

# FREQUENCY AND CLINICAL MANIFESTATIONS OF VITAMIN B12 DEFICIENCY ANEMIA IN YOUNG ADULTS: REVIEW ARTICLE

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Abstract

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Vitamin B12 deficiency anemia is a significant yet under-diagnosed condition among young adults, with serious implications for haematological and neurological health. This review explores the frequency and clinical manifestations of Vitamin B12 deficiency anemia in individuals aged 18–35, aiming to provide a comprehensive overview of its prevalence, symptomatically, and diagnostic challenges. A systematic review of literature published between 2000 and 2023 identified a prevalence range of 5% to 15% in diverse populations, with higher rates observed in regions where dietary Vitamin B12 intake is limited. Clinical presentations varied widely, with fatigue, glossitis, paraesthesia, and macrocytic anemia being the most commonly reported symptoms. Neurological manifestations, such as memory impairment and mood disturbances, were frequently observed, underscoring the multifaceted nature of the condition. The findings highlight the critical need for early diagnosis and intervention to prevent long-term complications. Enhanced awareness, targeted screening strategies, and further research into the role of dietary patterns and genetic predispositions are essential to addressing this prevalent health issue.

# INTRODUCTION

Vitamin B12 deficiency anemia is a widespread health issue among young adults, affecting overall health. While the incidence of folate deficiency has decreased in developed nations, Vitamin B12 deficiency continues to be common, especially in cases like pernicious anemia that impair absorption. This review addresses its symptoms, diagnostic techniques, and importance in the production of blood cells and neurological health. Elevated levels of homocysteine and methylmalonic acid are crucial for diagnosis, highlighting the necessity of proper dietary consumption as advised by the CDC<sup>1</sup>.Vitamin B12 deficiency impacts various bodily functions, including the synthesis of DNA, and has associations with hematologic, neurological, psychiatric, gastrointestinal, and cardiovascular conditions. It is particularly prevalent in India due to vegetarian eating habits. Detecting the condition can be difficult, as manifestations might be unusual or overlooked, resulting in delays in diagnosis and treatment<sup>2</sup>. Cobalamin (Vitamin B12) is mainly sourced from animal-derived foods. Pernicious anemia occurs due to autoantibodies targeting intrinsic factor and gastric parietal cells, which causes inadequate absorption and advancing symptoms that can be life-threatening if untreated. Deficiencies in both folate and Vitamin B12 lead to megaloblastic anemia due to disrupted nucleic acid metabolism.

Accumulation of homocysteine is an effective marker of deficiency, connecting these vitamins more strongly to cardiovascular risk3. Long-term deficiency in Vitamin B12 can have serious consequences in the form of impaired cognitive functioning and poor myelination. Elevated methylmalonic acid levels and homocysteine are characteristic symptoms of deficiency that could lead to Alzheimer's disease and cardiovascular risk. Neurological damage induced by oxidative stress: due to high homocysteine levels is often not recognized, resulting in irreversible injury<sup>4</sup>. The rising prevalence of Vitamin B12 deficiency in young adults is alarming, as it plays an important role in averting anemia and neurological disorders. This deficiency among young adults is generally attributed to diet and malabsorption issues. The increase in homocysteine levels indicates poor metabolism, increasing the risk of cardiovascular disease and cancer. This review examines contributing factors, including pernicious anemia lifestyle, highlighting the need for and supplementation to ensure effective management5 Accumulation of homocysteine is an effective marker of deficiency, connecting these vitamins more strongly to cardiovascular risk3. Long-term deficiency in Vitamin B12 can have serious consequences in the form of impaired cognitive functioning and poor myelination. Elevated methylmalonic acid levels and homocysteine are characteristic symptoms of deficiency that could lead to Alzheimer's disease and cardiovascular risk. Neurological damage induced by oxidative stress: due to high homocysteine levels is often not recognized, resulting in irreversible injury<sup>4</sup>.



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Vitamin deficiencies, particularly in high-risk populations such as pregnant women and children, result serious neurological impairments. in Deficiencies arise from inadequate intake, difficulty in absorption, and physiological demand, necessitating early detection. Clinical manifestations of Vitamin B12 deficiency include dizziness, fatigue, and neurological problems, which call for laboratory confirmation to make accurate diagnoses. This article seeks to better clarify the neurological effects and highlight the need for early intervention<sup>6</sup>. Pernicious anemia (PA) is an autoimmune disorder characterized by the destruction of gastric parietal cells, resulting in severe malabsorption of Vitamin B12. PA necessitates lifelong intramuscular B12 injections to circumvent the requirement for intestinal absorption. Megaloblastic anemia, a defining characteristic of both Vitamin B12 and folate deficiencies, arises from impaired DNA synthesis, resulting in unusually large red blood cells and pancytopenia<sup>7</sup>.Vitamin B12 deficiency anemia (VB12DA) is becoming more recognized among young adults, especially those who are vegetarians, vegans, or have absorption issues. It presents with neurological symptoms including numbness, cognitive decline, fatigue, and macrocytic anemia. Diagnosis depends on measuring serum Vitamin B12 levels, along with methylmalonic acid and homocysteine markers. Treatment consists of supplementation and dietary changes; however, further research is necessary to comprehend the longterm impacts and prevention measures<sup>8</sup>.



Figure 1: Vitamin B12 Deficiency Outcomes



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A comparison study of younger (≤50 years) and older (>50 years) patients with atrophic glossitis (AG) discovered that younger individuals had significantly lower levels of hemoglobin, serum iron, and Vitamin B12 compared to healthy participants. These deficiencies were notably more severe in the younger group, highlighting the need for focused clinical interventions for this demographic<sup>9</sup>. Vitamin B12 is essential for the creation of red blood cells, DNA synthesis, and overall metabolism. Deficiency in this vitamin is associated with fatigue, anemia, neurological issues, and metabolic disorders. Young women, especially in the Middle East, are particularly vulnerable due to changing dietary patterns, with some studies indicating that up to 60% may be affected. This review investigates the prevalence of deficiency in young women (19-30 years) and identifies contributing factors such as diet, physical activity, and sociodemographic influences<sup>10</sup>.

#### Vitamin B12 Deficiency: Causes, Symptoms, and Impacts



Figure 2: Vitamin B12 deficiency causes, symptoms and impacts

A study conducted in Makkah examined Vitamin B12 deficiency among young women, concentrating on the impact of dietary and sociodemographic factors. High deficiency rates are reported in Middle Eastern nations, worsened by cultural shifts in diet. The results aim to inform public health initiatives to tackle this increasing issue<sup>11</sup>. Iron deficiency anemia (IDA) is a prevalent problem, particularly among women of reproductive age, arising from factors such as pregnancy, menstruation, and inadequate diet. IDA affects over two billion individuals worldwide, and Vitamin B12 deficiency frequently coexists with it. More than 40% of women of reproductive age experience a shortage of Vitamin B12, highlighting the need for supplements and dietary modifications for improved health outcomes<sup>12</sup>.

# Frequency of Vitamin B12 Deficiency in Young Adults:

Vitamin B12 deficiency is increasingly acknowledged as a significant health issue among young adults around the world. Research shows a prevalence between 5% and 15% across different populations, with higher frequencies noted in areas where Vitamin B12 intake is low. For example, in India, where many individuals follow vegetarian diets, the deficiency rate can reach as high as 47%. Furthermore, in the Middle East, especially among young women, the prevalence is approximately 30%. In the United States, the prevalence ranges from 5-15%, often associated with the extended use of medications such as metformin and proton pump inhibitors (PPIs). Vegans, vegetarians, patients with malabsorption syndromes, and those on long-term therapy are at higher risk. Early detection and treatment can prevent the onset of subclinical to symptomatic deficiency, which can lead to severe complications including irreversible neurological impairment<sup>1-3</sup>.



Region	Prevalence (%)	Key Risk Factors
Global	5-15%	Dietary restrictions, chronic medication <sup>1</sup>
India	47%	Vegetarian diet <sup>2</sup>
Middle East	30%	Dietary restrictions <sup>10</sup>
United States	5-15%	Chronic medication use <sup>11</sup>

Table 1. P	Prevalence of	Vitamin	<b>B12</b> Deficiency	in Young Adults
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## Risk Factors of Vitamin B12 Deficiency:

The etiology of Vitamin B12 deficiency in young adults can be broadly categorized into dietary, gastrointestinal, and drug-related causes. Dietary causes contribute significantly to the risk, particularly in populations with poor access to animal food products. Vegetarian and vegan individuals are most susceptible because Vitamin B12 is not present in plant foods. Furthermore, malnutrition and proteinwhich are usually seen deficient diets. in socioeconomically disadvantaged populations, enhance the risk of deficiency. For instance, a study conducted in India found that 47% of young adults exhibited subclinical Vitamin B12 deficiency as a result of insufficient dietary consumption<sup>12</sup>. Gastrointestinal disorders such as pernicious anemia, Crohn's disease, celiacdisease, and Helicobacter

pylori infection can hinder the absorption of Vitamin B12. Pernicious anemia, characterized by an autoimmune attack on the stomach's parietal cells, is a primary contributor to malabsorption issues. Furthermore, individuals who have had gastric bypass surgery are at risk because of decreased production of stomach acid, which is essential for releasing Vitamin B12 from food<sup>13, 14</sup>. Medicationrelated factors encompass the prolonged use of metformin (used for diabetes) and proton pump inhibitors (PPIs). Metformin leads to reduced absorption of Vitamin B12 in the small intestine, while PPIs diminish stomach acid, which prevents the release of Vitamin B12 from dietary sources. Given the widespread use of these medications, regular monitoring of Vitamin B12 levels is crucial for patients undergoing long-term treatment<sup>15</sup>.

Table 2. Risk I actors for Vitalinin D12 Denetene	Table 2	. Risk Factors	for Vitamin	B12	Deficienc
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Category	Risk Factors
Dietary	Vegetarian/vegan diet, malnutrition <sup>16</sup>
Gastrointestinal	Pernicious anemia, Crohn's disease, H. pylori⁴
Medication-Related	Metformin, proton pump inhibitors (PPIs) <sup>3</sup>

## **Clinical Manifestations:**

Vitamin B12 deficiency presents a variety of symptoms that impact several bodily systems,

including hematological, neurological, gastrointestinal, and psychological functions.



#### Vitamin B12 Deficiency Symptoms

Figure 3: Clinical manifestations of Vitamin B12 Deficiency

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Hematological symptoms are frequently among the first to develop, with macrocytic anemia being the most prevalent result. Patients generally exhibit fatigue, pallor, dizziness, and shortness of breath due to a decreased ability of the blood to carry oxygen. If left untreated, severe cases can progress to pancytopenia, where there is a reduction in all types of blood cells, potentially leading to severe complications like bleeding and a greater risk of infections<sup>17, 18</sup>. Neurological symptoms are particularly alarming and can lead to lasting effects if not addressed promptly. Typical signs include peripheral neuropathy, which presents as tingling and numbness in the limbs, memory impairment, and ataxia (issues with balance). In critical cases, Vitamin B12 deficiency may result in subacute combined degeneration of the spinal cord, which can

irreversible neurological harm. Timely cause diagnosis and intervention are essential to avoid these permanent issues<sup>19</sup>. Gastrointestinal symptoms such as glossitis (inflamed tongue), weight loss, and diminished appetite are also commonly seen. Although these symptoms are nonspecific, they can offer significant diagnostic insights, especially when paired with hematological and neurological indicator<sup>20</sup>. Psychological symptoms represent another crucial element of Vitamin B12 deficiency. Individuals may suffer from depression, mood swings extreme psychosis. and in cases, These manifestations can complicate the overall clinical assessment and often result in a delay in diagnosis, as they may be misattributed to stress or other mental health issues<sup>21</sup>.

Category	Symptoms
Hematological	Fatigue, pallor, macrocytic anemia⁵
Neurological	Paresthesia, memory loss, ataxia <sup>18</sup>
Gastrointestinal	Glossitis, weight loss <sup>6</sup>
Psychological	Depression, irritability <sup>7</sup>

Table 3	Clinical	Manifestations	of Vitamin	B12 Deficiency
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## Diagnosis:

The identification of Vitamin B12 deficiency is based on a combination of clinical evaluation and laboratory analyses.

Serum Vitamin B12 levels are the most widely utilized diagnostic test, with levels falling below 200 pg/mL indicating a deficiency. However, serum measurements by themselves may not always accurately indicate functional deficiency; some individuals with normal serum levels might still display symptoms due to issues with the cellular use of Vitamin B12. In these instances, elevated levels of methylmalonic acid (MMA) and homocysteine offer a more reliable confirmation of functional deficiency<sup>22</sup>.

Complete Blood Count (CBC) typically shows macrocytic anemia, which is marked by an increased mean corpuscular volume (MCV). Furthermore, a peripheral blood smear may reveal hypersegmented neutrophils, which are a sign of megaloblastic anemia. For individuals suspected of having pernicious anemia, testing for intrinsic factor antibodies is advised. Although the Schilling test was once а standard method for diagnosing malabsorption, it is seldom used these days due to its complexity and the existence of more contemporary diagnostic techniques<sup>23</sup>.

Table 4. Diagnostic Methods for vitamin D12 Deficien	Table 4	. Diagnostic	Methods	for Vitamin	<b>B12</b> Deficience
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Diagnostic Test	Findings in Deficiency
Serum Vitamin B12 levels	$< 200 \text{ pg/mL}^1$ .
Methylmalonic acid (MMA)	Elevated <sup>17</sup>
Homocysteine levels	Elevated <sup>24</sup>
Complete Blood Count (CBC)	Macrocytic anaemia, hyper segmented neutrophils <sup>21</sup>



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### Treatment and Management:

The approach to treating Vitamin B12 deficiency is based on the severity of the condition and its underlying causes.

In mild cases, oral cyanocobalamin at a dose of 1-2 mg per day is generally sufficient. Studies have shown that high-dose oral Vitamin B12 is as effective as intramuscular injections in correcting deficiency, offering a more convenient alternative for most people<sup>25</sup>. In severe cases, especially when neurological symptoms are involved, intramuscular Vitamin B12 injections are indicated. The standard treatment regimen is 1000 µg per week for the initial

month, followed by monthly maintenance therapy. This facilitates the rapid correction of the deficiency and is particularly important in individuals with malabsorption<sup>26</sup>.

Dietary adjustments also have an important role in treatment. Patients are advised to increase their intake of Vitamin B12-rich foods like meat, fish, dairy products, and eggs. Those on plant-based diets typically need fortified foods or supplements to prevent deficiency. Long-term management includes regular monitoring of Vitamin B12 levels, especially in high-risk groups like those with pernicious anemia or malabsorption disorders<sup>27, 28</sup>.

Table 5. Treatmer	nt Options for	Vitamin B12 Deficiency
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Treatment Option	Dosage/Frequency	
Oral Cyanocobalamin	1-2 mg daily <sup>5</sup>	
Intramuscular Injections	1000 $\mu$ g weekly for 1 month, then monthly <sup>22</sup>	
Dietary Modifications	Increase intake of meat, fish, dairy etc <sup>23</sup>	

## **Conclusion:**

Vitamin B12 deficiency anemia is a severe condition that is often underdiagnosed in young adults, presenting with a range of symptoms affecting hematological, neurological, and psychological health. Early diagnosis and treatment are essential to prevent long-term effects, particularly irreversible neurological damage. Public health measures like nutritional education and food fortification are important in reducing the prevalence of this condition. Future research must focus on improving screening methods and studying new treatment modalities to address this growing health issue

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2 to 3 lines

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The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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