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An Analysis of Vitamin B12 Levels in Patients Admitted to the Internal Medicine Ward Over the Past Five Years and Their Relationship with Admission Diagnoses

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ABSTRACT

Introduction: Vitamin B12 is an essential micronutrient involved in various metabolic processes, including DNA synthesis and neurological function. B12 deficiency can lead to significant hematological and neurological disorders. This study aimed to evaluate changes in serum vitamin B12 levels in patients admitted to the internal medicine department over the past 5 years and examine their relationship with admission diagnosis.

Methods: This retrospective study included 500 patients hospitalized in the Internal Medicine Department at University of Health Sciences Turkey, İstanbul Training and Research Hospital between January 2020 and 2024. Patient data were obtained from the hospital information system and categorized according to demographic variables, reason for hospitalization, chronic diseases, vitamin B12 supplementation, metformin use, and serum vitamin B12 levels.

Results: The study cohort comprised 500 patients with a mean age of 63.1 years. No significant differences in B12 levels were found between different age groups or genders, nor across the years studied. However, patients hospitalized for pancreatitis and those using metformin had significantly lower B12 levels ($p<0.05$), whereas patients in palliative care or those with malignancies had significantly higher levels ($p<0.05$). The use of vitamin B12 supplements was correlated with significantly higher serum B12 levels ($p<0.05$).

Conclusion: The serum vitamin B12 levels of patients admitted to the internal medicine department remained stable over the past 5 years. However, certain subgroups, such as patients with pancreatitis, malignancies, and metformin use, exhibited significant variations in B12 levels. Regular monitoring of B12 levels in high-risk groups, such as patients with diabetes receiving metformin, is recommended to prevent deficiency-related complications. Elevated B12 levels in patients with cancer should prompt further investigation into the underlying malignancies.

Keywords: Vitamin B12, vitamin B12 deficiency, hematopeosis, pancytopenia, myelin, malignancy

Introduction

Vitamin B12, also known as cobalamin, is an essential micronutrient that must be obtained from animal-derived proteins because it cannot be synthesized or stored in the human body (1). Dietary sources of vitamin B12 include meat, fish, eggs, and dairy products (2).

Vitamin B12 involves many complex physiological pathways. It is essential for hematopoiesis and plays a key role in the production of leukocytes, erythrocytes, and platelets in bone marrow. Vitamin B12 deficiency impairs purine and thymidylate synthesis, disrupts DNA synthesis, and induces erythroblast apoptosis, leading to ineffective erythropoiesis and anemia (3). Therefore, vitamin B12 deficiency should be considered in the differential diagnosis of pancytopenia.

Vitamin B12 is vital for the health of the nervous system, particularly in maintaining myelin synthesis by oligodendrocytes and supporting both central and peripheral nervous system function (4). Vitamin B12 deficiency is associated with a range of neuropsychiatric disorders, from confusion to coma (5). Furthermore, studies indicate that vitamin B12 deficiency can impair the parasympathetic and sympathetic nervous systems (6). Although autonomic dysfunction associated with B12 deficiency is often clinically mild, it is associated with a significant risk of severe cardiac arrhythmia, contributing to increased morbidity and

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mortality. Additionally, sympathetic dysfunction can result in orthostatic hypotension, increasing the risk of falls and subsequent fractures in elderly patients (7). Reduced mobility and social isolation after such events can also lead to depression in this patient group (8).

Vitamin B12 deficiency is common across different populations, with those at greatest risk included the elderly, pregnant women, and individuals with renal or gastrointestinal diseases. Furthermore, vegetarian and plant-based diets have gained popularity across all age groups. As a result, long-term B12 deficiency has been increasingly observed, particularly among individuals adhering to vegetarian diets, leading to various hematological and neurological disorders (9). Neurological manifestations of vitamin B12 deficiency are often non-specific and may become irreversible if not promptly diagnosed. Therefore, an early identification using sensitive and specific markers is crucial (10).

In this study, we aimed to investigate the changes in serum vitamin B12 levels in patients admitted to the internal medicine department over the past 5 years and examine the relationship with admission diagnosis.

Methods

Ethics committee approval was received from the Ethics Committee of University of Health Sciences Turkey, İstanbul Training and Research Hospital (approval number: 14, date: 05.07.2024). All procedures performed in the study were in accordance with the 1964 Helsinki Declaration.

This retrospective study included patients hospitalized in the Internal Medicine Department of University of Health Sciences Turkey, İstanbul Training and Research Hospital during the month of January over the past 5 years. The inclusion criterion for this study was admission to the internal medicine ward within a specified timeframe. No exclusion criteria were applied. For each year, 100 patients were randomly selected for inclusion, resulting in a total of 500 patients. Patient data were retrieved from the hospital information system and categorized according to age, gender, reason for hospitalization, presence of chronic diseases, serum vitamin B12 levels, use of metformin, and administration of vitamin B12 supplementation. The variables were systematically recorded for analysis.

Statistical Analysis

Descriptive statistics were presented as mean, standard deviation, median, minimum, maximum, frequency, and percentage. The distribution of variables was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. For the analysis of quantitative independent data with a non-normal distribution, the Kruskal-Wallis test and Mann-Whitney U test were employed. Statistical analyses were performed using SPSS version 27.0.

Results

A total of 500 patients were included in the study, with 100 patients admitted to the internal medicine ward from January 2020 to 2024. The mean age of the patients was 63.1±17.7 years, with 53.4% being male and 46.6% female (Table 1).

The reasons for hospitalization, chronic conditions, and the percentage of patients receiving metformin are presented in Table 1.

The mean serum vitamin B12 level across the cohort was 440.5±383.4 pg/mL. A total of 24.8% of the patients (124 patients) were using vitamin B12 supplements, whereas 75.2% (376 patients) were not (Table 1).

No significant differences in B12 levels were observed between the 18-44, 45-54, 55-64, 65-74, and 75-101 ($p>0.05$), nor between male and female patients ($p>0.05$). B12 levels remained consistent across the years 2020, 2021, 2022, 2023, and 2024 ($p>0.05$) (Table 2).

B12 levels were lower in patients hospitalized for pancreatitis than in those not hospitalized for pancreatitis ($p<0.05$). Additionally, B12 levels were higher in the group hospitalized for palliative care than in those not receiving palliative care ($p<0.05$) (Table 2).

Among patients with diabetes, B12 levels were lower than in non-diabetic patients ($p<0.05$), whereas B12 levels were higher in patients with malignancy than in those without malignancy ($p<0.05$) (Table 3). Patients using metformin had lower B12 levels than those not using metformin ($p<0.05$), and patients taking vitamin B12 supplements had significantly higher B12 levels than those not using supplements ($p<0.05$) (Table 3).

No significant differences in B12 levels were found between patients with and without gastrointestinal bleeding, infection, acute renal failure, decompensated heart failure, diabetic ketoacidosis, hypertension, ischemic heart disease, chronic kidney disease, cerebrovascular disease-dementia, liver disease, or other diseases (all, $p>0.05$) (Tables 2, 3).

Discussion

Vitamin B12 deficiency has been extensively linked to a wide range of systemic diseases, particularly neurological and hematological disorders. In the field of neurology, deficiencies in B12 are primarily associated with conditions such as Alzheimer's disease, ischemic stroke, and peripheral neuropathies (11-13). Hematologically, it is strongly associated with isolated thrombocytopenia, megaloblastic anemia, pancytopenia, and pernicious anemia (14-17). Beyond these well-known associations, B12 deficiency has been implicated in disorders affecting various systems. For instance, studies have suggested a relationship between B12 deficiency and sarcopenia in older adults (18), excessive daytime sleepiness (19), and olfactory disorders (20). Furthermore, patients with autoimmune thyroid diseases have been found to have lower serum B12 levels than the general population (21). Additionally, Tamura et al. (22) highlighted the role of vitamin B12 in cellular immunity, suggesting that it acts as an immunomodulator.

In our study, we observed significantly lower serum B12 levels in patients hospitalized for pancreatitis compared with those hospitalized for other reasons. Pancreatitis, particularly non-biliary pancreatitis, is a common cause of emergency admissions to internal medicine departments. Diagnosing pancreatitis requires meeting two of the following three criteria: elevated pancreatic enzyme levels, characteristic abdominal pain, and supportive imaging findings (23). Although our study identified an association between lower B12 levels and pancreatitis, Glasbrenner et al. (24) reported no such link in their study of 137 patients with

chronic pancreatitis, suggesting that B12 deficiency is a rare finding in this patient population. However, Girish et al. (25) found that serum B12 levels were significantly lower in patients with chronic pancreatitis, supporting our findings. Although further research is needed to establish whether pancreatitis, particularly the chronic form, is a risk factor for B12 malabsorption, it is clear that healthy gastrointestinal tract and functional pancreatic enzymes are essential for B12 absorption.

Another significant finding of our study was the higher B12 levels observed in patients receiving palliative care. These patients, many of whom have malignancies, are typically hospitalized for short periods for symptom management, including pain management, correction of serum electrolyte imbalances, and blood sugar regulation. Elevated B12 levels in patients with cancer have been well documented, particularly in relation to lung, pancreatic, and liver cancers and hematological malignancies, such as myeloproliferative disorders (26). For instance, Fanidi et al. (27) supported the hypothesis that high serum B12 levels are associated with lung cancer. Similarly, Cinemre et al. (28) found that patients with myeloproliferative disease exhibited falsely elevated serum B12 levels. These findings indicate that high serum B12 levels in patients not receiving B12 supplementation should prompt consideration of an

Table 1. Demographic characteristics of the patients, distribution by years, comorbidities, serum B12 levels, metformin and B12 supplementation status

		Min-.max.	Median	Mean ± SD, (n %)
Age (years)		18.0-101.0	65.0	63.1±17.7
Age distrubition	18-44			84 (16.8%)
	45-54			67 (13.4%)
	55-64			90 (18.0%)
	65-74			111 (22.2%)
	75-101			148 (29.6%)
Gender	Male			267 (53.4%)
	Female			233 (46.6%)
Years	2020			100 (20.0%)
	2021			100 (20.0%)
	2022			100 (20.0%)
	2023			100 (20.0%)
	2024			100 (20.0%)
Reason for hospitalization				
Pancreatitis				22 (4.4%)
GIS bleeding				68 (13.6%)
Infection				176 (35.2%)
AKI				138 (27.6%)
Palliative				41 (8.2%)
DHF				29 (5.8%)
DKA				26 (5.2%)
Chronic diseases				
DM				93 (18.6%)
HT				51 (10.2%)
IHD				61 (12.2%)
CKD				68 (13.6%)
Malignancy				128 (25.6%)
CVE-dementia				27 (5.4%)
Hepatic diseases				21 (4.2%)
Others				1 (0.2%)
Metformin	(-)			426 (85.2%)
	(+)			74 (14.8%)
B12 level (pg/mL)		30.0-2000.0	310.0	440.5±383.4
B12 supplimentation	(-)			376 (75.2%)
	(+)			124 (24.8%)

GIS: Gastrointestinal system, AKI: Acute kidney injury, IHD: Ischemic heart disease, DHF: Decompensated heart failure, DKA: Diabetic ketoacidosis, DM: Diabetes mellitus, HT: Hypertension, CKD: Chronic kidney disease, CVE: Cerebrovascular event, Min.: Minimum, max.: Maximum, SD: Standard deviation

Table 2. Serum B12 levels according to patient demographics and reason for hospitalization

		B12 levels			p
		Min.-max.	Median	Mean ± SD	
Age disrubition	18-44	68.0-1760.0	304.0	388.6±276.0	0.731[K]
	45-54	64.0-2000.0	277.0	397.9±370.0	
	55-64	102.0-2000.0	306.5	416.0±348.2	
	65-74	30.0-2000.0	272.0	430.8±404.6	
	75-101	55.0-2000.0	358.5	511.4±436.7	
Gender	Male	30.0-2000.0	307.0	424.1±365.0	0.731[m]
	Female	55.0-2000.0	315.0	459.2±403.4	
Years	2020	30.0-1856.0	260.5	390.1±353.8	0.098[K]
	2021	68.0-2000.0	326.5	485.0±416.6	
	2022	96.0-2000.0	316.5	480.3±443.2	
	2023	102.0-1984.0	331.5	403.7±282.5	
	2024	55.0-2000.0	313.0	443.5±397.8	
Pancreatitis	(-)	30.0-2000.0	311.5	447.7±388.6	**0.010[m]**
	(+)	86.0-842.0	209.0	283.0±186.4	
GIS bleeding	(-)	30.0-2000.0	316.5	455.4±400.2	0.072[m]
	(+)	68.0-1315.0	267.5	345.9±231.7	
Infection	(-)	55.0-2000.0	319.0	419.7±338.9	0.798[m]
	(+)	30.0-2000.0	302.5	478.8±452.6	
AKI	(-)	30.0-2000.0	306.5	441.0±375.7	0.699[m]
	(+)	64.0-2000.0	319.0	439.0±404.2	
Palliative	(-)	30.0-2000.0	304.0	437.8±391.9	**0.033[m]**
	(+)	117.0-1525.0	444.0	470.7±271.0	
DHF	(-)	30.0-2000.0	304.0	435.7±383.1	0.051[m]
	(+)	55.0-1614.0	370.0	518.5±385.9	
DKA	(-)	30.0-2000.0	310.0	440.8±388.2	0.486[m]
	(+)	102.0-1247.0	316.0	434.9±286.5	

[K]Kruskal-Wallis (Mann-Whitney U test), GIS: Gastrointestinal system, AKI: Acute kidney injury, DHF: Decompensated heart failure, DKA: Diabetic ketoacidosis, Min.: Minimum, max.: Maximum, SD: Standard deviation

underlying malignancy. Additionally, patients with cancer often take vitamin supplements, which could further contribute to elevated B12 levels. Our study is consistent with the existing literature on this topic.

Consistent with the literature, our study found significantly lower serum B12 levels in patients with diabetes and those using metformin (29-31). This finding reinforces the need for regular monitoring of B12 levels in patients with diabetes, particularly those on metformin therapy, due to the well-established association between metformin use and B12 deficiency.

Conversely, we did not observe lower B12 levels in patients with chronic renal failure compared with those with other conditions. In contrast, Mushtaq et al. (32) found that patients undergoing chronic hemodialysis had significantly lower B12 levels, with the deficiency becoming more pronounced over time. We attribute the difference in our findings to the fact that many of the patients with CKD in our study did not undergo hemodialysis.

Moreover, in the aftermath of the COVID-19 pandemic, there has been a noticeable increase in the use of multivitamin supplements, as individuals seek to boost their immune systems and prevent deficiencies, sometimes without medical supervision. We hypothesized that the unsupervised use of vitamin B12 supplements during the COVID-19 pandemic may have resulted in increased supplementation post-pandemic because vitamin supplementation might be viewed as essential for supporting human health and the immune system. However, our findings did not support our hypothesis. The B12 levels of patients hospitalized in the internal medicine ward did not significantly differ over time.

Lastly, the growing influence of social media and the promotion of over-the-counter products by influencers may have long-term implications for public health. These promotions, which are often driven by economic interests, could influence vitamin intake and potentially alter population health outcomes. The full impact of these practices on vitamin levels in the general population is yet to be determined.

Study Limitations

The number of patients in this study is limited. A longer duration of vitamin B12 level evaluation with a higher number of participants could have provided more comprehensive results.

Table 3. Serum B12 levels according to comorbidities, serum B12 levels with metformin use and B12 supplementation

		B12 levels			p
		Min.-max.	Median	Mean ± SD	
DM	(-)	30.0-2000.0	333.0	463.9±391.6	**0.000[m]**
	(+)	62.0-2000.0	216.0	338.1±327.7	
HT	(-)	30.0-2000.0	304.0	444.0±397.9	0.157[m]
	(+)	134.0-1234.0	355.0	409.6±217.7	
IHD	(-)	30.0-2000.0	310.0	437.6±383.3	0.313[m]
	(+)	55.0-2000.0	321.0	461.5±386.0	
CKD	(-)	30.0-2000.0	307.0	435.1±366.4	0.889[m]
	(+)	108.0-2000.0	319.0	474.7±479.1	
Malignancy	(-)	55.0-2000.0	301.0	424.6±376.4	**0.024[m]**
	(+)	30.0-2000.0	347.5	486.7±400.8	
CVE-dementia	(-)	30.0-2000.0	306.0	435.1±380.6	0.066[m]
	(+)	62.0-2000.0	432.0	535.4±426.0	
Hepatic diseases	(-)	30.0-2000.0	310.0	434.9±373.0	0.837[m]
	(+)	108.0-1988.0	302.0	567.0±569.0	
Others	(-)	30.0-2000.0	310.0	440.9±383.7	0.690[m]
	(+)	257.0-257.0	257.0	257.0±	
Metformin	(-)	30.0-2000.0	334.0	467.7±392.6	**0.000[m]**
	(+)	62.0-1615.0	202.0	284.1±279.4	
B12 supplimentation	(-)	30.0-2000.0	256.0	304.3±236.3	**0.000[m]**
	(+)	209.0-2000.0	687.5	853.5±444.1	

[m]Mann-Whitney U test, DM: Diabetes mellitus, HT: Hypertension, IHD: Ischemic heart disease, CKD: Chronic kidney disease, CVE: Cerebrovascular event, Min.: Minimum, max.: Maximum, SD: Standard deviation

Conclusion

Vitamin B12 deficiency is a prevalent clinical condition affecting patients of all ages. Despite its relatively simple diagnosis, B12 deficiency is often overlooked in clinical practice. B12 deficiency can lead to complex, multisystemic disorders, particularly affecting neurological and hematological systems. With improved access to healthcare, diagnosing B12 deficiency may become more straightforward.

Our study found that serum vitamin B12 levels in patients hospitalized in the internal medicine department remained consistent over time. However, patients hospitalized for pancreatitis, malignancies, or palliative care exhibited significantly different B12 levels compared with the other patient groups.

It is important to remember that elevated serum vitamin B12 levels may warrant screening for underlying diseases, whereas low levels can contribute to various multisystemic conditions. Early detection and management of B12 deficiency are essential to prevent its associated complications.

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Informed Consent: Retrospective study.

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