Adiponectin and Body Mass Index in Type 2 Diabetes Mellitus

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ABSTRACT

Introduction: Diabetes Mellitus is a syndrome characterized by chronic hyperglycemia and disturbances of carbohydrate, fat and protein metabolism with absolute or relative deficiency of insulin secretion and/or insulin action. It is one of the most common non-communicable diseases in the world. Adiponectin is a protein secreted exclusively by adipocytes that regulates glucose and lipid metabolism. It has been found to influence the body's response to insulin thereby modulating insulin action and resistance. Several studies have found that adiponectin levels are inversely associated with the severity of diabetes mellitus. Our study, thus, aims to compare the association between levels of adiponectin, fasting blood glucose, body mass index and waist-hip ratio in patients of diabetes mellitus.

Material and Methods: This case control study was done in patients of type 2 diabetes mellitus attending Medicine OPD and ward from October 2016 to September 2018. A total of 88 people were included in the study; 44 cases and 44 controls.

Results: This study shows that serum adiponectin level is significantly decreased in type 2 diabetes mellitus patients as compared to controls and it also shows negative correlation with fasting blood glucose, body mass index and waist-hip ratio.

Conclusion: It can be concluded that serum adiponectin estimation may be a useful biomarker for the diagnosis of type 2 diabetes mellitus and it may be a useful adjunct in the treatment of type 2 diabetes mellitus.

Keywords: Adipocytes, Fasting Blood Glucose, Waist-Hip Ratio.

INTRODUCTION

Diabetes Mellitus (DM) is a syndrome characterized by chronic hyperglycemia and disturbances of carbohydrate, fat and protein metabolism with absolute or relative deficiency of insulin secretion and /or insulin action.[1] The number of patients affected by type 2 diabetes mellitus (T2DM) is increasing worldwide. In 2015, around 415 million people were affected and an expected number of nearly 650 million by 2040.[2] Adiponectin serves as a hormone having anti-inflammatory and insulin sensitizing properties.[3] Adiponectin synthesis is increased by both insulin and insulin-like growth factor-1(IGF-1), in adipocytes of visceral tissue.[4] Plasma adiponectin concentration is negatively correlated with body mass index and its level is lower in patients with type 2 diabetes mellitus or impaired glucose tolerance.[5,6] Many studies have been done on the role of adiponectin in insulin sensitivity and insulin resistance in T2DM in various parts the world, however no studies have been carried out in Manipur, India. So, this study was taken up to help elucidate the contradictory results of previous studies with the aims and objects to compare the association between levels of adiponectin, fasting blood glucose, body mass index and waist-hip ratio in patients of type 2 diabetes mellitus.

MATERIAL AND METHODS

This was a case control study done in patients of type 2 diabetes mellitus in the Department of Biochemistry in collaboration with Department of Medicine, RIMS Hospital, Imphal from October 2016 to September 2018. A total of 88 people were included in the study consisting of 44 cases and 44 controls. Cases were those diagnosed with type 2 diabetes mellitus attending medicine OPD and also admitted in the Medicine ward irrespective of sex, socio-economic status and ethnicity. A group of normal healthy individuals of comparable age and sex who were free from any systemic diseases were included in the control group. The inclusion criteria were: already diagnosed type 2 diabetes mellitus cases, new onset or recent onset type 2 diabetes mellitus cases, both sexes were included. Exclusion criteria were: type 1 diabetes mellitus, metabolic syndrome, chronic kidney disease, anorexia nervosa, coronary artery diseases, past history of vascular diseases.

Standard protocols were used to measure body weight, height with appropriate validation and quality control procedures. Fasting venous blood of about 5 ml was collected from the anterior cubital vein. About 2 ml of blood was collected in fluoride vial for blood glucose estimation and the remaining in sterile vial is centrifuged at 3000 rpm for 10 minutes to obtain serum for the estimation of adiponectin. Laboratory

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tests to be done were: serum adiponectin- measured by ELISA using Adiponectin ELISA E09 kit, Germany as described by Bluher M et al[7] and fasting blood glucose - estimated by GOD-PAP method[8] using glucose Liquicolor Kit manufactured by HUMAN, Germany. Ethical clearance was taken from Research Ethics Board RIMS, Imphal. A written informed consent was taken from all the subjects. Data analysis was performed using IBM SPSS software version 16. Descriptive statistics like frequency and percentages were used. Averages were calculated using mean with standard deviation. Test of significance was performed using Chi-square test for qualitative data and t-test for quantitative data. Correlation between two quantitative variables was performed using Pearson correlation. Probability value (*P* - value) of <0.05 was taken as significant.

RESULTS

It is evident from Table-1 that the majority of type 2 diabetic cases occurred in the age group of 41-50 years and majority of the normal controls were in the age group of 31-40 and 41-50 years of age. Some difference observed was found to be statistically insignificant (p>0.05). So, both the groups were comparable with respect to age.

Table 2 shows male predominance in both cases and controls. The difference was found to be statistically insignificant (p>0.05). So, both the groups were comparable regarding sex.

It is shown in Table 3 that majority of the cases were from rural areas and controls from urban areas as shown in Table 3. This finding was found to be statistically significant (p<0.05).

Overweight and obesity were more in cases than controls as shown in Table 4. This finding was found to be statistically significant (p<0.05). Mean BMI was also significantly higher in cases than in controls (p<0.05).

In table 5, the difference in waist:hip ratio among female cases and among controls was statistically significant (p<0.05). Same finding was observed among males.

In table 6, we can see that serum adiponectin level among female and male cases are almost similar and this finding

Age group (in years)	Cases N (%)	Controls N (%)	Total N (%)	Chi-square test *P* -value
20-30	2(4.5)	4(9.1)	6(6.8)	Value = 8.449 *P*-0.076
>30-40	3(6.8)	12(27.3)	15(17.0)	
>40-50	14(31.8)	12(27.3)	26(29.5)	
>50-60	12(27.4)	9(20.4)	21(23.9)	
>60	13(29.5)	7(15.9)	20(22.7)	
Total	44(100.0)	44(100.0)	88(100.0)	

Table-1: Age wise distribution of the respondents stratified by cases and controls

Sex	Cases n(%)	Controls n(%)	Total n(%)	Chi-square test *P* -value
Female	18(40.9)	20(45.5)	38(43.2)	Value = 0.185 *P*-0.830
Male	26(59.1)	24(54.5)	50(56.8)	
Total	44(100.0)	44(100.0)	88(100.0)	

Table-2: Distribution of the respondents by sex stratified by cases and controls

Address	Cases n(%)	Controls n(%)	Total n(%)	Chi-square test *P* -value
Rural	29(65.9)	13(29.5)	42(47.7)	Value=11.66 *P*-0.001
Urban	15(34.1)	31(70.5)	46(52.3)	
Total	44(100.0)	44(100.0)	88(100.0)	

Table-3: Distribution of the respondents by address stratified by cases and controls

BMI	Cases n(%)	Controls n(%)	Total n(%)	Chi-square test *P* -value
<18.5	0(0.0)	0(0.0)	0(0.0)	Value=62.5 *P*-0.00
18.5-24.9	5(11.4)	42(95.5)	47(53.4)	
25-29.9*	32(72.7)	2(4.5)	34(38.6)	
30 and above*	7(15.9)	0(0.0)	7(8.0)	
Total	44(100.0)	44(100.0)	88(100.0)	
Mean ±SD	27.4±2.7	22.9±1.6	-	t-test value=9.44 p-0.000
*Cells were clubbed together for analysis				

Table-4: Distribution of the respondents by BMI stratified by cases and controls

Sex	Waist:Hip Ratio Cases Mean ± SD	Waist:Hip Ratio Controls Mean ± SD	t-test *P*-value
Females	0.9±0.06	0.7±0.03	Value=9.39 *P*-0.000
Males	1.01±0.04	0.88±0.03	Value=10.8 *P*-0.000

Table-5: Distribution of the respondents by waist: hip ratio stratified by cases and controls and sex

Sex	Adiponectin Cases Mean ± SD (µg/ml)	t-test *P* -value
Females	5.7±2.0	Value=-0.141 *P* -0.889
Males	5.8±2.0	

Table-6: Distribution of the cases by serum Adiponectin level stratified by sex

Variables	Adiponectin Pearson correlation(r_p)	*P* -value
Fasting blood glucose	r_p= -0.234	*P* -0.126
BMI	r_p= -0.658	*P* -0.000
Waist-hip ratio	r_p= -0.785	*P* -0.000

Table-7: Correlation between other variables and serum adiponectin level among cases

was statistically insignificant (p>0.05).

Table 7 shows a negative poor correlation between fasting blood glucose with serum adiponectin level but it was statistically insignificant (p>0.05). With the increased in BMI there was decrease in adiponectin level (good negative correlation) and the finding was significant (p<0.05). Very good negative correlation was found between waist-hip ratio and serum adiponectin level and was found to be statistically significant (p<0.05).

DISCUSSION

In the present study, majority of the diabetics were above 40 years old. The importance of age on the prevalence of diabetes cannot be underestimated. The high prevalence of diabetes mellitus in middle aged population may be due to increased fat mass and reduced physical activity causing obesity.[9] Majority of diabetics in the world are in the age group of 45-65 years and the most important demographic factor appears to be the increase in the proportion of people > 65 years of age.[10] Our study shows more prevalence of type 2 diabetes mellitus in males than in females, which are similar with many studies including those of Bharati DR et al[11] and Warsy AS et al.[12] The prevalence of type 2 diabetes was found to be higher in rural areas as compared to urban areas. This finding is contradictory to the findings of other studies which showed higher prevalence in urban population, as seen in the studies of Zargar et al[13] and Sadikot et al.[14] The contradictory findings may be due to the fact that the study was carried out in a tertiary hospital where majority of patients were from rural areas.

The BMI was significantly higher in cases of type 2 diabetes mellitus as compared to controls. This finding is same with that of Pradhan AD et al[15] and Ganz ML et al.[16] A BMI of 18.5-22 is considered healthy for the Asian population according to WHO recommendation.[17] In our study, maximum of the cases had BMI above the recommended range. According to a report by Mckeigue et al[18], in Asian Indians every 0.04 unit increase in WHR was associated with a four-fold rise in diabetes. The present study shows that WHR of both female and male diabetic cases were high i.e. >0.80 in females and >0.95 in males. Increases WHR caused by increased abdominal and visceral fat leads to increased insulin resistance and consequently diabetes. The findings of our study is in accordance with that of Ramachandran et al.[19]

In the present study, the mean adiponectin level of diabetic cases were significantly lower than the controls. Among the cases, serum adiponectin level was only slightly lesser in females compared to males but Peake PW et al[20] reported significant differences The lower range of serum adiponectin in females of study group may be due to various factors like duration and progression of diabetes, effect of oral hypoglycemic etc.

The fasting blood glucose of the study group were significantly higher than the controls. The fasting blood glucose was negatively correlated with serum adiponectin in the study group. This finding is in accordance to the accepted notion i.e. serum adiponectin and fasting blood glucose have an inverse relationship and it is well supported by other studies, like that conducted by Looker HC et al.[21] The role of adiponectin on glucose metabolism is that it increases insulin sensitivity by inhibiting hepatic glucose production and increases glucose uptake in muscles. The molecular mechanisms underlying the glucose lowering effect of adiponectin has been shown to be partly due to its activation of AMP-activated protein kinase cascade in the liver and skeletal muscle.

Our study also shows a significant negative correlation of adiponectin with body parameters such as BMI and waist-hip ratio. The mechanism by which adiponectin secretion is reduced in obese subjects is not clear. Insulin resistance and enhanced TNF-α expression may contribute to this effect because adiponectin is stimulated by insulin and inhibited by TNF-α. In obesity, TNF-α produced by white adipose tissue is markedly upregulated and contributes to insulin resistance by interfering with insulin receptor signaling.[22] Adiponectin expression in white adipose tissue is also suppressed by TNF-α.[23]

The strength of this study is that it provides statistically significant evidence of the usefulness of serum adiponectin as a convenient sensitive biomarker for type 2 diabetes mellitus. The limitation of this study was the small sample

size. Future large scale studies are required for confirmation of the association.

CONCLUSION

Adiponectin is the most abundant adipose-specific protein and possesses anti-hyperglycemic properties. This study shows that serum adiponectin level is significantly decreased in type 2 diabetes mellitus patients as compared to controls and it also shows negative correlation with fasting blood glucose, BMI and WHR. Thus it can be concluded that serum adiponectin estimation may be a useful biomarker for diagnosis of type 2 diabetes mellitus and it may be a useful adjunct in the treatment of type 2 diabetes mellitus.

It is also noted that despite the relative small sample size, the present study provides evidence of the usefulness of estimation of serum adiponectin as a convenient sensitive biomarker for type 2 diabetes mellitus. Prospective and population based studies on a large-scale are however required to confirm the association.

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