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Full Length Research Paper

Clinical management of lipid profile, renal and liver function versus HbA_{1c} profile in diabetes affected patients of Vellore, Tamil Nadu, India

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The aim of this study is to examine clinical management of lipid profile, renal and liver function versus HbA1c value correlation in diabetic population of Vellore district in South India. A total of 1300 cases from three different diabetic clinics in Vellore were taken for the study. 25% of populations were selected as control.Parameters such as age, sex, fasting blood glucose, postprandial blood glucose, lipid profile, mean plasma glucose, urine micro albumin, and HbA1c were taken into consideration. A correlation between blood glucose levels and other parameters such as lipid profile, renal and liver functionand HbA1c levels were established using meta analysis. Analysis suggests people of age group from 40 to 60 years and male population were highly affected from diabetes. Also HbA1canalysis showed only 25% of the cases had HbA1c levels between 7-7.5%, while 57% cases had HbA1c levels above 7.5%. Further, a significant positive correlation was found between postprandial blood sugar levels, total cholesterol and triglyceride levels ($p<0.0001$) which in turn indicates a chance of cardio-vascular diseases and renal impairment. The data suggest poor control of diabetes among the population and correlation study with abnormal blood glucose levels indicate complications related to diabetes including cardiovascular risk and renal impairment in patients. Hence we propose that high HbA1c levels should be considered a marker for cardiovascular risks and renal impairment and subsequent treatment must be planned in compliance to HbA1c levels.

Key words: Diabetes, HbA_{1c}, lipid profile, renal function test, liver function test, meta-analysis.

INTRODUCTION

Diabetes is a leading cause of several maladies that includes but not constrained to cardiovascular morbidity as well as mortality, and is also a significant contributor to disability in many countries (Geulayov et al., 2010). The increasing prevalence of diabetes throughout the world (Phanse et al., 2012; Zohra et al., 2012; Anbreen et al., 2012) is because of various causes viz. increase in average age of the population owing to better facilities, tremendous change in lifestyle, improved diagnostic techniques and increasing health awareness in the masses (Chou et al., 1997). The issue in diabetes control is that it largely remains under-diagnosed. In fact, a major chunk of diabetic population does not realize they are suffering from it. By and large, the average onset lag between onset and diagnosis is 7 years (Saudek et al., 2008).

The early onset of diabetes, longer suffering period out of diabetic complications and early death makes Asian population more susceptible to this disease as compared

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to other regions. As a matter of fact, type II diabetes prevalence has reached to epidemic levels in Asia (Yoon et al., 2006). The number of cases of diabetes worldwide in the year 2000 among adults was estimated to be 171 million and will rise to 366 million by 2030. India is considered to be the “diabetic capital of the world”. Diabetic condition is known to be associated with environmental, behavioral, and lifestyle factors such as a sedentary lifestyle and highly rich nutrition. In addition, the daily human-environment interactions and real-life activities that cause an individual's blood glucose to fluctuate remain relatively unexplored owing in part to data collection challenges (Doherty, 2011). Global prevalence of diabetes was about 2.8% in 2000 and is estimated to be around 4.4% by 2030. It has been estimated that in the 30-year period, the prevalence of diabetes in India would increase by 195%, which is the highest in the world. The International Diabetes Federation estimates the total number of diabetic subjects to be around 40.9 million in India and this is further set to rise to 69.9 million by the year 2025 (Murugesh and Mani, 2011).

Public health and managed-care organizations typically use multiple data sources to track and monitor chronic diseases such as diabetes (Saydah et al., 2004). Several efficient but underutilized preventive-care practices have proven to reduce complications related to diabetes. This has been largely established with the support of several surveillance projects. However, strategies to identify individuals with diagnosed diabetes from various data sources have not been systematically evaluated. The focus of care for people with diabetes has shifted from hospital to general practice. Many practices now offer diabetes care via dedicated mini-clinics, shared care schemes or opportunistically (Pierce et al., 2000).

The main objective of our survey was to gather data of blood glucose level as well as lipid profile (Giansanti et al., 1999; Smith, 2007; Gotto, 2007; Khan et al., 2007; Selvin et al., 2006) from which we drew results such as: which areas are getting good, bad or average diabetes health care. This survey reconsiders the criteria for diagnosing diabetes and discusses screening criteria to make case finding easier for clinicians as well as patients. A cross sectional study of people belonging to all ages with diabetes was performed in this survey and varying results were so obtained. This survey shall present a clear detail about the prevalence of diabetes in Vellore district of Tamil Nadu in South India.

MATERIALS AND METHODS

Data were collected from three different diabetic clinics in Vellore. In total, 1300 cases were taken into consideration out of which 25% were taken as control population. Parameters such as age, sex, fasting blood glucose, postprandial blood glucose, lipid profile (total cholesterol, blood serum triglyceride (TGL), low-density lipoprotein (LDL), high-density lipoprotein (HDL), very low-density lipoprotein (VLDL), Cho/HDL, LDL/HDL), liver function tests (total protein, albumin, globulin A/G, total bilirubin), renal function test (plasma urea, creatinine, serum glutamic oxaloacetic transaminase (SGOT), serum glutamic pyruvic transaminase (SGPT), sodium (Na^+), potassium (K^+), chloride (Cl^-) and bicarbonate ions value), and HbA_{1c} were taken into consideration. The data was analyzed on the basis of age groups and sex in which individuals starting from age 10 were taken into consideration and their control over diabetes was analyzed on the basis of HbA_{1c} test values.

Data was analyzed using Chi-square ($\chi 2$) test. Correlation was also established between blood glucose levels and other parameters such as lipid profile, mean plasma glucose, urine micro-albumin and HbA_{1c} levels. To better understand the correlation between age, sex and HbA_{1c} levels of the diabetic population, certain techniques were employed. The parameters were also correlated were the lipid profile, urine micro-albumin and mean plasma glucose with impaired fasting and postprandial blood glucose levels. These were extensively recorded in control and diabetic patient groups. The clinics which aided the survey by supplementing the diabetic data are: Vellore Diabetic Clinic # 1, Vellore, India (Data size- 600); Vellore Diabetic Clinic # 2, Vellore, India (Data size- 400); Vellore Diabetic Clinic # 3, India (Data size- 300). All 1300 cases were diabetic but 25% were normalized after metformin treatment. Therefore, they were excluded from the study. The duration of the diabetic disease was 4 - 5 years and the patients were on metformin. Any major complications were not reported in the small duration.

Meta-analysis and statistical tests

Data analysis was conducted with statistical package ‘GraphPad Prism 5.0’, Microsoft Excel and meta-analysis tool. The χ^2 test, ANOVA test and Pearson coefficient were used to measure the association among the different variables. The results were generated in the form of averages, standard deviation and their 95% confidence interval (CI). Correlation was established using Pearson’s coefficient between fasting and postprandial blood glucose levels and various parameters such as total cholesterol, triglyceride levels, LDL, VLDL, urine micro-albumin, and mean plasma glucose. Type of correlation was established using coefficient of determination, r^2. The p values of < 0.05 were defined as significant.

RESULTS

Diabetes occurrence is dependent on age and sex

Out of the total data size of 1300, 557 were male diabetic patients and 402 were female diabetic patients (Table 1). The 341 individuals were close to normal, hence they were excluded from the study. The data was divided according to the age groups and sex. The tabulated data showed a peak in the age group of 50 - 60 years. The Figure 1 obtained showed that the population of male diabetes was more than the female diabetic in Vellore and also showed a peak in the age group of 50 - 60. Thus, it can be safely inferred that male individuals are more prone to diabetes in the middle age group of 40 - 60 years (Table 2). Even females suffering from diabetes were observed to be higher in age group of 40 - 60 years, but still the occurrence rate was found to be lower than the males. The difference in occurrence of diabetes between males and females can be due to difference in

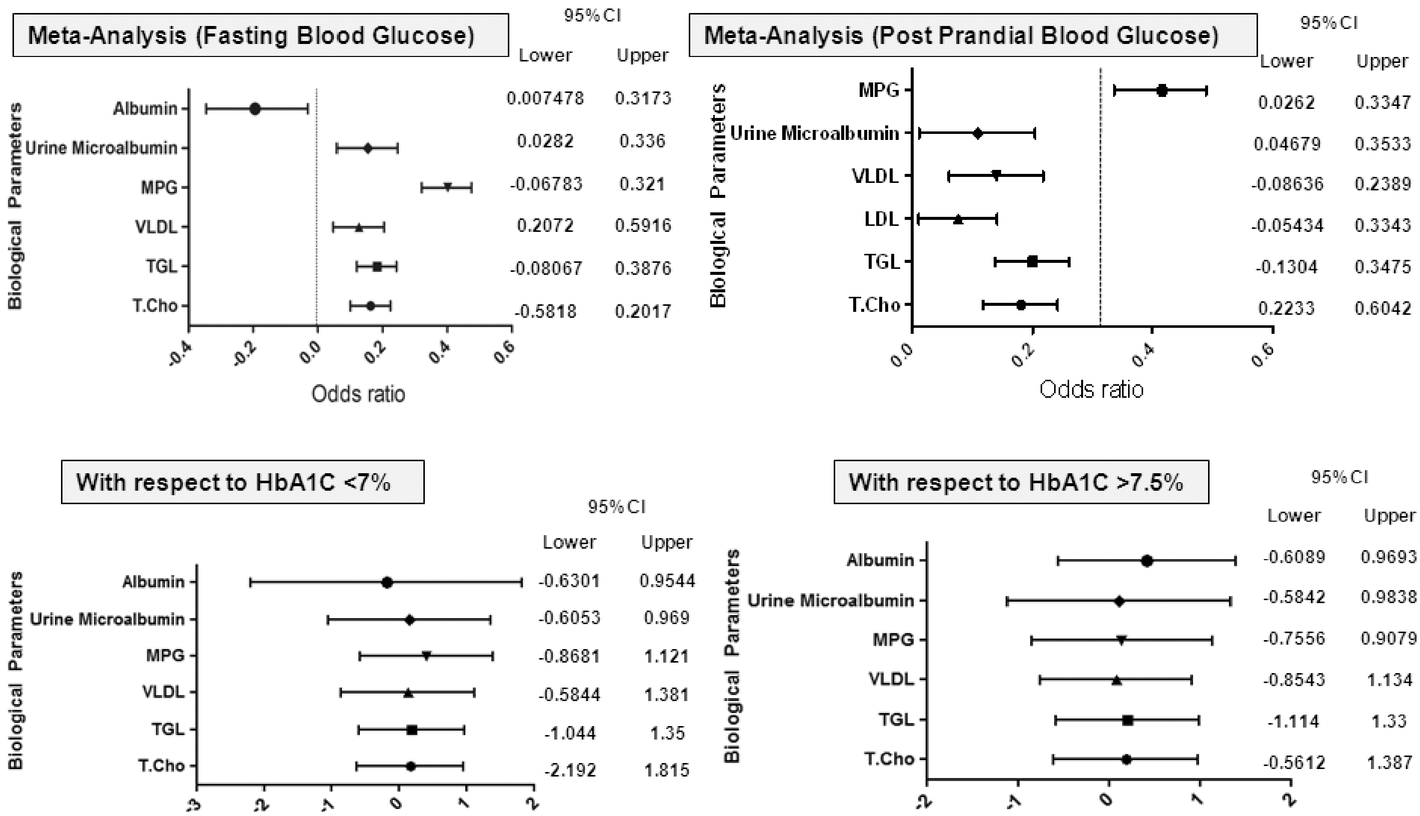

Figure 1. Meta-analysis of various parameters compared in patient's fasting glucose levels.

Table 1. Data on age- and sex-dependent diabetic patients

Age	Diabetic male	Diabetic female
10 - 20	0	3
20 - 30	17	9
30 - 40	82	66
40 - 50	169	126
50 - 60	190	122
60 - 70	74	66
70 - 80	24	10
80 - 90	1	0

Table 2. Results on the sex-dependent HbA_{1c} value fluctuation.

Parameter	HbA_{1c} values		
	<7%	7-7.5%	>7.5%
Diabetic male	96	101	226
Diabetic female	68	66	60

their lifestyle. The survey findings suggest that the males must do more exercise and reduce sedentary lifestyle so as to come over the bias of high susceptibility to diabetes. Stress could also be one of the prominent factors for higher occurrence of diabetes in males.

HbA_{1c} value in diabetic patients

The HbA_{1c} values were categorized based on the findings that the HbA_{1c} level for a diabetic patient should be around 7-7.5 %. The data was grouped under three categories viz. <7%, 7-7.5 and >7.5% HbA_{1c} levels. Amongst these, the category comprising of >7.5% showed the maximum especially for diabetic male population. Therefore, it can be safely concluded that the majority of the diabetic population in Vellore region lacks proper control over the glucose levels. Furthermore, the health care facilities provided for the control of diabetes might not be adequate.

Correlation between blood glucose and renal/liver function and lipid profile in diabetic patients

Statistical studies were conducted to correlate fasting blood glucose to total cholesterol and lipid profile in the populations. In addition, correlation was also established between postprandial glucose and total cholesterol con-

Table 3. Results on the correlation between fasting and postprandial blood glucose levels with total cholesterol, triglyceride (TGL) levels, low density lipoprotein (LDL), very low density lipoprotein (VLDL), mean plasma glucose (MPG) and urine micro-albumin.

Parameter	Pearson (r)	95% CI	p value	R squared
Fasting glucose and Total cholesterol	0.1628	0.09980 to 0.2245	< 0.0001	0.02651
Postprandial glucose and total cholesterol	0.1810	0.1181 to 0.2423	< 0.0001	0.03274
Fasting glucose and TGL	0.1826	0.1199 to 0.2438	< 0.0001	0.03333
Postprandial and TGL	0.2006	0.1381 to 0.2615	< 0.0001	0.04024
Postprandial and LDL	0.07647	0.01068 to 0.1416	0.0228	0.005848
Fasting glucose and VLDL	0.1271	0.04807 to 0.2046	0.0017	0.01616
Postprandial and VLDL	0.1406	0.06145 to 0.2179	0.0005	0.01976
Fasting glucose and MPG	0.4013	0.3211 to 0.4758	< 0.0001	0.1610
Postprandial glucose and MPG	0.4157	0.3361 to 0.4894	< 0.0001	0.1728

centration as tabulated in Table 3. The same table also depicts correlation between fasting and postprandial glucose and triglycerides level in diabetic patients. However, no significant correlation was observed with other noted parameters; hence they were excluded from the analysis.

DISCUSSION

Several studies have analyzed and reported the clinical management of diabetes at zonal level, however, the Vellore region has largely remained ignored in this aspect (Annette, 2012; Evelyn et al., 2012; Health Educ. Res., 2012). From the values obtained in Table 3, we were able to find a positive correlation between various parameters. There was a significant and positive correlation between fasting blood glucose level and total cholesterol (r =0.1628, 95%CI= 0.09980 to 0.2245, p= <0.0001) and postprandial blood glucose and total cholesterol (r = 0.1810, 95% CI= 0.1181- 0.2.423, p= <0.0001). Also, there was a positive correlation between fasting blood glucose and triglyceride (TGL) levels (r = 0.1826, 95%CI = 0.1199 to 0.2438, p= <0.0001); and postprandial blood glucose and TGL levels (r = 0.2006, 95%CI= 0.1381 to 0.2615, p= <0.0001). Positive correlation was also found between postprandial LDL levels (r = 0.07647, 95% CI= 0.01068 to 0.1416, p = 0.0228) and fasting blood glucose and VLDL (r = 0.1271, 95%CI= 0.04807 to 0.2046, p= 0.0017), and postprandial blood glucose and VLDL (r = 0.1406, 95% CI= 0.06145 to 0.2179, p=0.0005).

The positive correlation between fasting blood glucose and postprandial blood glucose with total cholesterol, triglyceride levels, LDL and VLDL indicate the risk of cardiovascular diseases in the patients. Thus, we can conclude that the diabetic populations with higher blood glucose levels in Vellore are more prone to cardio-vascular diseases. The correlation was also established between fasting blood glucose and mean plasma glucose (MPG) (r = 0.4013, 95%CI= 0.3211 to 0.4758, p<0.0001) and postprandial blood sugar and MPG (r = 0.4157, 95% CI= 0.3361 to 0.4894, p= <0.0001). Thus, impaired blood glucose levels were found to be responsible for high MPG levels. We also found a correlation between fasting blood glucose and urine micro-albumin (r = 0.1544, 95% CI= 0.5872 to 0.2472, p= 0.0017) and postprandial blood glucose and urine micro-albumin (r = 0.1093, 95% CI= 0.1203 to 0.2044, p= 0.0277). This correlation was also found to be positive and significant and indicated the risk of renal disorders due to impaired blood glucose levels in the diabetic population in Vellore. However, no significant correlation was found for liver dysfunction.

Herein, we concluded that random sampling of diabetic population reflects that propensity of diabetes is much higher in male (between 40 - 60 years age group) than the female population in Vellore. Furthermore, we observed that the percentage of glycosylated blood (HbA1c) value in mass population is beyond the normal range of 6.5 - 7%, indicating a sedentary life style, more calorie and glucose intake as well as poor awareness towards the health condition (Colberg, 2012; Cinar et al., 2012; Grandy et al., 2012; Tsang, 2012) that could be attributed to financial constraints. In addition, correlation between diabetes and cardiovascular risk is well established. In our study, we found that the lipid profile is altered in diabetic patients than the normal population. Also, the renal failure and diabetic nephropathy is a lethal downstream event in the diabetic population that is clearly observed with high urine micro-albumin levels in Vellore population. Therefore, these findings are beneficial to treat the diabetic patients more effectively and can help to combat diabetic-related disorders since the management of diabetes is poor in Vellore, Tamil Nadu, India. The diabetic individuals may further be suggested for self-diabetes management programs. The government bodies and concerned authorities may launch training and educational programs to raise awareness in the masses (Lynch et al., 2012).

Conclusion

We have found that there is correlation between higher HbA1C value and cardiovascular risk, renal function and liver function test. Therefore, this region needs to focus more on diabetes management and diabetes-related disorders.

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