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A Study on the Relationship Between Vitamin B12 Levels and Lipid Profile in Serum of Type 2 Diabetic Patients with Dyslipidemia in Thi Qar Province, Iraq

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***Abstract*— This study aimed to investigate the relationship between serum vitamin B12 concentrations and lipid profiles in type 2 diabetic patients with dyslipidemia. We conducted this study in Thi Qar Province, Iraq, during the late summer and early fall of 2023. The investigation included 50 patients with confirmed type 2 diabetes and a comparison group of 50 healthy volunteers who helped establish baseline values. The findings were quite revealing that patients dealing with dyslipidemia showed much higher triglyceride, total cholesterol, LDL, and VLDL levels than our control group (P≤0.05). Conversely, HDL cholesterol levels were significantly reduced in this group (P≤0.05). we also noticed that Type 2 diabetics with dyslipidemia had considerably worse lipid profiles compared to those with normal lipid measurements. We found a relationship between vitamin B12 levels and abnormal lipid patterns in the dyslipidemia group. These findings suggest that monitoring vitamin B12 status should be considered as part of comprehensive lipid management strategies in type 2 diabetic patients. Our findings open doors to potential new treatment approaches, as B12 deficiency might be playing a significant role in lipid disorders among Type 2 diabetics - something that's often overlooked in current treatment protocols.**

***Keywords*— Atherogenic index, Diabetes, Lipid profile, Vitamin B12.**

I. INTRODUCTION

Type 2 diabetes has become one of medicine's biggest challenges today, affecting about 463 million people globally. The disease gets worse as insulin resistance builds up and insulin production drops, causing high blood sugar and complications beyond just heart disease risks (1). Among diabetics, messed-up fat metabolism is super common and really raises heart risks (2). Most patients showed a worrying pattern in their blood fats like high triglycerides, elevated LDL cholesterol levels combined with insufficient HDL cholesterol create a dangerous lipid profile that significantly increases cardiovascular risk (3). These metabolic disturbances require intensive clinical intervention. Healthcare providers must implement aggressive lipid management strategies to protect patients from cardiovascular complications.

Vitamin B12 has several key roles in metabolism, especially for processing fats. It helps convert homocysteine to methionine while supporting DNA production and protecting nerve cells (4). When B12 gets too low, various health issues can pop up, from megaloblastic anemia to nerve damage (5). In recent years, researchers have found connections between low B12 levels and higher risks for both type 2 diabetes and abnormal blood fats (6),(7).

A meta-analysis revealed that individuals with vitamin B12 deficiency demonstrated a 21% increased risk of developing diabetes (8). B12 deficiency also links to insulin resistance—a key diabetes precursor. Several studies have shown associations between low B12 status and concerning lipid parameters, especially high LDL and triglycerides, among diabetics (9) (10). But we still don't fully understand exactly how B12 deficiency contributes to diabetes and dyslipidemia. Some evidence suggested that high homocysteine levels, often resulting from B12 deficiency, might drive insulin resistance and vascular complications (11). Research examined the association between vitamin B12 levels and lipid profiles in diabetic populations has yielded inconsistent findings, with certain studies demonstrating notable correlations and others revealing weak or negligible relationships (12) (13).

Research consistently shows that patients with both diabetes and dyslipidemia typically have lower B12 levels than healthy people (14). Encouragingly, B12 supplements seem to improve both blood sugar control and lipid profiles in diabetic patients (15) (16).

This study aims to enhance research in Iraq and globally regarding diabetes and dyslipidemia, particularly in patients with type 2 diabetes. By investigating the relationship between vitamin B12 levels and lipid profiles, it can contribute with valuable insights to previous work.

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II. Materials and Methods

A. Study Design

We conducted this research across multiple locations in Thi-Qar Governorate, including Al-Hussein Teaching Hospital, Al-Nasiriyah General Hospital, and various specialized clinics. Medical specialists supervised all patient interactions and data gathering throughout the study. Our research included 100 total participants. We studied 50 people diagnosed with type 2 diabetes - 30 men and 20 women. We also included 50 healthy individuals as our control group, with the same gender breakdown of 30 men and 20 women.

Everyone who participated in our study was between 30 and 70 years old, giving us a wide and representative age range for our research.

B. Methods

Venous blood samples (approximately 5 ml) were obtained from both type 2 diabetic patients presenting with dyslipidemia and healthy control subjects participating in this study. Following collection, all samples were processed using standard centrifugation protocols to isolate serum for subsequent biochemical analysis.

Serum separation was achieved through centrifugation at 3000 rpm for 10 minutes, which effectively isolated the cellular and plasma components. The extracted serum samples were subsequently stored at -20°C until biochemical analysis to preserve sample stability and ensure accurate results.

B12 levels were determined using ELISA methods, which provided us with quantitative measurements of this vitamin. The lipid profiles were analyzed through spectrophotometry, measuring cholesterol, triglycerides, HDL, and LDL concentrations in participant serum. Such methodical processing guaranteed consistency across all samples and allowed for meaningful comparisons between our diabetic dyslipidemia group and healthy controls.

TABLE (1): DATA OF THE STUDIED GROUPS

Groups	NO.	Sex(Male/Female)	Age(years)
Controls	50	30/20	30-70
Diabetes mellitus	50	30/20	30-70
Total	100		

C. Statistical Analysis

Statistical analysis was performed using SPSS software version 20.0, with all data presented as mean ± standard deviation (mean ± SD). One-way ANOVA was employed to evaluate differences in parameters between study groups, and statistical significance was defined as $p < 0.05$.

III. Results

A. Lipid Profile

A serum total cholesterol level was evaluated for patients who were diagnosed with diabetes type 2 mellitus (T2DM) and who also experienced dyslipidemia. Individuals with dyslipidemia (316.15 ± 42.57 mg/dL) had considerably greater levels ($P \leqslant 0.05$) in comparison to the control group (129.51 ± 137.84 mg/dL). Individuals with T2DM and dyslipidemia (281.49 ± 29.11 mg/dL) had significantly higher blood triglyceride levels ($P \leqslant 0.05$) than the control group (108.21 ± 17.62 mg/dL).

Patients with dyslipidemia (22.63 ± 3.85 mg/dL) in T2DM showed a substantial ($P \leqslant 0.05$) decrease in HDL levels compared to the control group (41.07 ± 4.52 mg/dL). Patients with T2D and dyslipidemia had serum LDL values of 204.71 ± 28.62 mg/dL. By comparing the control group, which comprised individuals with LDL levels of 66.41 ± 7.94 mg/dL, these values were shown to be considerably higher ($P \leqslant 0.05$).

Patients with type 2 diabetes mellitus (T2DM) with dyslipidemia (57.13 ± 9.58 mg/dL) had significantly higher serum levels of VLDL ($P \leqslant 0.05$) than the control group (22.94 ± 4.36 mg/dL). A statistically significant ($P \leqslant 0.05$) increase in the levels of atherogenic index in the serum was observed among patients with type 2 diabetes mellitus (T2DM) who had dyslipidemia (9.05 ± 2.47 mg/dL). This rise was noticed in compared to the control group (1.58 ± 0.58 mg/dL) as shows Table (2).

TABLE (2): SERUM LİPİD PROFİLE OF CONTROLS AND PATİENTS GROUPS

Groups / Parameter	Control (50)	Patients (50)	P-Value
Total cholesterol mg/dL	129.51±13.84	316.15±42.57*	0.001
Triglyceride mg/dL	108.21±17.62	281.49±29.11*	0.001
HDL mg/dL	41.07±4.52	22.63±3.85*	0.001
LDL mg/dL	66.41±7.94	204.71±28.62*	0.001
VLDL mg/dL	22.94±4.36	57.13±9.58*	0.001
Atherogenic index	1.58±0.58	9.05±2.47*	0.001

B. Vitamin B12

Table(3) shows that patients with type 2 diabetes and dyslipidemia exhibited significantly reduced serum vitamin B12 concentrations (227.94±19.85 pmol/L) compared to healthy controls (519.48±36.15 pmol/L). This finding indicates a notable deficiency in vitamin B12 status among the diabetic cohort.

TABLE (3): SERUM VITAMIN B12 OF CONTROLS AND PATIENT'S GROUPS

Groups / Parameter	Control (50)	Patients (50)	P-Value
vitamin B12 (pmol/L)	519.48±36.15	227.94±19.85*	0.001

C. Correlation Between Vitamin B12 and Lipid Profile

T2DM patients with dyslipidemia

In persons with type 2 diabetes mellitus (T2DM) who have dyslipidemia, the current analysis found that there is an association between the levels of vitamin B12 and the lipid profiles (Table 4). According to the data, there is a negative correlation between vitamin B12 and all of the lipid profile measurements, with an- exception of HDL, which has a positive correlation with vitamin B12 (Figure 1,2,3,4,5 and 6).

TABLE (4) THE CORRELATİONS BETWEEN THE STUDY VARİABLES

Variables	R
Vitamin B12–total cholesterol	**-0.945**
Vitamin B12–triglyceride	**-0.9001**
Vitamin B12–HDL	**0.8962**
Vitamin B12–LDL	**-0.957**
Vitamin B12–VLDL	**-0.7942**
Vitamin B12–Atherogenic index	**-0.8829**

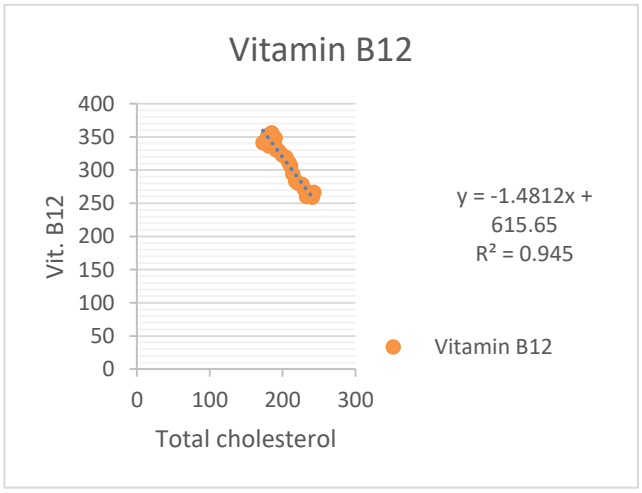
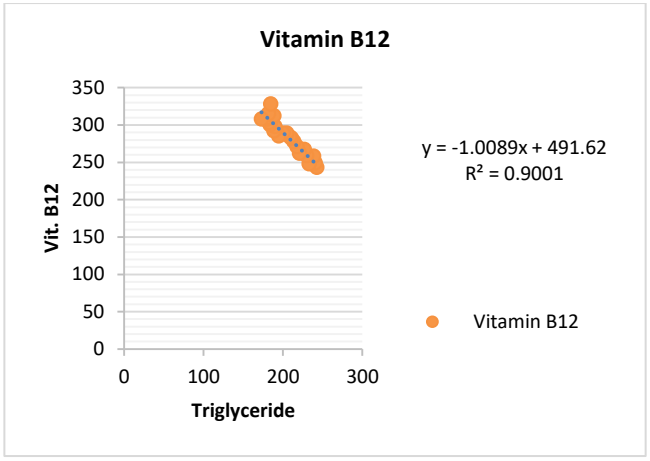


FİGURE (1):CORRELATİON BETWEEN VİTAMİN B12 AND TOTAL CHOLESTEROL İN T2DM PATİENTS WİTH DYSLİPİDEMİA



FİGURE(2):CORRELATİON BETWEEN VİTAMİN B12 AND TRİGLYCERİDE İN T2DM PATİENTS WİTH DYSLİPİDEMİA

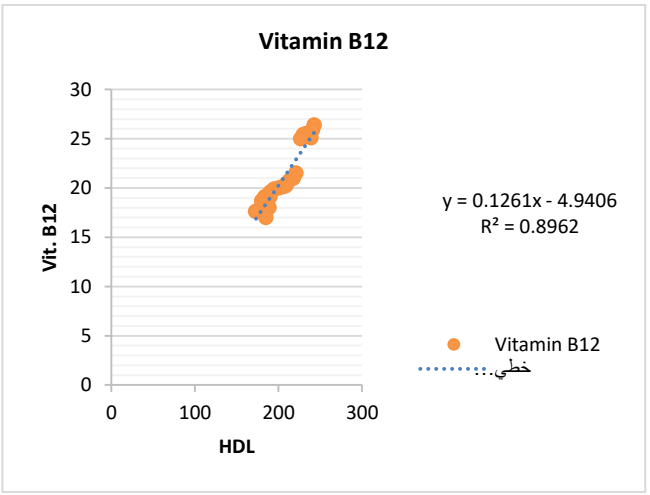


FİGURE (3):CORRELATİON BETWEEN VİTAMİN B12 AND HDL İN T2DM PATİENTS WİTH DYSLİPİDEMİA

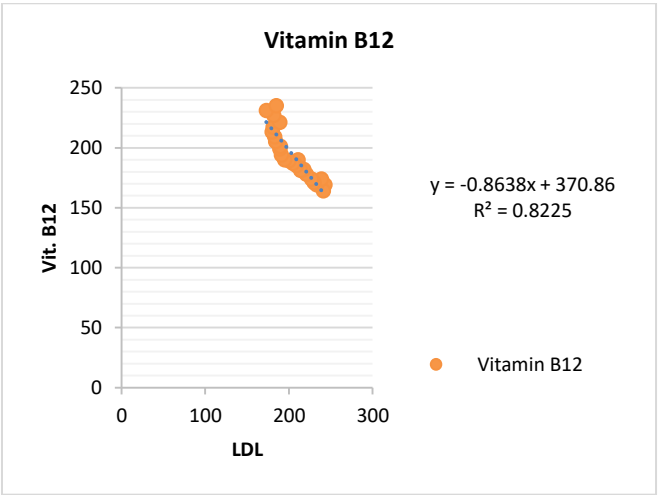


FİGURE (4):CORRELATİON BETWEEN VİTAMİN B12 AND LDL İN T2DM PATİENTS WİTH DYSLİPİDEMİA

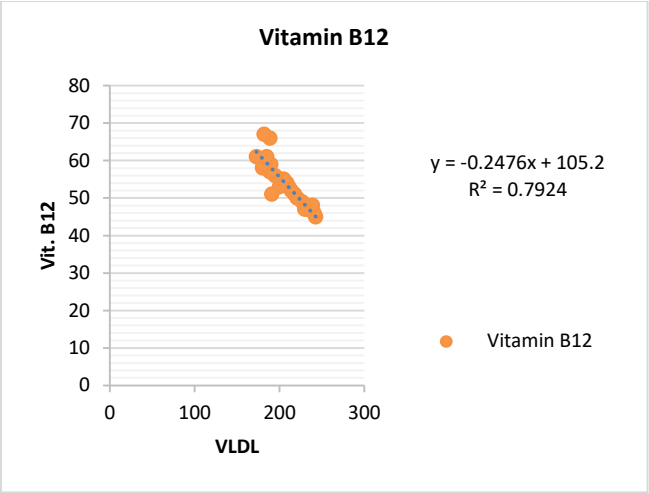
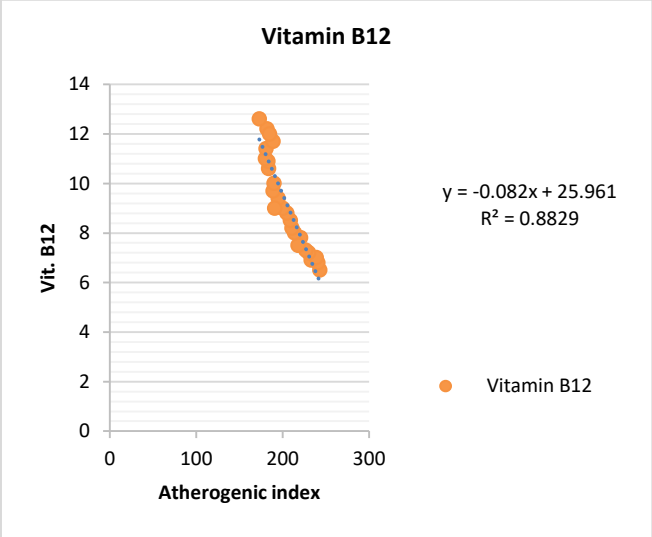


FİGURE (5):CORRELATİON BETWEEN VİTAMİN B12 AND VLDL İN T2DM PATİENTS WİTH DYSLİPİDEMİA



FİGURE(6):CORRELATİON BETWEEN VİTAMİN B12 AND ATHEROGENİC İNDEX İN T2DM PATİENTS WİTH SEVEREDYSLİPİDEMİA

IV. DISCUSSION

Type 2 diabetes mellitus in patients with dyslipidemia represents a multifaceted metabolic disorder where impaired insulin action and secretion coexist with abnormal lipid profiles, creating a bidirectional pathophysiological relationship that perpetuates vascular damage and metabolic dysfunction. This complex interplay involves insulin resistance promoting abnormal lipid metabolism while dyslipidemia further exacerbates pancreatic β-cell dysfunction and insulin resistance, creating a vicious cycle that accelerates both conditions and significantly increases cardiovascular risk beyond either condition alone (17).

Heart doctors call this combination of abnormal blood fats an "atherogenic profile" - basically a recipe for plaque buildup in arteries. The real-world impact is serious. People with diabetes face 2-4 times higher risk of heart problems compared to non-diabetics (18).

This complex disruption of blood fats reflects widespread metabolic problems caused by insulin resistance. Total cholesterol often inches higher as insulin resistance makes it harder for cells to absorb cholesterol and slows down how quickly the liver removes LDL, while simultaneously ramping up liver cholesterol production (19).The Metabolic dysfunction significantly impairs triglyceride metabolism, with triglyceride processing being disproportionately affected. High triglycerides are one of the earliest and most consistent warning signs in diabetic patients. They spike for two main reasons. First, the liver pumps out more VLDL particles as it receives more fatty acids. Second, the body struggles to clear triglycerides because insulin resistance hampers lipoprotein lipase activity (20). As triglycerides rise, protective HDL cholesterol typically drops through several connected processes. Research shows insulin resistance accelerates HDL breakdown through overactive liver enzymes, reduces HDL production by compromising cellular transport mechanisms, and enhances transfer proteins that lead to triglyceride-loaded and ultimately degraded HDL particles (21).While LDL levels might not spike dramatically in diabetic dyslipidemia, the LDL particles undergo dangerous changes. The insulin-resistant environment creates smaller, denser LDL particles that stay in circulation longer by evading normal removal pathways. These altered particles penetrate artery walls more easily, stick strongly to arterial tissues, and oxidize readily—making them much more dangerous despite potentially normal-looking LDL-C measurements (22).

Further examination of these pathophysiological mechanisms reveals additional complexity in the postprandial state, where hyperinsulinemia exacerbates chylomicron remnant clearance defects through downregulation of hepatic receptors. This diminished clearance capacity creates a proatherogenic environment as prolonged circulation of these remnant particles significantly contributes to atherosclerotic plaque formation independently of LDL pathways (23).

Researchers have found important links between low vitamin B12 and type 2 diabetes with abnormal blood fats. The relationship works both ways: metformin (the primary diabetes medication) interferes with B12 absorption in the gut, while abnormal fat metabolism disrupts how B12 moves through the bloodstream (24).

When B12 drops, homocysteine levels typically rise, creating a chain of problems. High homocysteine damages blood vessels and can worsen insulin resistance—essentially adding fuel to an already problematic metabolic situation (25). This suggests diabetic patients, especially those with lipid abnormalities, need regular B12 monitoring and appropriate supplements when necessary (26).

Recent studies highlight the important interplay between vitamin B12 and cholesterol regulation. (27) They discovered how B12 deficiency relates to problematic cholesterol elevations through disrupted methylation processes essential for proper lipid control. Building on this work, (28) revealed a fascinating two-way relationship where B12 deficiency affects lipids, and abnormal lipid profiles can interfere with how the body utilizes this crucial vitamin.

A. Correlation Vitamin B12 and Lipid Profile

The results demonstrated a notable positive correlation between elevated vitamin B12 concentrations and favorable

lipid profiles. Participants with adequate B12 status exhibited decreased triglyceride and LDL cholesterol levels, concurrent with elevated HDL cholesterol concentrations (28).

Further investigation into this association revealed that vitamin B12 influences lipid metabolism through homocysteine-mediated pathways that significantly impact hepatic fat processing. Additional research demonstrated that B12 supplementation activates peroxisome proliferator-activated receptors (PPARs), which regulate genes involved in lipid metabolism and transport, thereby enhancing fat oxidation while preventing hepatic lipid accumulation (29) (30).

An inverse relationship exists between B12 levels and most lipid parameters, as B12 deficiency impairs methylation processes and homocysteine metabolism. Insufficient B12 status results in elevated total cholesterol, triglycerides, LDL, and VLDL concentrations due to compromised fat processing capacity and increased lipogenesis. The consequent hyperhomocysteinemia induces oxidative stress and inflammation, exacerbating dyslipidemia and cardiovascular risk (31) (32).

Conversely, vitamin B12 demonstrates a positive correlation with HDL cholesterol through multiple pathways. B12 deficiency elevates methylmalonic acid (MMA) levels, generating oxidative stress that impairs HDL functionality (33). Additionally, vitamin B12 facilitates methionine synthesis, influencing phospholipid metabolism and HDL formation, while B12 deficiency disrupts PPAR-α expression, a key regulator of HDL metabolism (34)(35).

V. Conclusion

The present investigation revealed a statistically significant inverse correlation between serum Vitamin B12 concentrations and atherogenic lipid parameters (total cholesterol, LDL-C, triglycerides) in individuals with type 2 diabetes (T2D)-associated dyslipidemia. The progression of T2D exacerbates Vitamin B12 deficiency, potentially due to malabsorption and inadequate intake, worsening metabolic dysregulation and lipid homeostasis. Notably, hypovitaminosis B12 showed a dose-dependent association with elevated lipid fractions, suggesting its role in modulating dyslipidemia. Correcting Vitamin B12 deficiency through targeted interventions may help mitigate lipid abnormalities and cardiovascular risks. Therefore, surveillance of Vitamin B12 status, along with supplementation, should be integrated into management strategies for T2D patients with dyslipidemia.

Conflict of interest

Authors declare that they have no conflict of interest.

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