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RESEARCH ARTICLE

Analysis of Serum Vitamin B12 Values in Healthy Young Adult Population

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ABSTRACT

Vitamin B12 is an essential vitamin that plays a vital role in cellular metabolism, especially in DNA production, red blood cells, and nervous system function. Vitamin B12 deficiency can cause megaloblastic anemia and neurological disorders. The normal range of vitamin B12 values in serum may vary based on age, gender, and genetic and environmental factors. This study involved 120 subjects consisting of 60 men and 60 women with an average age of 30 years. Vitamin B12 levels were measured using the Electro Chemiluminescence Immunoassay (ECLIA) method with the Cobas e411 device. The device's measurement range is 36.9-1474 pmol/L, and the lower limit measurement of the blank is 36.9 pmol/L, with a minimum detection limit of 73.8 pmol/L and a quantity limit of 111 pmol/L. The study showed that the reference range value of serum vitamin B12 in healthy young adults is 364.8-1014.0 pmol/L, with values in men 389.7-1101.1 pmol/L and women 328.6-919.8 pmol/L. The results of this study indicate that the reference range values of serum vitamin B12 in a healthy young adult Population are consistent with the reference ranges reported in various international studies.

INTRODUCTION

According to the World Health Organization (WHO), adulthood is a productive age, in the 20-60 years (1). then young adulthood begins around the age of 18 to 22 years and ends at the age of 35 to 40 years. (2). While the definition of healthy is a perfect state physically, mentally, and socially and not only free from disease and disability, health is the most basic right of every human being, without discriminating against race, religion, politics, and socio-economic conditions. Healthy young adults can be interpreted as individuals between 18 and 40 years old and in a perfect state physically, mentally, and socially. (3).

The age of young adults is a physically very healthy age compared to other age groups. Besides that, young people are also productive and have many activities and activities that make their lifestyle become unorganized, including eating patterns. Usually, they prefer to consume fast food and drink. An irregular and unhealthy diet due to the density of activities in young adults makes nutrient intake unfulfilled, one of which is micronutrients such as vitamins (4).

Vitamins are organic compounds in tiny amounts of food essential to metabolic reactions. Vitamins are complex organic substances needed in small quantities and generally cannot be formed by the body. Therefore, it must be imported from food (5). One of the essential vitamins is Vitamin B12, especially for young adults who are productive and active because it functions in carbohydrate, fat, and protein metabolism and affects energy production at the cellular level throughout the body, helps the formation of healthy red blood cells, prevents anemia, and optimizes nerve and brain function (6).

Vitamin B12 is a water-soluble vitamin, the most significant part of the vitamin B complex, with a molecular weight of more than 1000 g/mol. Vitamin B12 has a large and complex chemical structure compared to other vitamins. Vitamin B12 is unique among other vitamins because it contains metal ions, namely cobalt (Lubis, 2010). The range of vitamin B12 is normal (>250 pmol/L), considered low (150-249 pmol/L), and acute deficiency (<149 pmol/L) (7).

Vitamin B12 is found in animal protein sources but not in vegetables. Familiar sources of vitamin B12 are meat, poultry, fish, cheese, eggs, and cereals that have this vitamin added. (8)Food consumption patterns that selectively choose foods are a factor that directly affects the intake of vitamin B12 in the body. (9)Based on this, it can be concluded that the intake of vitamin B12 in the body depends on what type of food is consumed, as it is known that the primary source of vitamin B12 can only be obtained from animal food and cannot be obtained from plant food. That is why a vegetarian is more prone to vitamin B12 deficiency than people with an unrestricted diet, such as non-vegetarians. (10).

Age factors can also affect vitamin B12 levels in the body, older age groups often experience vitamin B12 deficiency due to lack of intake from food and gastric physiological functions that have decreased compared to young age so that vitamin B12 from food cannot be broken down from food optimally so that the amount of vitamin B12 that will be absorbed in the ileum is small. (11)

In addition, ethnicity also affects vitamin levels (12). Black ethnicity has higher blood levels of vitamin B12 compared to white ethnicity. So far, the reference values used are based on reference values that have been established and derived from studies that have been carried out on a small number of adults of white ethnicity and universally applied to all ages, genders, and groups in most diagnostic settings, this causes a diagnostic dilemma, especially in geographical areas with diverse ethnicities (13).

Based on the above statement, it is known that the reference value for vitamin B12 levels in the blood that has been determined only describes vitamin B12 levels in specific populations but is applied to all ages and gender without considering factors that can affect vitamin B12 levels in the blood, based on this, researchers are interested in examining the analysis of the Reference range of serum vitamin B12 in the healthy young adult Population, especially in the Population in Makassar.

METHOD

Research Design: This research is Observasional Study using the Samples were collected from March to May 2024 at the Clinical Pathology Laboratory, Research Unit of Hasanuddin University Hospital (RSUH), Makassar City, Indonesia.

Population and research samples: The population of this study was a group of healthy young adult subjects with 120 healthy individuals at Hasanuddin University Makassar. The sample in this study was the blood serum of healthy young adult patients who volunteered to be research subjects.

Data Analysis

Version 27 of the Statistical Package for Social Sciences (SPSS) software was used to analyse the data. The serum vitamin B12 reference range values were set by setting boundary values between percentiles 2.5% and 97.5%.

RESULTS AND DISCUSSION

This research was conducted from March to May 2024 at RSPTN, Hasanuddin University, Makassar and Clinical Pathology Laboratory of Labuang Baji Hospital with a total sample size of 120 subjects consisting of 60 males and 60 females with an average age of 31 years. In this research, serum samples and vitamin B12 were tested using the ECLIA (ElectroChemiLuminescence ImmunoAssay) method at the Labuang Baji Regional Hospital Laboratory. Based on the characteristics of the research subjects, the following data were obtained (Table 1): This table describes the characteristics of the samples that passed the screening stage based on the inclusion and exclusion factors of the research sample. There are several parameters that were taken into consideration, namely the age range in this research. The research sample is 18-40 years old, then the body mass index, in this study the BMI range is 18.1-27.69 Kg/m^2, then the fasting glucose in this research sample is the range 70-124 mg/dL and pressure 100-130 mmHg for systole and 60-90 mmHg for diastole.

Table 1. General Characteristics of Research Subjects

Variables	n	(%)	Mean±SD	Median	Min-Max
Age (years)			30.48±5.53	31.00	19-40
Gender Male Female	 60 60	 50 50			
FBG (mg/dL)			96.24±10.34	96.00	77.03-118.00
BMI (Kg/m^2)			23.05±2.70	23.25	18.10-27.69
Systolic BP (mmHg)			115.80±8.88	120	100-130
Diastolic BP (mmHg)			75.10±7.63	77.5	60-90

Table 1 shows the inclusion criteria of the study subjects in healthy young adults. Based on the study subjects collected, this was based on the study of Oliveira et al. (2022) [14], and the inclusion factor for the serum vitamin B12 level test was based on the study of Bor et al., 2010 [15]. These data provide a snapshot of the demographic and physical characteristics of the Population under study, which will be further analyzed in the context of a broader study.

There are some exclusive criteria that can affect the examination of serum vitamin B12 levels, such as taking PPI class drugs because they can inhibit gastric acid synthesis, thus interfering with the absorption of serum vitamin B12 obtained from food. A decrease in blood serum vitamin B12 levels also occurs during pregnancy due to metabolic changes. Then, the disease history of diabetes mellitus and obesity does not have a significant impact on vitamin B12 levels; this is shown in the results of research conducted by Mercantile, 2023. [16]. After the descriptive test is performed on the subjects, a normality test of the data is performed. The function of the normality test is to determine whether the data are normally distributed.

Table 2. Testing the normality of serum vitamin B12 levels

	Gender	n	*P*
Vitamin B12 serum (pmol/L)	Male	60	0.20
	Female	60	0.20

Table 2 shows the distribution of normally distributed data, from Table 2 shows a significance value of 0.20, where for the interpretation of the results of the normality test (Kolmogorov-Smirnov test) if the p-value is >0.05 it means that the data are considered normally distributed, while if the p-value value <0.05 means that the data are not normally distributed. In this study, after performing the Kolmogorov-Smirnov normality test, the p-value was 0.20, where the p-value was more than 0.05, which means that the data is normally distributed.

Since the data are normally distributed, we can proceed with the next statistical test, which is a descriptive test that aims to determine the mean, standard deviation, and minimum and maximum range with a percentage of 2.5%-97.5% to determine the reference range value for serum vitamin B12 in healthy young adult population.

Table 3. Vitamin B12 *Reference Range* Values

	n	**Mean**	**SD**	***Reference range* (pmol/L)**
Vitamin B12 Serum	120	622,70	159,70	364,80-1014,00

Table 3 shows the reference range values for serum vitamin B12 as a whole, without grouping by sex. In this study, there were 120 samples with serum vitamin B12 levels ranging from 364.8-1014.0 pmol/L. After knowing the reference range value for vitamin B12 in all samples, I then tested the reference range value for vitamin B12 based on gender. Table 4 shows the reference range value for vitamin B12 for 60 males and 60 females. I then tested the difference between the serum vitamin B12 reference range values in men and women using a statistical test.

Table 4. Reference range of serum Vitamin B12 by gender

	Gender	**n**	***Range***	***p***
independent T-Test	Male	60	389,7-1101,1	0,06
	Female	60	328,6-919,8	

Table 4 shows shows the Reference range value of serum vitamin B12 based on gender grouping. In this study, serum vitamin B12 levels obtained in the male group were 60 people 389.7-1101.1 pmol / L, and for the female group were 60 people 328.6-919.8 pmol / L. This study showed that serum vitamin B12 levels in the male group were higher than those in the female group.

To add to the following reading reference, I, as the author, present the reference range values for serum vitamin B12 in various countries. This reference range value can be used as a comparison and benchmark between the serum vitamin B12 reference range value in this study and other countries. Below are the reference range values for serum vitamin B12 in different countries with different age groups and assay methods/tools in each country.

Table 5. Reference range of vitamin B12 in various countries

Reference	**Country**	**Age group**	**Inspection method/tool**	**Vitamin B12 reference range value**
Galakande et al. 2011	Uganda	18-30 years old	Radioimmunoassay	152 -1029pg/mL
Schwettmann et al 2015	Norway	18-65 years old	Bootstrap (abbot architect)	5.2 - 29.2 nmol/L

Jiang et al., 2020	China	21-80 years old	Roche Cobas E602 ECLIA system	250.8 - 957.1 pg/ml
Abildgaard et al., 2022	Newyork	18-<65 years old	Competitive chemiluminescent immunoassay	200-600 Pmol/L
Jassam et al., 2023	English	18-80 years old	Roche Cobas	190-678 ng/mL
Sobczyńska-Malefora et al., 2023	English	0-80 Years	ARCHITECT® immunoassay by Abbott Diagnostic	black skin: 166-805 pmol/L White/Asian: 134-511 pmol/L.
This research 2024	Indonesia	18-40 years old	Roche Cobas (ECLIA)	364.8-1014.0 pmol/L

Table 5 shows the reference range value of serum vitamin B12 in various countries based on research. This table shows the reference range value of serum vitamin B12 in multiple countries, which is different because it is influenced by different habits, cultures, and food sources in various countries.

This study uses respondents with an age range of 18-40 years who do not have a history of disease with the following indications are not DM (GDP ≤ 125 mg/dl), not hypertensive (systolic ≤ 140 mmHg and diastolic 90 mmHg), not obese with a BMI> 30 kg/m2 , and no history of chronic disease and not taking drugs that can reduce gastric acid production so that it can affect blood levels of vitamin B12.

According to Puspitasari, 2023 (21), using drugs that can reduce gastric acid production, such as Proton Pump Inhibitor (PPI) class drugs, is closely related to vitamin B12 deficiency. There are two ways these drugs can reduce gastric acid production: the first is by decreasing stomach acidity, which interferes with the release of vitamin B12 from proteins in the stomach; second, by increasing the pH of the stomach, which will reduce the absorption of vitamin B12. (21).

In addition to taking drugs that can reduce gastric acid production, a factor in the occurrence of vitamin B12 deficiency is a vegetarian diet, according to Rizzo & Laganà, 2020 (22) vitamin B12 can only be obtained from foods of animal origin so that a vegetarian lifestyle can reduce vitamin B12 intake, resulting in vitamin B12 deficiency. (22).

According to Hannibal et al., 2016 (7), the reference value of vitamin B12 in the blood in humans is > 300 pmol/L. considered vitamin B12 deficiency when the total serum vitamin B12 value is between 150-249 pmol/L, and includes acute deficiency when serum vitamin B12 levels < 149 pmol/. In this study using the Cobas e 411 instrument (Roche) of, 120 samples obtained reference range values of 364.8-1014.0 pmol/L, then grouped again based on gender obtained the following results: male 389.7-1101.1 pmol/L and female 328.6-919.8 Pmol/L.

In Table 5, it can be concluded that each country has different reference range values for vitamin B12. This is due to many factors that influence blood levels of vitamin B12, one of which is the diet and animal food sources in each country are different, Galukande M et al. (23) stated that reference range values may differ significantly between populations and cultures whose food intake is different.

In addition to diet, vitamin B12 levels in the blood are also influenced by ethnicity, this is shown in research conducted by Sobczyńska-Malefora et al in 2023. This study shows that vitamin B12 levels in black ethnicity have higher vitamin B12 levels than white or Asian ethnicity, but it has not explained the correlation between vitamin B12 levels in the blood and skin color, so future researchers may be able to add variables about the correlation between skin color and vitamin B12 levels in the blood.

CONCLUSION

The Serum Vitamin B12 reference range was higher in males (389.7-1101.1 pmol/L) than in females (328.6-919.8 pmol/L). The reference range of serum Vitamin B12 in the healthy young adult population is classified as normal status and not deficient (364.8-1014.0 pmol/L).

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