International Journal of Medical & Health Research

Volume 2, Issue 1, 2025

VITAMIN B12 DEFICIENCY ANEMIA IN YOUNG ADULTS: FREQUENCY AND CLINICAL MANIFESTATIONS

Mudassar Imran

*[*3]Department of Medical Laboratory Technology Superior University Lahore Faculty of Allied Health Sciences*

mudassarimran878@gmail.com

Keywords
Button mushroom, Agaricus bisporus, therapeutic properties, management of lipid peroxidation, animal model.

Article History
Received: 01 January, 2025
Accepted: 21 February, 2025
Published: 31 March, 2025

Copyright @Author
Corresponding Author: *
Mudassar Imran

Abstract
Vitamin B12 deficiency anemia is a common yet often underdiagnosed condition in young adults, with significant hematological and neurological implications. This review examines its prevalence, clinical manifestations, and diagnostic challenges in individuals aged 18–35. A systematic review of literature from 2000 to 2023 revealed a prevalence ranging from 5% to 15%, with higher rates in regions with low dietary B12 intake. Common symptoms included fatigue, glossitis, paraesthesia, and macrocytic anemia, while neurological issues such as memory impairment and mood disturbances were also frequently reported. These findings emphasize the need for early diagnosis and intervention to prevent long-term complications. Greater awareness, targeted screening, and further research into dietary and genetic factors are crucial for addressing this widespread health concern.

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[1].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[2]. 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[4]. 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 and lifestyle, highlighting the need for 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[4]. Vitamin deficiencies, particularly in high-risk populations such as pregnant women and children, result in serious neurological impairments. 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[6]. 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[7].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 long-term impacts and prevention measures[8].

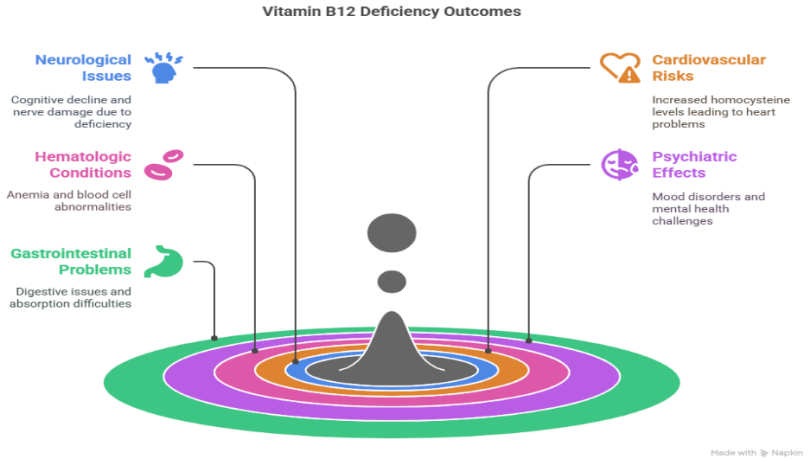

Figure 1: Vitamin B12 Deficiency Outcomes

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[9]. 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[10].

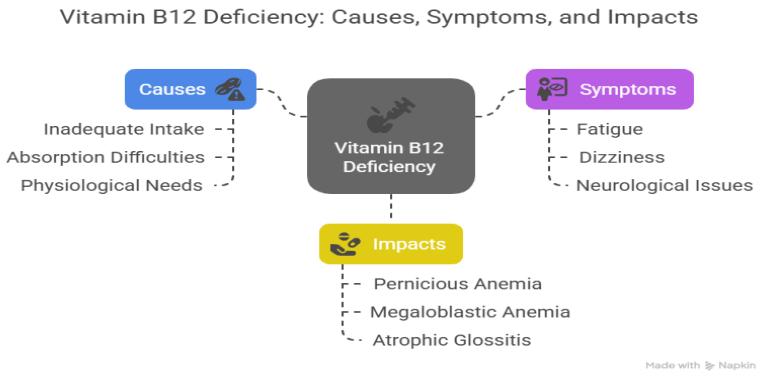

Figure 2: Vitamin B12 deficiency causes, symptoms and impacts

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[11]. 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[12].

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[1-3].

Table 1. Prevalence of Vitamin B12 Deficiency in Young Adults

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

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 protein-deficient diets, which are usually seen 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[12]. 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[13, 14]. Medication-related 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[15].

Table 2. Risk Factors for Vitamin B12 Deficiency

Category	Risk Factors
Dietary	Vegetarian/vegan diet, malnutrition[16]
Gastrointestinal	Pernicious anemia, Crohn's disease, H. pylori[4]
Medication-Related	Metformin, proton pump inhibitors (PPIs)[3]

Clinical Manifestations:

Vitamin B12 deficiency presents a variety of symptoms that impact several bodily systems, including hematological, neurological, gastrointestinal, and psychological functions.

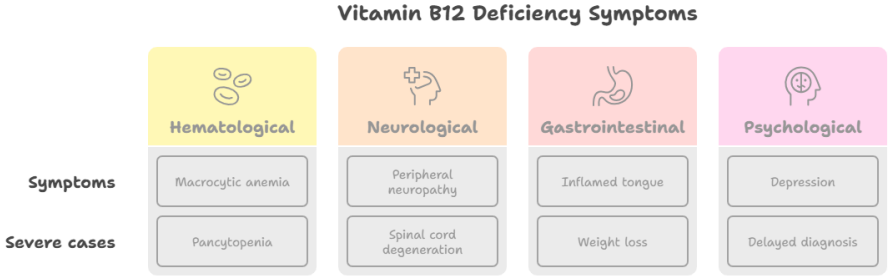

Figure 3: Clinical manifestations of Vitamin B12 Deficiency

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[17, 18]. 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 cause irreversible neurological harm. Timely diagnosis and intervention are essential to avoid these permanent issues[19]. 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[20]. Psychological symptoms represent another crucial element of Vitamin B12 deficiency. Individuals may suffer from depression, mood swings and in extreme cases, psychosis. 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[21].

Table 3. Clinical Manifestations of Vitamin B12 Deficiency

Category	Symptoms
Hematological	Fatigue, pallor, macrocytic anemia[5]
Neurological	Paresthesia, memory loss, ataxia[18]
Gastrointestinal	Glossitis, weight loss[6]
Psychological	Depression, irritability[7]

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[22].

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 a standard method for diagnosing malabsorption, it is seldom used these days due to its complexity and the existence of more contemporary diagnostic techniques[23].

Table 4. Diagnostic Methods for Vitamin B12 Deficiency

Diagnostic Test	Findings in Deficiency
Serum Vitamin B12 levels	< 200 pg/mL[1].
Methylmalonic acid (MMA)	Elevated[17]
Homocysteine levels	Elevated[24]
Complete Blood Count (CBC)	Macrocytic anaemia, hyper segmented neutrophils[21]

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[25]. 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[26].

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[27, 28].

Table 5. Treatment Options for Vitamin B12 Deficiency

Treatment Option	Dosage/Frequency
Oral Cyanocobalamin	1-2 mg daily[5]
Intramuscular Injections	1000 µg weekly for 1 month, then monthly[22]
Dietary Modifications	Increase intake of meat, fish, dairy etc[23]

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

Acknowledgments:

2 to 3 lines

Originality and submission Status of Manuscript:

The work done and material used in this manuscript has not been previously published and is not being concurrently submitted elsewhere.

Ethical Approval:

Mention

Funding Source:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors

Declaration of Conflicting Interest:

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.

REFERENCES

Means RT, Fairfield KM. Clinical manifestations and diagnosis of vitamin B12 and folate deficiency. Up to Date. Available online: HYPERLINK "https://www/"https://www. uptodate. com/contents/clinical-manifestations-and-diagnosis-of-vitamin-b12-and-folate-deficiency (accessed on 30 November 2021). 2022.

Singh J, Dinkar A, Gupta P, Atam V. Vitamin B12 deficiency in northern India tertiary care: Prevalence, risk factors and clinical characteristics. Journal of Family Medicine and Primary Care. 2022 Jun 1;11(6):2381-8.

Jatoi S, Hafeez A, Riaz SU, Ali A, Ghauri MI, Zehra M. Low vitamin B12 levels: an underestimated cause of minimal cognitive impairment and dementia. Cureus. 2020 Feb;12(2).

Torrez M, Chabot-Richards D, Babu D, Lockhart E, Foucar K. How I investigate acquired megaloblastic anemia. International journal of laboratory hematology. 2022 Apr;44(2):236-47.

Azzini E, Raguzzini A, Polito A. A brief review on vitamin B12 deficiency looking at some case study reports in adults. International journal of molecular sciences. 2021 Sep 7;22(18):9694.

Nieto-Salazar MA, Ordσρez KN, Carcamo ZD, Cristina A, Ordσρez A, Saldana EA, Herrera LL, Ramos VM, Yannamani A, Calderon-Martinez E, Khasawneh G. Neurological dysfunction associated with vitamin deficiencies: a narrative review. Open Access J Neurol Neurosurg. 2023 Mar 28;18:1-9.

Boumenna T, Scott TM, Lee JS, Palacios N, Tucker KL. Folate, vitamin B-12, and cognitive function in the Boston Puerto Rican Health Study. The American Journal of Clinical Nutrition. 2021 Jan 1;113(1):179-86.

Hópsch-Marzec H, Pawlak R, Skaba D. Understanding vitamin B12. Journal of Stomatology. 2019 Jul 1;72(4):184-9.

Wu YH, Wu YC, Chang JY, Lee YP, Chiang CP, Sun A. Significantly lower mean serum vitamin B12 and folic acid levels and a significantly higher frequency of serum iron deficiency in younger than in older atrophic glossitis patients. Journal of Dental Sciences. 2022 Oct 1;17(4):1487-93.

Al-Musharaf S, McTernan PG, Hussain SD, Aleisa KA, Alnaami AM, Wani K, Saravanan P, Al-Daghri N. Prevalence and indicators of vitamin B12 insufficiency among young women of childbearing age. International Journal of Environmental Research and Public Health. 2021 Jan;18(1):1.

Basalamah MA, Ibrahim MO, Qutob MS, Jazar AS, Bakr ES, Alazzeh AY, Al-Slaihat AH, Azzeh FS. Vitamin B12 status among asymptomatic young adult females and its association with some anthropometric and biochemical parameters: A cross-sectional study from Makkah (cobalamin deficiency in young adult females). Medicine. 2023 Nov 3;102(44):e35838.

Atzaz N, Khattak M, Zuhra FT, Afzal J, Khaliq S, Saeed S. The frequency of vitamin B12 derangements in females presenting for workup of iron deficiency anemia. Journal of Rawalpindi Medical College. 2023 Jun 24;27(2).

Krishnamurthy S, Kumar B, Thangavelu S. Clinical and hematological evaluation of geriatric anemia. Journal of Family Medicine and Primary Care. 2022 Jun 1;11(6):3028-33.

Azzini E, Raguzzini A, Polito A. A brief review on vitamin B12 deficiency looking at some case study reports in adults. International journal of molecular sciences. 2021 Sep 7;22(18):9694.

Yadav SK, Liu B, Hussein G, Xu Q, Byrd D, Le-Kumar V, Seegobin K. Vitamin B12 Deficiency and Hemolytic Anemia Presenting As Pseudo Thrombotic Microangiopathy: A Systematic Review. Blood. 2023 Nov 28;142:5220.

Wolffenbuttel BH, Wouters HJ, Heiner-Fokkema MR, van der Klauw MM. The many faces of cobalamin (vitamin B12) deficiency. Mayo clinic proceedings: innovations, quality & outcomes. 2019 Jun 1;3(2):200-14.

Song Y, Quan M, Li T, Jia J. Serum Homocysteine, Vitamin B 12, Folate, and Their Association with Mild Cognitive Impairment and Subtypes of Dementia. Journal of Alzheimer's Disease. 2022 Jan 1;90(2):681-91.

Lee YP, Loh CH, Hwang MJ, Lin CP. Vitamin B12 deficiency and anemia in 140 Taiwanese female lacto-vegetarians. Journal of the Formosan Medical Association. 2021 Nov 1;120(11):2003-9.

Bando T, Tokuda M, Katsuda I, Emi N, Tomita A. Involvement of folate and vitamin B12 deficiency in patients with normocytic anemia. Fujita medical journal. 2023;9(2):134-41.

Green R, Miller JW. Vitamin B12 deficiency: Clinical manifestations and diagnosis. UpToDate. 2023.

Allen LH, Miller JW. Review of folate and vitamin B12 status in relation to anemia and cognitive impairment. Am J Clin Nutr. 2023;118(3):528-536.

Kennedy D. O. B vitamins and the brain: mechanisms, dose and efficacy—a review. Nutrients. 2016;8(2):68.

Smith A. D, Refsum H. Vitamin B12 and cognition in the elderly. Am J Clin Nutr. 2018;112(6):1422-1429.

Clarke R, et al. Folate and vitamin B12 status in relation to cognitive impairment and anaemia in voluntary fortification settings. Br J Nutr. 2023;130:12-18.

Basalamah MA, Ibrahim MO, Qutob MS, Jazar AS, Bakr ES, Alazzeh AY, Al-Slaihat AH, Azzeh FS. Vitamin B12 status among asymptomatic young adult females and its association with some anthropometric and biochemical parameters: A cross-sectional study from Makkah (cobalamin deficiency in young adult females). Medicine. 2023 Nov 3;102(44):e35838.

Atzaz N, Khattak M, Zuhra FT, Afzal J, Khaliq S, Saeed S. The frequency of vitamin B12 derangements in females presenting for workup of iron deficiency anemia. Journal of Rawalpindi Medical College. 2023 Jun 24;27(2).

Krishnamurthy S, Kumar B, Thangavelu S. Clinical and hematological evaluation of geriatric anemia. Journal of Family Medicine and Primary Care. 2022 Jun 1;11(6):3028-33.

Azzini E, Raguzzini A, Polito A. A brief review on vitamin B12 deficiency looking at some case study reports in adults. International journal of molecular sciences. 2021 Sep 7;22(18):9694

International Journal of Medical & Health Research