Article

Study of Vitamin B12 Status among Older Adult Iraqi Patients with Diabetic Retinopathy

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Abstract

Background: Diabetic retinopathy (DR), a typical consequence of diabetes mellitus (DM). is the main cause of vision loss in middle-aged and older adults. Unchecked and severe cases of DR could lead to blindness. DR is categorized into nonproliferative and proliferative variants based on the existence or absence of ocular neovascularization. The association between serum levels of vitamin B12 and various indicators, such as body mass index (BMI), fasting blood sugar (FBS), HOMA-β, fasting insulin (FI), HOMA-IR, and HbA1c, is studied in patients with DM and DR.

Method and Results: In this study, thirty healthy individuals and sixty patients were examined. Two subgroups were divided for the patients: thirty with DM and thirty with DR. For each group, serum levels of vitamin B12, FBS, FI, HOMA-β, HOMA-IR, and HbA1c have been investigated. Levels of vitamin B12 in serum demonstrated a significant decrease for each DM and DR with healthy subjects (391.57 ± 90.67 vs. 660.23 ± 168.01, P = 0.001) and (263.27 ± 79.15 vs. 660.23 ± 168.01, P = 0.001), respectively, and also demonstrated a significant decrease between DM and DR (391.57 ± 90.67 vs. 263.27 ± 79.15, P = 0.001). The correlation between vitamin B12 and other clinical indicators has been examined. Through these results, it is observed that vitamin B12 exhibited a significant negative association with age (r = -0.673) and a significant positive correlation with FI (r = 0.513), HOMA-β HOMA-IR (r = 0.333), and HOMA-IR (r = 0.268), while it revealed a non-significant negative correlation with BMI (r = -0.082), FBS (r = -0.108), and HbA1c (r = -0.172).

Conclusion: The results of this investigation showed that serum levels of vitamin B12 were significantly lower in individuals with DR than in the healthy subjects and those with DM.

Introduction

Diabetes mellitus (DM) is a long-term metabolic illness whose incidence has been steadily increasing globally [1]. According to this trend, it is quickly spreading to other parts of the world and is predicted to impact twice as many people over time as a result of an aging population. This will exacerbate the stress currently placed on healthcare providers, particularly in less developed nations [2, 3]. There are numerous subcategories of DM, these subcategories including type 1 (T1DM), type 2 (T2DM), newborn diabetes, maturity-onset diabetes of the young (MODY), gestational diabetes mellitus and steroid-induced diabetes [4, 5]. According to WHO, the most common type of diabetes among the types mentioned above is T2DM [6]. T2DM is defined by a complex process where the basic problem is a balance between beta cell production of insulin and the effect of insulin, leading to insulin resistance to insulin-stimulated blood glucose [7, 8]. Many complications for patients with DM may appeared. One of them is DR [9].

DR is a common microvascular complication that results from uncontrolled diabetes and can damage vision [10]. It weakens the light-sensitive inner coating of the fundus and has a significant effect on the retinal blood vessels [11]. Regular screening and early detection of this condition are necessary for efficient processing using artificial intelligence methods [12]. DR is closely associated with long time of T2DM, suddenly hyperglycemia and high blood pressure Although it is believed to be a microvascular condition, retinal neurodegeneration is also a factor [13, 14]. People who have had a history of poor glycemic control are significantly more likely to get it; The probability of having type 1 or type 2 diabetes increases with age [15]. DR may impact many biomarkers in the body, such as vitamin B12.

vitamin B12 is a crucial component in cellular metabolism; insufficient amounts can result in macrocytic anemia and neurological impairments [16]. Sufficient amounts of B12 are required for healthy blood production and brain function. Inadequate food consumption, particularly in vegans, may be the cause of deficiency, but more often than not, issues with

absorption—which is more complicated than those of other vitamins are to blame [17]. This study aims to investigate the level of serum B12 in patients with DM and DR.

Material and method

Through this investigation, a case-control study was conducted. The collection of specimens took place between November 2023 and April 2024. Cardiovascular disorders and kidney disorders associated with other inflammations are not included in this research. Ninety individuals in all (30 control and 60 cases). Two subgroups were created from the patient groups: 30 patients with diabetes mellitus and 30 patients with diabetic retinopathies. IBM SPSS 26.0 (Statistical Package for Social Sciences) has examined the data using statistical analysis. The distribution of serum concentrations of biomarkers, vitamin B12, insulin, serum glucose, HOMA-IR, and HOMA-β is normal. Based on the results, mean ± SD, one-way ANOVA (which compares biomarkers and accepts a significant level of $P<0.05$), and the Pearson correlation test (which finds the relationship between variables) are the descriptive statistical methods used in statistical analysis.

Results and Discussion

The present study has been carried out between patients with DM and DR and healthy subjects. The study involved the assessment of age and BMI, FBS, FI, HbA1c, HOMA-β, HOMA-IR, and vitamin B12 for patients and healthy participants. The comparison study of age for three groups, DM, DR, and healthy individuals, demonstrated a non-significant difference between the control group and DM and DM and DR, while there was a significant difference between the healthy subjects and DR. BMI revealed significant differences. According to the findings shown in Table 1, other parameters exhibited significant differences between the control group and both DM and DR except HOMA-β, and HOMA-IR demonstrated a non-significant difference between DM and DR.

The correlations between vitamin B12 and other biomarkers were examined in this work. Based on the data presented in Table 2, Vitamin B12 exhibited a significant positive association with FI (P = 0.001), HOMA-β (P = 0.009), and HOMA-IR (P = 0.038), and it exhibited a significant negative association with age (P = 0.001). Furthermore, vitamin B12 demonstrated a non-significant negative association with BMI (P = 0.533), FBS (P = 0.412), and HbA1c (P = 0.190), as illustrated in Figs 2.

Table 1. General characteristics for both the patients with DM and DR and the control group.

Parameters	Control (n=30) Mean ± SD	Diabetes Mellitus, DM (n=30) Mean ± SD	Retinopathy, DR (n=30) Mean ± SD	*P* – Value
Age (years)	56.40 ± 6.30	58.57 ± 7.59	60.73 ± 5.96	a= 0.211 b= 0.014 c= 0.211
BMI kg/m^2	23.91 ± 1.35	27.62 ± 3.41	25.82 ± 3.18	a= 0.001 b= 0.007 c= 0.023
FBS mg/dl	91.60 ± 4.48	196.47 ± 40.42	247.37 ± 83.05	a= 0.001 b= 0.001 c= 0.001
FI µIU/ml	3.22 ± 1.16	4.01 ± 1.28	2.34 ± 1.03	a= 0.012 b= 0.005 c= 0.001
HOMA-β	2.16 ± 0.93	0.51 ± 0.24	0.37 ± 0.13	a= 0.001 b= 0.001 c= 0.388
HOMA-IR	0.67 ± 0.27	1.47 ± 0.61	1.39 ± 0.69	a= 0.001 b= 0.001 c= 0.718
HbA1c mg/dl %	4.17 ± 0.48	8.37 ± 1.18	9.62 ± 1.22	a= 0.001 b= 0.001 c= 0.001
Vit-B12 ng/ml	660.23 ± 168.01	391.57 ± 90.67	263.27 ± 79.155	a= 0.001 b= 0.001 c= 0.001

Table 2. Correlation relationships between vit-B12 and clinical biomarkers in patients with diabetic nephropathy.

Parameter	r	P-value
Age	-0.673**	0.001
BMI	-0.082	0.533
FSG mg/dl	-0.108	0.412
FI µIU/ml	0.513**	0.001
HOMA-β	0.333**	0.009
HOMA-IR	0.268*	0.038
HbA1c mg/dl %	-0.172	0.190

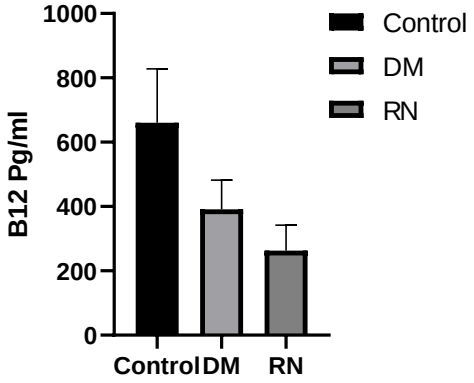
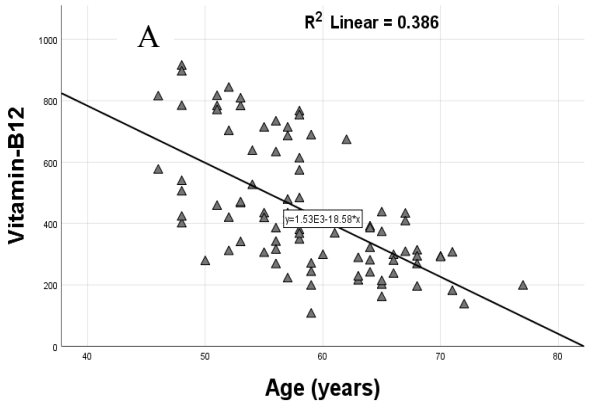
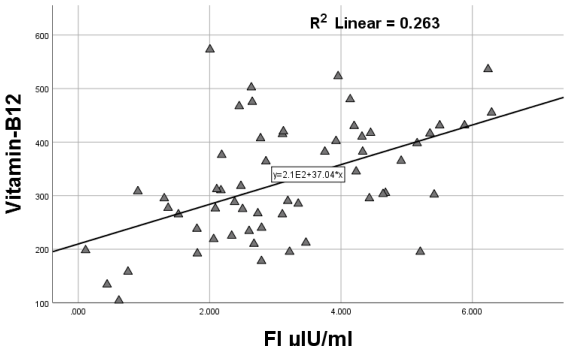
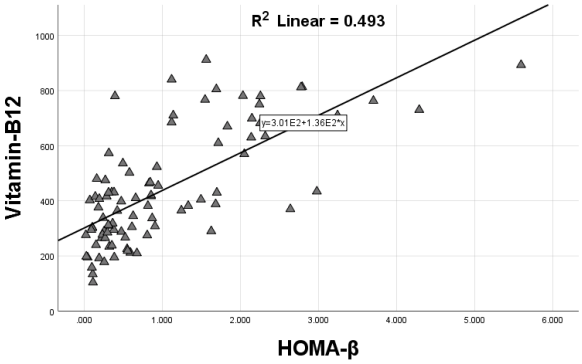


Figure 1. Comparison of vitamin B12 in patients with DM and DR.







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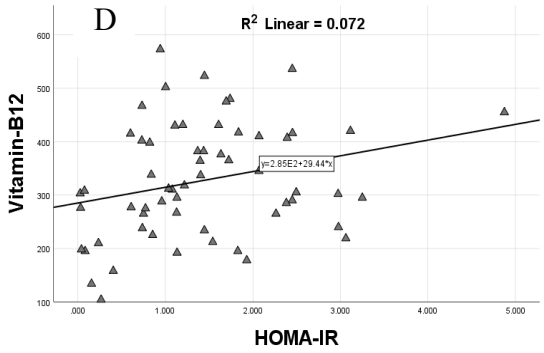

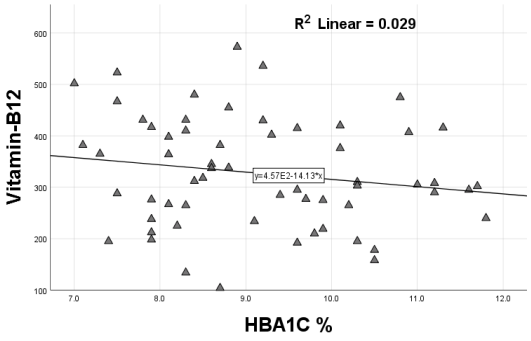

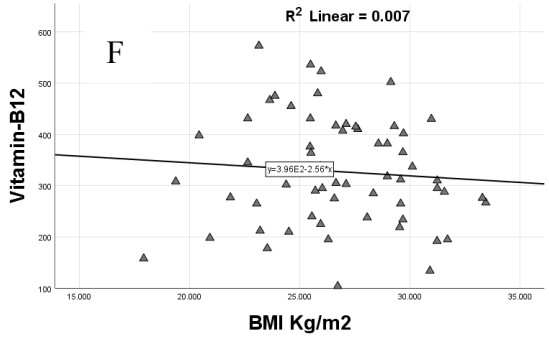

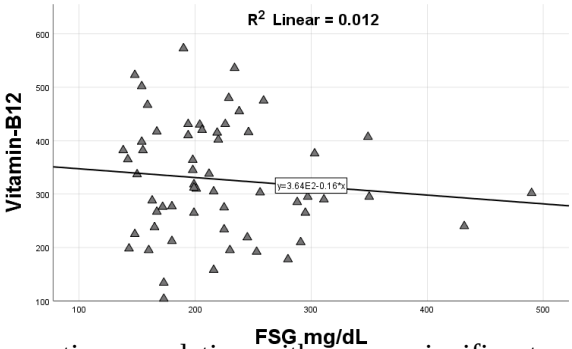

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Figure 2. Vitamin B12 demonstrated a significant negative correlation with age, a significant positive correlation with (B) FI, (C) HOMA-β, and (D) HOMA-IR, and a non-significant negative correlation with (E) HbA1c, (F) BMI, and (G) FBS.

In the DR group, the average age (60.73 ± 5.96 years) is remarkably higher than that of the healthy participates (56.40 ± 6.30 years). Given that the difference is statistically significant (*P*=0.014) between the control and DR groups, it is pointing to that age plays a role in the development of DR in individuals with diabetes. This is consistent with The Wisconsin Epidemiological Study, which discovered an association between retinopathy severity and advanced age [18]. The study's findings demonstrate that there are important differences between the groups in terms of both fasting insulin (FI) levels and HOMA-β values. Specifically, the DR group had lower FI levels (2.34 ± 1.03 µIU/ml) than the control group (3.22 ± 1.16 µIU/ml) and the DM group (4.01 ± 1.28 µIU/ml). Additionally, both the DM and the DR groups had significantly lower HOMA-β values, which indicates impaired β-cell function. Furthermore, compared to the control group (0.67 ± 0.27), both the DM and DR groups have higher (HOMA-IR) values (1.47 ± 0.61 and 1.39 ± 0.69, respectively). This suggests that diabetes patients have higher levels of insulin resistance. These results highlight the metabolic abnormalities associated with diabetes and how these problems worsen when retinopathy is present [19, 20].

In our investigation, we found that patients with DR had far lower serum vitamin B12 levels than both the control group and the DM patients without retinopathy. In particular, the control group had mean vitamin B12 levels of 660.23 ± 168.01 ng/ml, the DM group had mean levels of 391.57 ± 90.67 ng/ml, and the DR group had mean levels of 263.23 ± 79.155 ng/ml as illustrated in fig 1. All comparisons revealed extremely significant differences (P = 0.001). Additionally, Ang's meta-analysis revealed a pattern of consistently lower serum vitamin B12 levels in DR patients across several investigations. The meta-analysis found a strong correlation between patients with type 2 diabetes and low vitamin B12 levels, which lends credence to the theory that vitamin B12 deficiency may play a role in the pathophysiology of DR [21]. Also, Singla R et al. looked at the relationship between vitamin B12 status and diabetic sequelae, such as retinopathy, in Indian patients with type 2 diabetes. The vitamin B12 levels of patients with DR were found to be considerably lower than those of the healthy participates and patients without DR. The study's findings indicated that vitamin B12 insufficiency is common among diabetic individuals who have retinopathy, and it recommended routine testing and treatment as a prophylactic approach [22]. Furthermore, the SIRSIKAR MN investigation revealed that the

T2DM group with DR had noticeably lower serum vitamin B12 levels than the control group [23]. The results of the current investigation, Yang's meta-analysis, and other published studies indicate that vitamin B12 insufficiency is a serious risk factor for diabetic patients, particularly those with DR. Numerous investigations have consistently shown that vitamin B12 may have a role in the etiology and development of DR [24-26].

In patients with diabetic nephropathy, the study examines the relationship between vitamin B12 levels and other clinical indicators. It finds a significant negative connection between age and vitamin B12 levels (r = -0.673, P = 0.001), suggesting a reduction in vitamin B12 levels with aging. Furthermore, a markedly positive association (r = 0.513, P = 0.001) was discovered between vitamin B12 levels and fasting insulin (FI), HOMA-β (r = 0.333, P = 0.009), and HOMA-IR (r = 0.268, P = 0.038). These results imply that increased vitamin B12 levels are linked to enhanced β-cell function and insulin sensitivity. Nevertheless, no statistically significant associations were found between vitamin B12 and BMI, FBS, or HbA1c, suggesting that vitamin B12 levels do not have a direct influence on these parameters in individuals with diabetic nephropathy. These results are consistent with previous research that documents the decrease in vitamin B12 levels.

Conclusion

According to the study, vitamin B12 levels are considerably lower in older adults with DR than in those without DR. This deficiency may make DR worse and progress more quickly. According to the results, vitamin B12 levels in diabetic patients, especially those with DR, should be regularly checked. Supplementation should also be taken into consideration as part of diabetes therapy.

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