



Association of Serum Lipids and Vitamin B12 in Subjects with type 2 Diabetes Mellitus

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Introduction: Type 2 Diabetes Mellitus (T2DM) is a common health problem worldwide and associated with dyslipidemia. Many study reported, vitamin B12 deficiency is prevalent in T2DM patients. Therefore, the aim of this study was to study association of serum lipids with vitamin B12 in patients with T2DM.

Methods: This study was a cross-sectional and hospital based, carried out among 155 patients with T2DM. The Socio-demographic variables were collected and biochemical parameters were estimated in blood of all the study population. The categorical data were reported in percentage and numerical data were presented as mean \pm SD. The descriptive analysis was performed to get mean, standard deviation and percentage. The association between serum lipids and vitamin B12 were analyzed using Pearson's correlation. $P < 0.05$ was considered as a significance.

Results: The mean age of study subjects was 52.21 ± 15.78 and BMI was 28.10 ± 5.21 . The vitamin B12 deficiency was noticed in 28.38% patients with diabetes mellitus. The serum total cholesterol, triglycerides, LDL-C, VLDL, Non-HDL-C, TC/HDL-C ratio and TG/HDL-C ratio showed negative association with vitamin B12 levels in patients with diabetes mellitus. However, serum HDL-C showed positive association with vitamin B12 levels. The association was statistically significant ($p < 0.001$).

Conclusion: The present study showed the adverse association between vitamin B12 and serum total cholesterol, triglycerides and LDL-cholesterol and positive association with HDL-cholesterol in type 2 diabetes patients.

Keywords: Serum lipids, Type 2 diabetes mellitus, Vitamin B12

Introduction

Type 2 Diabetes mellitus (T2DM) is a common public health problem in a worldwide and due to relative or absolute deficiency of insulin.^{1,2} It is predicted that by 2024, the patient of T2DM will reached to 700 million.³ A study reported, more than 75% of T2DM patients have mixed dyslipidemia characterized by low level of HDL-C and high levels of TG which indicates close association of T2DM and dyslipidemia.⁴ Vitamin B12 is a micronutrient has various metabolic functions like DNA methylation, lipid metabolism.⁵ Vitamin B12 deficiency causes microvascular complications like neuropathy which can worsen this condition due to presence diseases like diabetes.^{6,7} The study conducted by Adakalakeswari et al. reported vitamin B12 deficiency independently associated with triglycerides and cholesterol/HDL ratio in type 2 diabetes patients.⁸ Some studies showed the negative correlation of total cholesterol and positive correlation of HDL-cholesterol with vitamin B12.^{9,10} The connection between vitamin B12 and serum lipids maybe due to this mechanism: vitamin B12 act as a coenzyme in the conversion of methylmalonyl CoA to succinyl-CoA.^{11,12}

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This reaction is blocked if there is vitamin B12 deficiency, resulting in accumulation of methylmalonyl CoA which causes inhibition of CPT1- carnitine palmitoyl transferase (rate-limiting enzyme of fatty acid oxidation) thus causing lipogenesis.¹³ Therefore, this study was designed to study association between serum lipids and vitamin B12 in subjects with T2DM population of Nepal.

Study design and population

This was a cross-sectional hospital based study, carried out among 155 patients with T2DM. The study was carried at clinical biochemistry laboratory, Manipal Teaching Hospital, Pokhara from March 2022 to April 2023. The consent was taken before the enrollment of patients.

Sample collection and analysis

The blood samples were collected by taking aseptic precautions. The 5 ml venous blood samples were collected from patients and centrifuge at 4000 rpm for 10 minutes to obtain the serum. The biochemical tests were performed immediately and in delay case, it was store at -20°C. The serum lipids, blood sugar, urea, creatinine, sodium and potassium were analyzed in VITROS 4600 dry chemistry analyzer (Ortho Clinical Diagnostics). The HbA1c levels were measured using Bio-Red D-10 analyzer and vitamin B12 level were measured in VITROS 3600 immunodiagnostic analyzer (Ortho Clinical Diagnostics).

Ethical consideration

The study was approved by institutional Review Committee of Manipal College of Medical Sciences, Pokhara (IRC No: MEMG/IRC/378/GA) before enrollment of study population.

Statistical analysis

The data were analyzed using SPSS version 21 statistical software. The categorical data were reported in percentage and numerical data were presented as mean±SD. The descriptive analysis was performed to get mean, standard deviation and percentage. The association between serum lipids and vitamin B12 were analyzed using Pearson's correlation. P<0.05 was considered as a significance.

Results

The mean age of study subjects was 52.21 ± 15.78 and BMI was 28.10 ± 5.21. The vitamin B12 deficiency was noticed in 28.38% patients with diabetes mellitus. The level of serum vitamin B12 was 427.28 ± 220.64. The mean and SD of TC, TG, HDL-C, LDL-C, VLDL-C and Non-HDL-C were 168.50 ± 17.84, 164.64 ± 60.76, 37.42 ± 8.08, 92.43 ± 18.81, 32.81 ± 12.24, and 126.00 ± 21.12, respectively. Similarly, mean and SD of FBS, PPBS, HbA1c, urea, creatinine, sodium and potassium were 128.43 ± 38.73, 225.21 ± 82.55, 7.32 ± 1.25, 28.42 ± 5.41, 0.63 ± 0.11, 138.69 ± 3.06 and 4.25 ± 0.35 respectively (Table 1).

Table 1: Basic characteristics of study population

Characteristics	Mean±SD
Age (years)	52.21 ± 15.78
BMI (Kg/m ²)	28.10 ± 5.21
TC (mg/dl)	168.50 ± 17.84
TG (mg/dl)	164.64 ± 60.76
HDL-C (mg/dl)	37.42 ± 8.08
LDL-C (mg/dl)	92.43 ± 18.81
VLDL-C (mg/dl)	32.81 ± 12.24
Non-HDL-C (mg/dl)	126.00 ± 21.12
FBS (mg/dl)	128.43 ± 38.73
PPBS (mg/dl)	225.21 ± 82.55
HbA1c (%)	7.32 ± 1.25
Vitamin B12 (pg/ml)	427.28 ± 220.64
Vitamin B12 deficiency	44 (28.38%)
Urea (mg/dl)	28.42 ± 5.41
Creatinine (mg/dl)	0.63 ± 0.11
Sodium (mmol/L)	138.69 ± 3.06
Potassium (mmol/L)	4.25 ± 0.35

BMI (Body Mass Index), TC (Total Cholesterol), TG (Triglycerides), HDL-C (High Density Lipoprotein-Cholesterol), LDL-C (Low Density Lipoprotein-Cholesterol), VLDL (Very Low Density Lipoprotein), FBS (Fasting Blood Sugar), PPBS (Post-Prandial Blood Sugar)

The serum total cholesterol, triglycerides, LDL-C, VLDL, Non-HDL-C, TC/HDL-C ratio and TG/HDL-C ratio showed negative association with vitamin B12 levels in patients with diabetes mellitus. However, serum HDL-C showed positive association with vitamin B12 levels. The association was statistically significant (p<0.001) (Table 2, Figure 1).

Table 2: Association of serum lipids with vitamin B12 in study subjects

Parameters	Vitamin B12	
	r	p-Value
TC	-0.637**	<0.001
TG	-0.529**	<0.001
HDL-C	0.508**	<0.001
LDL-C	-0.607**	<0.001
VLDL-C	-0.531**	<0.001
Non-HDL-C	-0.678**	<0.001
TC/HDL-C ratio	-0.682**	<0.001
TG/HDL-C ratio	-0.502**	<0.001

** Correlation is significant at the 0.01 level (2-tailed).

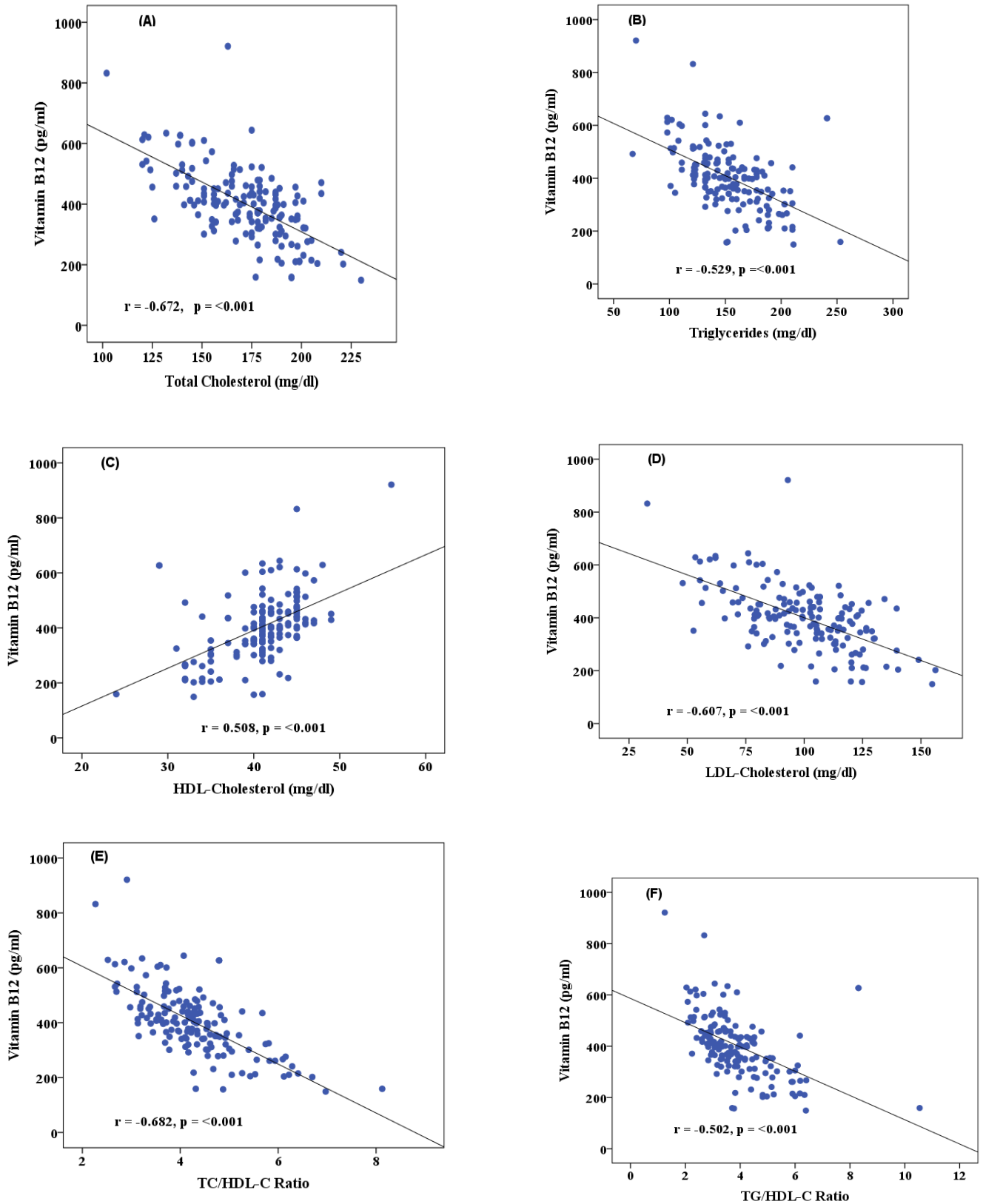


Figure 1: Association between serum lipids with serum vitamin B12 levels. (A) Association between total cholesterol and serum vitamin B12 levels. (B) Association between triglycerides with vitamin B12 levels. (C) Association between HDL-C with vitamin B12 levels. (D) Association between LDL-C and vitamin B12 levels. (E) Association between TC/HDL-C ratio with vitamin B12 levels. (F) Association between TG/HDL-C ratio with vitamin B12 levels. P-value obtained from the Pearson correlation test.

Discussion

In this study, the mean age of study subjects was 52 years and prevalence of vitamin B12 deficiency was 28.41% in type 2 diabetes patients. The study conducted among metformin user T2DM patients showed prevalence of vitamin B12 deficiency was from 5.8% to 33%.¹⁴⁻¹⁶ A study conducted among Indian population reported 12% vitamin B12 deficiency.⁸ Similarly, Niafar et al reported 14% deficiency of vitamin B12 in T2DM.¹⁷ However, Refsum et al reported higher prevalence (54%) of vitamin B12 deficiency in north Indian patients with T2DM.¹⁸

In present study, the serum TC, triglycerides, LDL-C, VLDL, Non-HDL-C, TC/HDL-C ratio and TG/HDL-C ratio showed negative association with vitamin B12 levels in patients with diabetes mellitus. However, serum HDL-C showed positive association with vitamin B12 levels and the association was statistically significant. The study conducted by Adaikalakoteswari et al. reported vitamin B12 deficiency independently associated with triglycerides and TC/HDL ratio in type 2 diabetes patients.⁸ Similarly, some studies reported the negative correlation of total cholesterol and positive correlation of HDL-cholesterol with vitamin B12⁹⁻¹⁰ which was supporting our findings. A study conducted in Pakistan by Memon et al., reported significant positive correlations between vitamin B12 deficiency and TG, TC, LDL-C and HDL-C.¹⁹ Similarly, a study by Khoharo et al. reported the high level of TC, HDL-C and LDL-C in vitamin B12 deficient patients.²⁰ A clinical trial study reported that short and long term consumption of Metformin causes 14% and 19% decrease in vitamin B12 level in patient with diabetes mellitus respectively.^{14, 21} S-adenosylmethionine is a universal donor of methyl group and play role in lipid metabolism. Methylmalonyl-CoA is accumulated in vitamin B12 deficiency which can inhibit carnitine palmitoyl transferase-1 and decreases fatty acid oxidation and increases lipogenesis.^{22,23} A study reported that vitamin B12 deficiency causes increase in expression of gene involved in cholesterol synthesis.⁸ Therefore, it is important to measure the serum level of Vitamin B12 and lipid profile in patients with diabetes mellitus. The supplement of vitamin B12 can help to prevent the risk of cardiovascular disease among the diabetes patients.

Conclusion

The present study showed the adverse association between vitamin B12 and serum total cholesterol, triglycerides and LDL-cholesterol and positive association with HDL-cholesterol in type 2 diabetes patients. The prevalence of vitamin B12 deficiency was higher in diabetes patients. Therefore, regular check up of vitamin B12 level and serum lipids was required to prevent risk of other disease in T2DM patients. Further, a large scale study is needed to confirm the prevalence of vitamin B12 deficiency in T2DM patients.

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