Original Research Article

CORRELATION OF SERUM THIAMINE WITH PHYSICAL AND BIOCHEMICAL PARAMETERS AMONG TYPE 1 AND TYPE 2 DIABETICS: A CROSS-SECTIONAL ANALYSIS

ABSTRACT

Objective: Thiamine or vitamin B1 is an essential micronutrient and enzyme cofactor that is needed for most of the anabolic and catabolic reaction that occurs in organisms. Deficiency of Thiamine has been associated with numerous complications in diabetes mellitus (DM) patients. Therefore, this study was intended to evaluate various biochemical and anthropometric parameters with serum thiamine levels in type I and type II diabetic patients.

Methodology: This was a case-control study carried out in diabetic outpatient department (OPD) of Jinnah post graduate medical institute, Karachi by using non-probability convenient sampling technique. The duration of the study was about six months after approval of synopsis. A total of 60 participants with type I and II diabetes mellitus of both genders with age < 25 to > 46 years were selected; 30 participants with type I diabetes whereas 30 participants had type II diabetes. The Pearson's correlation test was used to evaluate correlation between thiamine levels and height, weight, heart rate, temperature, dyslipidemia, creatinine, urea in type I and II diabetic patients.

Results: The study results showed that among type I diabetics, none of the patient characteristics studied were significantly correlated with the thiamine levels of these patients. On the other hand, the study results showed that among type II diabetics, height was significantly negatively correlated with the thiamine level ($p=0.045$) where patients with greater height had lower thiamine level and vice versa. Moreover, both heart rate and total cholesterol were marginally insignificantly correlated with thiamine level ($p=0.065$ and $p=0.069$ respectively) where patients with higher heart rate and lower total cholesterol had lower thiamine level and vice versa.

Conclusion: This study concluded that all anthropometric and biochemical parameters were insignificantly correlated with thiamine levels in type I and II diabetic patients. However, height had significant negative correlation with the thiamine level among type II diabetics reflecting patients with more height had lower thiamine level.

Keywords: Thiamine levels, total cholesterol, type I diabetes, type II diabetes, Urea, Creatinine

INTRODUCTION

Thiamine is also termed as vitamin B1 which is a water-soluble vitamin and a coenzyme that participated in carbohydrate metabolism and branched-chain amino acids. [1]Thiamine is a essential dietary element that is found in different food sources; however multiple factors are involved in variation of its serum levels for instance elevated temperatures and pH, use of diuretics, high-calorie diet comprising simple carbohydrates, prolonged use of alcohol, pyrexia, too much exercise, lactation and pregnancy, tension and trauma. [2,3] Moreover, thiamine has a short half-life of about 1−12 hours with limited body store .[4] Over the past years, prompt alterations in food regimes and standard of living that have happened owing to industrialization, urbanization, economic progression and globalization that led to modify dietary regimes to high-saturated, high-fat, and low-energy providing diet resulting an insufficient intake of thiamine.[5,6] It is evidently supported that thiamine insufficiency is related to multiple diseases such as CVDs and diabetes, angina, myocardial infarction (MI), dyslipidemia, obesity and psychological disorders.[7]

Diabetes mellitus (DM) is one of the most serious health concerns, and its prevalence is rising promptly in all age groups. Multiple environmental, genetic, host factors are associated with DM. The two basic courses that develop diabetes are autoimmune and metabolic paths. The noticeable possible factors to develop DM are inappropriate absorption of nutrients, being overweight, laziness, and hormonal discrepancy [8,9]. Generally, DM is categorized into two types; type I (insulin-dependent diabetes mellitus) and type II (insulin-independent diabetes mellitus). Type I DM arises because of the autoimmune devastation of pancreatic beta cells causing an incapable to produce insulin by pancreatic beta cells, whereas type II DM is

frequently prevailing disease particularly in Pakistan that is caused by the development of insulin resistance and reduced insulin receptor sensitivity [8,9]. Multiple factors typically associated with fat and carbohydrate metabolism including many micronutrients to some extent causes Type II DM. The consequences and complications of diabetes are triggered by developing imbalance between free radical formation and their control by natural antioxidants [10].

Prolonged use of diuretics leads to Thiamine deficiency, causing an abrupt reduction in excretory thiamine that may lead to renal impairment [11]. One of the most severe complications of diabetes is Diabetic nephropathy that is clinically manifest as the existence of micro-albuminuria that eventually develops macro-albuminuria. Therefore, at this phase, acceptable renal replacement treatment for kidneys is necessary for effective functioning [12]. The prevalence of micro-albuminuria is recognized as indicator of diabetic nephropathy in diabetic patients and also shows cardiovascular disorders [13,14]. The development of diabetic nephropathy in patients with type I DM can be inhibited by regulating glucose level in blood and blood pressure with administration of angiotensinogen-converting enzyme (ACE) inhibitor remedy that decreases the chances of micro-albuminuria [15]. It is proposed that increased renal clearance of thiamine leads to reduction of thiamine level in diabetes [16]. It is recommended that thiamine therapy at higher doses may have a remedial influence on diabetic nephropathy which is effective at an early-stage [17]. Thiamine therapy is also suggested for averting renal impairment and cardiovascular illnesses in type II DM people, in this manner improving the quality of life and decreasing the probability of complications [18].

As far as the association between DM and thiamine is concerned,substantialpercentage of healthy individuals (36-47%) presented as deficiency of thiamine in a hyperglycemic episode for instance in a high carbohydrate diet, pregnancy and diabetes [19]. It was reported in one research that low plasma level of thiamine was observed in type Idiabetes [20].It was also revealed in another research that low thiamine level in blood, low functional activity of erythrocyte transketolase(T*k*) and high functional activity of erythrocyte thiamine pyrophosphate (TPP) are associated with diabetic patients [21]. Thiamine level was assessed by transketolase activity in mammals. The low level of thiamine in diabetes may be due to the fact that decreased level of apo-enzyme from the disease itself instead of thiamine deficiency [9]. Furthermore, plasma

thiamine level has been revealed to be reduced by 76% in type I and 75% in type II diabetes that was relatedto higher renal clearance and fractional elimination of thiamine from the body [22].

Nonetheless, there is ambiguity regarding association between thiamine ingestion and diabetes, CVDs, dyslipidemia and renal clearance. Therefore, the present study was intended to explore the correlation of anthropometric and biochemical parameters such as Triglycerides, Total Cholesterol, Urea, and Creatinine with the thiamine level in patients of diabetes type I and II.

METHODOLOGY

This was a case-control study carried out in diabetic outpatient department (OPD) of Jinnah post graduate medical institute, Karachi by using non-probability convenient sampling technique. The duration of the study was about six months after approval of synopsis. A total of 60 participants were selected; 30 participants with type I diabetes whereas 30 participants had type II diabetes. Patients with type I and II diabetes mellitus of both genders with age < 25 to > 46 years were included in the study whereas those patients who were taking diuretics, had significant co-morbidities like chronic Liver diseases, Ischemic heart diseases, patients who undergone major transplant surgeries, end phase renal disease and gastro intestinal disease were excluded from the study.

After receiving informed consent from the participants, data was documented from diabetic clinics of medical wards of Jinnah Post graduate Medical Center (JPMC) Karachi. Blood Samples were gathered from the diabetic clinics of Jinnah Post graduate Medical Center (JPMC), Karachi and Dow University Ojha Campus, Karachi. Collected Blood samples in the non-heparinized tube were immediately centrifuged at 2000 rounds per minute (rpm) for 20 minutes duration. The clear supernatant serum was used for the evaluation of many biochemical investigative parameters comprising random blood sugar (RBS) levels, fasting blood sugar (FBS) levels, creatinine, urea, hemoglobin A1c (HbA1c), blood and urinary thiamine levels.The height, weight, and blood pressure were estimated by usual method.

The data was entered and analyzed by SPSS Statistics version 20. The Pearson's correlation test was used to evaluate correlation between thiamine levels and height, weight, heart rate,

temperature, dyslipidemia, creatinine, urea in type I and II diabetes patients. P value < 0.05 was taken as statistically significant.

RESULTS

Secondary data analysis of total 60 patients was performed for this study, 30 each in type 1 and type 2 diabetes group.

The study results showed that among type 1 diabetics, none of the patient characteristics studied was significantly correlated with the thiamine levels of these patients (table 1).

On the other hand, the study results showed that among type 2 diabetics, height was significantly negatively correlated with the thiamine level (p=0.045) where patients with greater height had lower thiamine level and vice versa. Moreover, both heart rate and total cholesterol were marginally insignificantly correlated with thiamine level (p=0.065 and p=0.069 respectively) where patients with higher heart rate and lower total cholesterol had lower thiamine level and vice versa (table 2).

Table 1: Correlation between serum thiamine and patient characteristics among type 1 diabetics

Variables (n=30)	Serum Thiamine	
	ρ	p
Height	-0.036	0.850
Weight	-0.183	0.333
Heart Rate	0.147	0.438
Temperature	-0.020	0.915
Triglycerides	-0.075	0.994
Total Cholesterol	-0.280	0.134
Urea	0.205	0.276
Creatinine	0.288	0.123

Table 2: Correlation between serum thiamine and patient characteristics among type 2 diabetics

Variables (n=30)	Serum Thiamine	
	ρ	p
Height	-0.369	0.045

Weight	-0.054	0.776
Heart Rate	-0.342	0.065
Temperature	0.133	0.484
Triglycerides	0.010	0.956
Total Cholesterol	0.337	0.069
Urea	0.094	0.622
Creatinine	0.120	0.529

DISCUSSION

Diabetes has been observed to be linked with low thiamine level deposits in the body, as thiamine concentration in the body directly affects carbohydrate formation, breakdown, and inter-conversion. The present study demonstrated the influence of thiamine level on anthropometric and biochemical parameters in patients with type I and II diabetes mellitus.

Thiamine has a significant role in inhibition of atherosclerotic plaque as it has a protectiveinfluence on proliferation mediated by glucose and insulin on human arterial smooth muscle cells.[23] Another data support this statement that consistent thiamine managementaugments endothelial functions and impedes atherosclerosis development, [24] One of the researches demonstrated that both types I and II DM patients showed significantly higher level of triglycerides and cholesterol as compared to controls.[25]These findings were similar to another research by Tai VML, who demonstrated type I DM patients had significantly higher triglycerides and cholesterol level than in controls($p=0.008$) [26]. Similarly, another analysis revealed that triglycerides levels were significantly greater intype II DM patientsthan in controls ($p<0.001$) [27]. The present study did not endorse the above reported researches and showed that there was no association existed between the thiamine level and triglycerides and total cholesterol in both types of diabetes mellitus ($p>0.05$) indicating there was no significant change seen in thiamine level with reference to types of diabetes.

Importantly, another research observed that most of the biochemical parameters are associated with diabetes type Iand revealed that extremely significant differences was observed between adults with and without diabetes type I. In their study, it was observed that total cholesterol, serum glucose and triglycerideslevels were significantly higher ($p<0.001$, 0.001 and 0.008),

correspondingly in diabetes type Ipatients as compared to controls. Therefore, it demonstrated arobustrelationship between blood thiamine levels with various biochemical indicators included blood glucose, HDL and serum creatinine level ($p<0.008$, 0.001 and 0.001), correspondingly. It was evidently proved the significant function of thiamine and thiamine phosphate esters in averting the metabolic variations and probably the complications associated with diabetes type I; reflecting these thiamine levels and thiamine phosphate esters were interrelated with diabetes along with associated biomarkers, such as blood glucose, HDL, triglycerides and cholesterol in addition tomicroalbuminuria and excretory thiamine.[28]The present study was inconsistent with the above findings and showed that there was no association reported between thiamine levels with biochemical parameters ($p>0.05$) including total cholesterol, triglycerides, urea and creatinine in both diabetes type I and type II.

Similarly, one prospective study assessed the thiamine levels and serum creatinine in diabetes mellitus.It showed a positive and significant association between serum creatinine and urinary thiamine levelsin both Type I and type II diabetes ($p<0.001$). [10] The present study was not supported the above research and revealed that levels of thiamine was insignificantly associated with urea and creatinine levels in both types of diabetes.($p>0.05$).

Likewise, in a cross-sectional comparative analysis ofhealthy controls, micro-albuminuria and macro-albuminuriadiabetic patients, reported that lower thiamine level was found in diabetics, with agradually reductionin albuminuria, as well as inmacro-albuminuria. It was also showed that a negative correlation found between thiamineand lipid parameters in micro-albuminuriaAdditionally, Thiamine had greatly significant negative correlation with total cholesterol,triglycerides, and LDL cholesterol, whereasit had anextremely significant positive correlation with HDL cholesterol in all diabetic groups [27].These findings were not in agreement with our study and revealed that there was no correlation observed between thiamine levels and Triglycerides and total cholesterol in type I and II diabetes. Nonetheless, this study can have selection bias owing to a non-probability sampling technique and observer bias. Therefore, it is recommended that prospective researches with a probability sampling technique are used to elaborate this association in bigger samples to acquire more accurateresults.

CONCLUSION

This study concluded that all anthropometric and biochemical parameters were insignificantly correlated with Thiamine levels in type I and II diabetic patients. However, height had significant negative correlation with the thiamine level among type II diabetics reflecting patients with more height had lower thiamine level.

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