors associated with the occurrence of Diabetes Mellitus. The most recent laboratory results were recorded for both cases and controls.

Collected data were analysed using SPSS 13 version. Frequency, percentage, mean and standard deviation were calculated and associations between variables were assessed using chi-square test. Also, t-test was used to find significant differences of two means and ANOVA was employed to find the significance of more than two means. The 95% confidence interval was calculated to find the significance of observed data. In all cases, p value <0.05 was considered statistically significant.

RESULTS

Duration of Diabetes: According to the data collection, 128 participants having type 2 diabetes whereas 159 participants do not. The duration of diabetes as follows; < 5 years in 41.4% of the patients, 6 - 10 years in 28.7% of the patients, 11-15 years in 15.3% of the patients and > 15years in 14.6%.

Socio demographic factors: Table 1 shows the distribution of factors associated with type 2 diabetes.

Table 2 shows the mean weight, height, blood glucose, blood pressure, mean serum cholesterol, low-density lipoprotein (LDL), and high-density lipoprotein (HDL) of the cases and controls.

Table 1: Comparison of sociodemographic factors between cases and controls.

Variables		Controls (n=128)		Cases (n=159)		*P* value
		Count	%	Count	%	
Gender	Male	19	15.1	60	38.0	< 0.0001
	Female	107	84.9	98	62.0	
Age in years	< 20	9	7.4	0	0.0	< 0.0001
	20 - 30	44	36.1	7	4.6	
	31 - 40	22	18.0	10	6.6	
	41 - 50	23	18.9	36	23.7	
	51 - 60	18	14.8	50	32.9	
	> 60	6	4.9	49	32.2	
Educational level	Illiterate	10	7.9	52	34.0	< 0.0001
	Primary	13	10.2	31	20.3	
	Secondary	30	23.6	16	10.5	
	Intermediate	18	14.2	24	15.7	
	Bachelor degree	50	39.4	27	17.6	
	Master degree	6	4.7	3	2.0	
Family history of diabetes in blood relations	Mother/father/brother/sister	75	58.6	114	71.7	< 0.0001
	Grandmother/father	40	31.3	27	17.0	
	Uncle/aunt	24	18.8	18	11.3	
Salary (LKR)	< 5000	15	12.9	21	14.2	< 0.0001
	5000 - 10000	28	24.1	69	46.6	
	10000 - 15000	25	21.6	30	20.3	
	15000 - 20000	17	14.7	17	11.5	
	> 20000	31	26.7	11	7.4	
Marital status	Single	36	29.8	8	5.2	< 0.0001
	Married	71	58.7	113	73.4	
	Divorced / Widowed	14	11.6	33	21.4	
Nature of job	Physically active work	12	9.4	23	14.5	0.300
	Physically inactive work	11	8.6	12	7.5	
	Not applicable	105	82	124	78	
Hypertension	Yes	27	21.6	77	49.7	< 0.0001
	No	98	78.4	78	50.3	

Table 2: Clinical finding in control and cases

Parameter	Control			Cases		
	Mean	SD	*n*	Mean	SD	*n*
Weight	65.2	16.6	92	75.4	16.5	88
Height	158.7	9.9	85	154.6	30.8	69
Blood glucose level (last reading) Fasting blood sugar (mg/dL)	—	—	—	137.4	71.1	80
Blood glucose level (last reading) Postprandial blood sugar (mg/dL)	—	—	—	143.5	95.3	35
Systolic BP (mmHg)	119.9	18.3	61	129.9	20.3	76
Diastolic BP (mmHg)	77.2	10.1	61	81.3	23.5	77
Cholesterol (mg/dL)	127.4	69.8	9	182.9	37.6	30
Total cholesterol (mg/dL)	142.3	63.3	10	177.1	83.6	24
HDL (mg/dL)	40.7	7.3	12	47.6	27.2	42
LDL (mg/dL)	135.7	53.3	14	111.4	36.0	41

BP: blood pressure; HDL: high-density lipoprotein; LDL: low-density lipoprotein; SD: standard deviation.

DISCUSSION

When compared with controls, cases were more likely to be men, less educated, unemployed/housewives, retired, or less salaried. Diabetic patients were also more likely to be either married or divorced and had a history of diabetes in a first-degree relative (mother, father, brother, or sister). Amongst the women, 17.7% of the cases had a history of gestational diabetes compared with 11.9% of the controls.

We found that male gender, age >40 years, low educational attainment (illiterate or having completed primary school), salaries >20000 LKR, marital status (married or divorced), and smoking status (current smoker) were risk factors associated with diabetes in adult Sri Lankans. It is probable that these individuals have the least information about dietary factors and the importance of self-care.

Regarding the non-modifiable risk factors of diabetes (age, gender, and genetic factors), our findings that diabetic patients were more likely to be >40 years old and likely to have a family history of diabetes are similar to those reported earlier in the literature. In previous studies, [13–15] it was reported that the prevalence of diabetes was higher in patients aged 45–64 years and in those who had a family history of diabetes. [13–15] Contrary to our finding, the authors, [13,15] reported that diabetes was predominant in women. However, our results are consistent with those of other authors who also reported diabetes to be more frequent in men. [16]

In the current study, diabetic patients were more likely to be less educated; they were also more likely to have lower annual incomes. In a previous study [17] it was reported that low education and a higher annual income were associated with diabetes. Other authors [18] showed that the prevalence of diabetes was higher in women who had low incomes and a low socioeconomic status.

We demonstrated that the prevalence of diabetes was higher in married or divorced persons. Previous findings showed that marital status was not correlated with DM; however, differences in the prevalence of diabetes were slightly more noticeable in widowed or divorced persons. [19] Another study [20] showed that singlehood was associated with an increased risk of developing diabetes for women and an increased likelihood of death for men. Since it was not our aim to determine the association between marital status and diabetes, further studies is warranted to explore this factor.

Diabetic patients were more likely to have hypertension compared with non - diabetic patients. Hypertension was diagnosed prior to the diagnosis of diabetes in 33.3% of the patients, whereas diabetes was diagnosed before hypertension in 43.1% of the patients; hypertension and diabetes were diagnosed concurrently in 23.6% of the cases.

Our finding of an increased prevalence of hypertension in diabetic persons is similar to those reported in other studies. [21] It has been shown that although both hypertension and diabetes occur independently, they are known to exacerbate each other. [22] Furthermore, we found that a greater proportion of patients developed hypertension after diabetes diagnosis (43.1%) as compared with 23.1% of patients in whom hypertension was diagnosed prior to the diagnosis of diabetes. Since up to 75% of cardiovascular diseases in diabetic patients are attributed to hypertension, in persons with coexistent diabetes and hypertension, a more aggressive treatment and lifestyle management are recommended to reduce blood pressure to 140/90 mmHg. In our sample, the mean blood pressure of diabetic hypertensive patients was 129.9/81.3 mmHg, which is within the range recommended by the American Diabetes Association. ; However, most of the patients attended clinics for follow-up.

The mean total cholesterol level of the cases in our study was 182.9 mg/dL, which is also within the recommended reference range for diabetic patients (<200 mg/dL). We attribute this finding to the use of lipid lowering agents among the cases in our study. Conversely, the mean LDL level of our patients was 111.4 mg/dL, which is above the range recommended for diabetic patients (<100 mg/dL). [3] Hence, our cases have an increased risk to develop cardiovascular diseases. The mean HDL level among our cases was 47.6 mg/dL, which falls within the recommended range for men (>40 mg/dL) but not for women (recommended level, >50 mg/dL). [23] Since diabetes is associated with multiple risk factors, diabetic hypertensive patients need more vigorous control of both lipids and glycosylated hemoglobin levels.

Cases were more likely to have a body mass index (BMI) ≥ 25 kg/ m^2. Nevertheless, there was no significant association between activity level and diabetes. Patients who were physically active, those who did not perform household chores, and those who had a servant were more likely to have DM2; however, these results were not statistically significant. Similarly, there was also no significant association between diabetes and the patients' self-perception of being physically active.

We showed that high BMI was significantly associated with diabetes, which might be because obesity enhances insulin resistance. Similar to our findings, previous studies [24] including a study conducted Sri Lanka also showed a direct relationship between BMI and diabetes. The increasing incidence of DM in the Sri Lankan population has been linked to obesity, which is a consequence of major sociocultural and lifestyle changes. The promotion of fast foods, change in the traditional Sri Lankan diet, both in quantity and quality, and physical inactivity are as a result of urbanization. Hence, similar to other authors, [25] we propose weight reduction and weight gain prevention as measures to control the rising incidence of diabetes. This is important because adult-onset diabetes, besides being linked to high BMI in men, is also associated with the duration of weight gain.

Fifteen of the patients (10.1%) had hypothyroidism as against 80.5% who did not have hypothyroidism; 9.4% of the patients did not know whether they had a thyroid disorder.

Approximately 8.2% of the cases used more than four teaspoons of sugar as compared with 11.2% of the controls; 14.7% of the cases consumed sugar daily as compared with 37.3% of the controls. Regarding the frequency of consumption, 19.2% of the cases as against 19.0% of the controls consumed sweets three to six times weekly; 38.5% of the cases versus 34.1% of the controls consumed sweets <3 times weekly.

Conversely, 27.5% of the cases as against 9.5% of the controls did not consume sweets. Among the cases, approximately 6.4% consumed soft drinks daily, 5.8% consumed soft drinks 3-6 times weekly, and 34.0% drank soft drinks <3 times weekly; 53.8% did not consume soft drinks. On the other hand, 17.5%, 17.5%, and 30.2% of the controls drank soft drinks daily, 3-6 times weekly, and <3 times weekly, respectively; 34.9% of the controls did not consume soft drinks.

The frequency of consumption of fatty foods differed among the cases: 15.5% ingested fatty foods daily, 24.3% consumed fats 3–6 times weekly, and 35.8% had fatty foods <3 times weekly. Only 24.3% of the cases did not consume fried or fatty foods. In comparison, 28%, 44%, and 47% of the controls consumed fatty foods every day, 3–6 times per week, and <3 times per week, respectively; 8% of the controls did not consume fried or fatty foods.

Among the cases, 42.2% consumed starch every day, 25.3% consumed starch 3–6 times per week, and 26.6% consumed starch <3 times per week; 5.8% of the cases had starch-free diets. In comparison, 66%, 31%, and 24% of the controls consumed starch daily, 3–6 times per week, and <3 times per week, respectively; 4% of the controls had starch-free meals.

Thirty-six of the 159 cases (22.6%) smoked as compared with six of the controls (4.7%). Among the smokers, all of the six patients (100.0%) in the control group smoked cigarettes, while 57.7% of the cases smoked cigarettes. Regarding smoking duration, 23.8%, 9.5%, and 66.0% of the cases had smoked for <5 years, >5 years, and >10 years, respectively. On the other hand, 20%, 40%, and 40% of the controls had smoked for <5 years, >5 years, and >10 years, respectively. None of the cases had tried to quit smoking as compared with 16.7% of controls.

Current smoking status is an independent modifiable risk factor for type 2 diabetes since it is associated with glucose intolerance, impaired fasting glucose, and, consequently, diabetes. Our findings are consistent with those of other authors, [21] who showed an association between diabetes and current smoking status. Therefore, an important measure of reducing the incidence of DM2 in the Sri Lankan population may be to organize massive campaigns aimed at decreasing smoking across all age groups.

We found that 44.7% of the cases consumed sugar regularly in tea and coffee as compared with 75.6% of the controls. Among participants who consumed sugar regularly, 67.0% of the cases as compared with 42.1% of the controls consumed <2 teaspoons of sugar daily. On the contrary, 24.7% of the cases versus 46.7% of the controls consumed 2–4 teaspoons of sugar.

Among the cases, 39.6% consumed vegetables daily, 29.2% consumed vegetables 3–6 times weekly, and 21.4% had vegetables <3 times weekly; 9.7% of the cases did not consume vegetables. On the contrary, 34.6%, 24.4%, and 27.6% of the controls consumed vegetables daily, 3–6 times weekly, and <3 times weekly, respectively; 13.4% of the controls did not consume vegetables.

Approximately 47.1% of the cases consumed fruits every day; 24.8% of the cases consumed fruits 3–6 times per week, while 24.8% had fruits <3 times per week. About 3.2% of the cases did not consume fruits. In comparison, 30.6%, 26.6%, and 35.5% of the controls had fruits every day, 3–6 times per week, and <3 times per week, respectively; 7.3% of the controls did not consume fruits.

Among the cases, 38.7% consumed grains daily; 21.3% consumed grains 3–6 times weekly, while 20.6% had grains <3 times weekly. About 19.4% of the cases did not consume grains. In comparison, 16.1%, 18.5%, and 37.1% of the controls had grains daily, 3–6 times weekly, and <3

times weekly, respectively; 28.2% of the controls did not consume grains.

A large proportion of cases (93.6%) took their medicines regularly. Approximately 55.3% of the cases checked their sugar level regularly, whereas 9.4% checked their sugar occasionally.

Of the cases, 25.2% did not have their glucose levels checked regularly. Of these, 31.8% checked their sugar levels at a health centre; 22.7% measured their blood glucose at home, while 45.5% checked their blood glucose levels at health centres and at their homes.

Of the cases, 92.7% attended diabetes clinics for follow-up, whereas 7.3% did not go for follow-up visits. We found that diabetic patients who visited clinics took their medicines regularly (93.6%), only half of the cases checked their glucose levels regularly and approximately 58.2% were knowledgeable about diabetic foot care. This is of concern because it is imperative for diabetic patients to be aware of the complications that may arise from diabetes, such as chronic leg ulcers and possible amputation as a result of peripheral vascular disease.

Approximately 58.2% of the cases were trained to take care of their feet, whereas 41.8% were not knowledgeable about diabetic foot care; 25.8% wore shoes designed for diabetic patients, while 74.2% did not.

We found that among patients who were aware about foot care, only 25.8% wore adequate shoes for diabetic patients. Hence, pharmacological control is not the only means of controlling diabetes, but education and self-awareness are also vital to prevent complications of diabetes.

Of the cases, 74.1% reported having adequate sleeping hours, whereas 25.9% reported not having enough sleep. Approximately 15.1% of the cases had 2–4 hours of nightly sleep; 27.0% had 5-6 hours of nightly sleep; 57.9% had a nightly sleep duration of >7 hours at night.

About 32.6% of the cases reported having psychological stress, whereas 67.4% did not report psychological stress.

CONCLUSIONS

Massive educational and training programs aimed at counselling diabetic patients about all aspects of self-care have to be initiated. Our data provide strong evidence to establish diabetic counselling for patients by nurses and physicians. Physicians have to be aware about these aspects and should be trained to counsel and guide diabetic patients. They should also be able to identify and counsel people who are at risk of developing diabetes. Besides, massive campaigns should be organized and aimed at educating the general population about the risk factors of DM. Young adults should also be informed that modernization, limited physical activity and, consequently, obesity are triggering factors for the onset of diabetes.

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