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Estimate Prevalence of Vitamin B_{12} Deficiency and Its Correlation with Hematological Parameters: A One Year Study

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ABSTRACT

Vitamin B_{12} deficiency is relatively common in Indian population especially in peoples with strictly vegetarian diet. Aim: To estimate prevalence of Vitamin 12 deficiency in different age groups and gender and its correlation with hematological parameters. This study was carried out in 197 individuals. Vitamin B_{12} levels were measured using a Mindray CL-900i Chemiluminescence Immunoassay Analyzer and CBC was done using Mindray 5 part fully automated hematology analyzer. Results were distributed according to age groups and gender. In the study 197 individuals were included. Amongst which there were 48.7% males and 51.3% females. In total 197 individuals, 78.2% had variable Vitamin B_{12} deficiency and 21.9% was having sufficient Vitamin B_{12} levels. 31.5% individuals had Borderline Vitamin B_{12} deficiency, 28.4% had Vitamin B_{12} deficiency, 18.3% had severe Vitamin B_{12} deficiency. Vegetarian individuals usually get affected from deficiency of Vitamin B_{12}. Since there may be severe complications of Vitamin B_{12} deficiency, so Vitamin B_{12} supplements and fortification of foods is recommended.

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Key Words
Vitamin B_{12} deficiency, hematological parameter, Vegetarian diet

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INTRODUCTION

Vitamin B_{12} is a water-soluble vitamin, it has role in the formation of RBCs and it is also important in the normal functioning of the nervous system[1]. Vitamin B_{12} and folic acid combinedly needed for DNA synthesis, synthesis of neurotransmitters and phospholipids by converting homocysteine to methionine[2,3]. Chief dietary sources are of animal origin of Gille and Schmid[4] and other sources are fermented foods. Malabsorption and disorders of intestine lead to Vitamin B_{12} deficiency Just and Kozakiewicz[5] Strict vegetarian individuals have high risk[6]. Megaloblastic anaemia is the most common manifestation of B_{12} deficiency. Ahmed *et al*.[7] Many individuals have Pancytopenia with raised Mean Corpuscular Volume in CBC.Vitamin B_{12} is an essential micronutrient that is indispensable for the biological synthesis of macronutrients, red blood cells and DNA, as documented in the literature[8]. The acquisition of this particular nutrient is reliant upon dietary sources, including animal-derived foods, seaweed and fermented vegetables, as the human body lacks the ability to synthesise it[9,10]. The extent to which B_{12} is absorbed and utilised by the body is contingent upon the quantity and form of its consumption through dietary sources[8]. Given that animal-derived products are the primary source of B_{12}, individuals who adhere to vegan or vegetarian diets are susceptible to inadequate B_{12} intake and consequent dietary insufficiency[9]. Inadequacy can also ensue from hindered absorption of vitamin B_{12} caused by insufficient hydrochloric acid and/or intrinsic factors[10]. The insufficiency of vitamin B_{12} is linked to various health complications, which include but are not limited to mild fatigue and anaemia, severe neurological dysfunction, osteoporosis and metabolic diseases. Additionally, there is an elevation in the biochemical markers of disease risk associated with vitamin B_{12} deficiency. These findings have been documented in various studies[10-15]. In accordance with epidemiological research, it has been found that there is a correlation between vitamin B_{12} deficiency and various health conditions such as obesity, gastrointestinal disease, bariatric surgery and renal insufficiency[16-18]. Research has indicated a correlation between inadequate levels of vitamin B_{12} and specific ethnic groups[19], reduced income Allen *et al*.[20] and certain lifestyle behaviours such as increased alcohol consumption[15], tobacco or caffeine use Ulvik *et al*.[21] and a sedentary way of life[9]. The consistent utilisation of specific pharmaceuticals, for instance, metformin Aroda *et al*.[22] and proton pump inhibitors[23], may potentially result in a deficiency of vitamin B_{12}. The prevalence of vitamin B_{12} deficiency in young adults has not been extensively studied, as it is commonly perceived as a concern primarily affecting the elderly population[24].

The prevalence rates of vitamin B_{12} deficiency range from 2.5-60%, differing by age group, gender and ethnicity[15,25,26]. The majority of research has utilised a threshold of <148 pmol L^{-1} to establish the presence of vitamin B_{12} deficiency[15,26,27]. However, certain studies have suggested a higher threshold (220 pmol L^{-1}) based on the assessment of homocysteine and methyl malonic acid levels, which serve as tissue markers for vitamin B_{12} deficiency[15,19,28]. The latest National Health and Nutrition Examination Survey conducted in the United States reports that the prevalence of vitamin B_{12} deficiency in the general population aged 19 years and older varies from 3-26%, depending on the threshold employed. Moreover, the survey reveals that women exhibit a higher likelihood of being deficient in vitamin B_{12} than men[26].

MATERIALS AND METHODS

This study was done in Central India during the period from April 2022 to March 2023. Purposive sampling was done for the selection of the subjects. So, 197 subjects were included in the study after taking their informed consent and was found to be within ethical standards as the Helsinki Declaration was followed. We measured the Vitamin B_{12} levels using a Mindray CL-900i Chemiluminescence Immunoassay Analyzer and CBC was done using Mindray 5 part fully automated hematology analyzer. Venous blood samples were collected in clot activator serum tube for Vitamin B_{12} and in EDTA anticoagulant vial for CBC. Samples were tested within 1 hr of collection to minimize variations due to sample aging. Vitamin B_{12} and CBC estimation was done and results were noted. Results were distributed according to age groups and gender. Data will be entered into excel spreadsheets and analyzed. Quantitative data was expressed in mean and SD while qualitative in proportion or percentages.

RESULTS

In the study 197 individuals were included. Amongst which there were 48.7% males and 51.3% females.

In total 197 individuals, 78.2% had variable Vitamin B_{12} deficiency and 21.9% was having sufficient Vitamin B_{12} levels (Table 1).

About 31.5% individuals had Borderline Vitamin B_{12} deficiency, 28.4% had Vitamin B_{12} deficiency, 18.3% had severe Vitamin B_{12}deficiency.

As represented in Table 2, Mean Corpuscular Volume is raised in Vitamin B_{12} deficiency individuals and there is significant negative correlation between MCV and Vitamin B_{12} levels. The WBCs count and platelet count also lowered as the severity of deficiency increases.

Table 1: Vitamin 12 levels variation with Age groups (n = no. of subjects) (Total = 197)

	Normal (211-911 pg mL^{-1})				Borderline deficiency (170-211 pg mL^{-1})				Vitamin B_{12} deficiency (170-100 pg mL^{-1})				Severe vitamin B_{12} deficiency (<100 pg mL^{-1})			
	Male		Female		Male		Female		Male		Female		Male		Female	
Age groups	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Child (0-16 years)	4	2.1	6	3	4	2.1	4	2.1	2	1	3	1.5	3	1.5	2	1
Young adults (17-30 years)	5	2.5	6	3	9	4.6	10	5.1	8	4	7	3.6	5	2.5	4	2.1
Middle-aged adults (31-45 years)	5	2.5	4	2.1	9	4.6	9	4.6	9	4.6	9	4.6	5	2.5	6	3
Old-aged adults (Above 45 years)	7	3.6	6	3	8	4	9	4.6	8	4	10	5.1	5	2.5	6	3

Table 2:Comparision of severity of Vitamin B_{12} deficiency withHematological parameters

	Hemoglobin (g dL^{-1})	MCV (fL)	MCH (pg)	MCHC (g dL^{-1})	WBCs (10^9 L^{-1})	Platelets (lakh $cumm^{-1}$)
Borderline deficiency	9±1	108±9	34±4	31±3	6±1	1.3±0.1
Vitamin B_{12} def.	7±1	108±12	32±7	30±4	5±1	0.8±0.2
Severe vitamin B_{12} deficiency	5±1	111±9	34±5	32±3	3±1	0.5±0.4

DISCUSSIONS

The clinical manifestation of vitamin B_{12} deficiency is observed as megaloblastic anaemia, while prolonged deficiency can result in neurological disorders. In addition to its other effects, folate deficiency is also associated with the development of megaloblastic anaemia[29].

The study findings indicate that a significant proportion of the participants (78.2%) exhibited a deficiency in vitamin B_{12}. This observation is consistent with the findings of Ahmed et al, who reported a vitamin B_{12} deficiency prevalence of 72.6% in their study population. Ahmed *et al*.[30] and Sarode *et al*.[31] In their respective studies of Sen *et al*.[32] and Hashim and Tahir[33] have reported a high prevalence rate of 76% for B_{12} deficiency. Individuals with anaemia who are deficient in vitamin B_{12} exhibit a mean corpuscular volume (MCV) greater than 100 femtoliters. Our research aligns with the findings of Wheeler *et al*.[34], which also reported this phenomenon.

CONCLUSION

Vegetarian individuals usually get affected from deficiency of Vitamin B_{12}. Timely estimation of Vitamin B_{12} levels may helps in early evaluation of deficiency. Since there may be severe complications of Vitamin B_{12} deficiency, so Vitamin B_{12} supplements and fortification of foods is recommended.

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