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Correlation Red Blood Inidces to Hemoglobin Levels in Addolescent at SMK-TI High School, Badung, Bali

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KEYWORDS

red blood cell indices; Hemoglobin; adolescent

ABSTRACT

The Complete Blood Count (CBC) or hemogram is a panel of test results on the cellular components of blood: the Red Blood Cells (RBCS), White Blood Cells (WBCS), and platelets (PLTS). Each of the portions can be interpreted separately in a methodical fashion and the interpretation has two aims for laboratorians. parameter that is quite sensitive to testing errors and interferences (often flagged) is the Mean Cell *Hemoglobin* Concentration (MCHC). The purpose of checking *Hemoglobin* levels is to assess the level of anemia, response to anemia therapy, or the development of diseases related to anemia and polycythemia. Other uses for checking *Hemoglobin* include assessing the level of anemia, the response to anemic women and the development of diseases related to anemia. This research used a crosssectional analytic method with the aim of finding a correlation red blood indices to *Hemoglobin.* Teenagers are the most prominent investors and the next generation of the nation's ideals. However, in adolescence, many problems can have a negative impact on health, such as adolescent nutrition. The quality and quantity of nutritional intake consumed during adolescence is an important factor in the emergence of nutritional problems in adolescents.

INTRODUCTION

Erythrocytes, red blood cells, first appear in the yolk sac during the mesoblastic period; this period begins at approximately two weeks gestation and peaks at approximately six weeks gestation.6 The RBC count measures the number of circulating erythrocytes. A mature RBC is a nonnucleated, biconcave disc, surrounded by a flexible membrane. Fetal (and neonatal) RBCs differ from adult RBCs in that they are larger in size, have a shorter life span, altered shape and deformability, and they contain a high fetal *Hemoglobin* concentration. The hematocrit is the proportion of blood volume that consists of the RBCs. It is expressed as a percentage on the CBC. *Hemoglobin* in blood is measured in grams per one deciliter of whole blood and is expressed as g/dL (mmol/L) on the CBC. Two conditions that can be identified by evaluating the RBC count are anemia and polycythemia (Lilyne, 2010). Anemia in adolescence is one of the most common health problems worldwide, with an increasing prevalence yearly. The World Health Organization (WHO) reported in 2019 that the prevalence of anemia in adolescent girls reached 30%. In Southeast Asia, the prevalence of anemia in adolescent girls was 42%, with approximately 27% occurring in developing countries, including Indonesia, and 6% in developed countries (Baderan et al., n.d.)The Indonesian Ministry of Health's Basic Health Research reported in 2013 that the prevalence of anemia in adolescents aged 15 years and over was 37.1%, increasing to 48.9% in 2018. The prevalence of anemia is higher in women than in men, which is even more concerning. An alarming 84.6% of anemia cases occur in pregnant women aged 15 years and over (Baderan et al., n.d.). *Hemoglobin* can be used to find out whether someone is experiencing blood deficiency or not, by measuring *Hemoglobin*

levels. The purpose of checking *Hemoglobin* levels is to assess the level of anemia, response to anemia therapy, or the development of diseases related to anemia and polycythemia. Other uses for checking *Hemoglobin* include assessing the level of anemia, the response to anemic women and the development of diseases related to anemia.

Teenagers are the most prominent investors and the next generation of the nation's ideals. However, in adolescence, many problems can have a negative impact on health, such as adolescent nutrition. The quality and quantity of nutritional intake consumed during adolescence is an important factor in the emergence of nutritional problems in adolescents. The high incidence of anemia in adolescent girls can affect various impacts of change and adolescent growth and development, one of which is the lack of growth in adolescent girls. Deficient *Hemoglobin* levels can be used as an indicator of iron deficiency anemia. In terms of public health, nutritional anemia is associated with iron deficiency anemia. The prevalence of iron deficiency in developing countries is much higher than in developed countries, at 36% and 8%, respectively, the prevalence of iron deficiency anemia in adolescent girls in several countries: 82.5% in Bangladesh, 23% in China and 42.2% in the Philippines. India found 74.7% of adolescent girls (12-19 years) (Millenia & Rahmadyanti, 2024).

There are other indices that can provide estimates of the average size of the erythrocytes and the average concentration and quantity of *Hemoglobin* in the erythrocytes. These indices can be measured directly or calculated electronically using modern hematology analyzers. They can be useful in further classifying anemia according to the *Hemoglobin* quantity in the RBCs or the size of the RBCs or in identifying the pathologic process causing the anemia. The erythrocyte indices include the MC, the MCHC, and the MCH. The MC measures the average size of circulating erythrocytes. It can help to quantify anemia as microcytic (small cells) or macrocytic (large cells). An elevated MC is seen with hyperviscosity/polycythemia and also in anemia caused by folate or vitamin B12 deficiency. The MCHC measures the *Hemoglobin* concentration in a given volume of red blood cells. The RBCs can be described as normochromic, hypochromic, or hyperchromic, depending on their color, which is determined by the amount of *Hemoglobin* present in the RBC. The MCH measures the average amount of *Hemoglobin* per RBC in a sample of blood The MCHC can be used to identify anemia due to an acute or chronic blood loss (Lilyne, 2010).

In this study, it was found that 2 students experienced a decrease in *Hemoglobin* and a decrease in red blood cell indices. These 2 students are female and aged 16 and 17 years. Anemia in adolescents females can occur due to menstruation, insufficient intake of vitamins, or a diet lacking in iron. In the case of the 2 students, after taking their medical history, they often complained of headaches, low concentration in learning and fatigue. This is consistent with research by (Baderan et al., n.d.) Adolescent girls are highly susceptible to anemia because they experience menstrual cycles every month, leading to significant blood loss and a need for increased iron intake to form *Hemoglobin*. The desire to achieve an ideal body weight often causes adolescent girls to adopt poor eating habits, resulting in nutritional anemia and growth disorders. Anemia is a condition characterized by a deficiency of red blood cells due to insufficient iron intake (Baderan et al., n.d.) . another study by Sekar et al has a same results which is he low level of *Hemoglobin* causes a change in individual behavior and cognitive function (Utomo et al., 2023) .(Ahmed et al., 2020).(Aulya et al., 2022)

The correlation between red blood cell indices and *Hemoglobin* levels in this study has shown a strong correlation because both are indicators of the body's capacity to transport oxygen. Red blood cell indices, which include measurements such as mean corpuscular volume (MCV), mean corpuscular *Hemoglobin* (MCH), and mean corpuscular *Hemoglobin* concentration (MCHC), provide information about the size and composition of red blood cells.

When *Hemoglobin* levels are low, these indices often reflect changes in red blood cell size, density, and overall health. For example, a decrease in *Hemoglobin* may be accompanied by alterations in MCV and MCH, indicating that the red blood cells are either smaller or less concentrated than normal. This strong correlation helps in diagnosing conditions such as anemia, where both *Hemoglobin* and red blood cell indices will typically show significant changes. Thus, their strong correlation is crucial for understanding and assessing the oxygen-carrying capacity of the blood. this study is also conducted by (Utomo et al., 2023) *Hemoglobin* plays the role of transporting oxygen from the lungs to all body tissues and carbon dioxide from body tissues back to the lungs low *Hemoglobin* levels impact the incidence of anemia, where there is a decrease in the number of red blood cells in circulation, abnormality of the *Hemoglobin* content of red blood cells, or both. The erythrocyte index is a limitation used to determine the size and content of erythrocyte *Hemoglobin*. This examination consists of mean corpuscular volume (MCV), mean corpuscular *Hemoglobin* (MCH), and mean corpuscular *Hemoglobin* concentration (MCHC). Anemia is a condition of decreasing the number of red cell mass, practically characterized by a decrease in *Hemoglobin*, hematocrit, or erythrocyte count (Sari et al., 2022)(Utomo et al., 2023)(A. N. Pertiwi, 2021) (Ahmed et al., 2020)

Anemia remains a critical public health issue among adolescents, particularly females, as highlighted by (Akhtar et al., 2021)), who emphasized the need for targeted interventions to address its prevalence. Proper nutritional intake plays a vital role in preventing anemia, as demonstrated by (C. M. Pertiwi et al., 2021)), while (Fitriani, 2023)) confirmed a significant correlation between nutritional status and hemoglobin levels in adolescents. Red blood cell indices and hemoglobin levels serve as reliable indicators for diagnosing anemia, as noted by (Anggriani et al., 2022), providing valuable tools for early detection. Furthermore, (Rahmaniar et al., 2023)) revealed that low hemoglobin levels could adversely impact cognitive function and learning in adolescents, underscoring the broader implications of anemia. (Lynch et al., 2015)emphasized the detrimental effects of iron deficiency anemia on growth, cognitive function, and overall adolescent well-being. Guidelines from the American Society of (Cuker et al., 2022)further highlight the importance of age- and sex-specific reference ranges for accurately diagnosing anemia, while the American Journal of (Elke et al., 2019)examined hemoglobin changes during adolescence, emphasizing gender-specific differences that must be addressed in prevention strategies. Collectively, these findings underscore the critical importance of addressing anemia among adolescents through comprehensive nutritional and diagnostic approaches.

RESEARCH METHOD

This research used a crosssectional analytic method with the aim of finding a correlation red blood indices to *Hemoglobin* among student at SMK-TI Jimbaran, Badung. The research location will be held at SMK-TI Jimbaran, Badung for the period November-December 2024 The target population in this study were students at SMK-TI Jimbaran Badung, who had their

complete blood count checked at VirtuDigiLab Nusa Dua period November until December 2024.

RESULT AND DISCUSSION

The research carried out was "Complete Blood Count (CBC) especially Red Blood Indices and *Hemoglobin* (Hb) at VirtuDigilab Nusa Dua for the period November-December 2024. The sample was students who came to VirtuDigilab and had a CBC examination. After the sample is taken, the sample is examined using hematology Analyzer, Flocytometri method, then the results of the examination will be collected and data analyzed.

Characteristics of research subjects

The subjects in this research were students who came to the VirtuDigilab laboratory and had CBC tests aged around 16-18 years, both girls and boys. The characteristics of the research subjects obtained in the form of gender are presented in the following table:

Table 1. Charateristic sample by Gender

Gender	Total (Person)	Percentage (%)
Male	31	60,8
Female	20	31,2
Total	**51**	**100**

Based on Table 1 The number of male students was 31 people (60.8%) while the number of female students was 20 people (31.2%), so the total number of research samples was 51 people (100%). The characteristics of the research subjects were obtained from students who underwent CBC examinations for the period November to December 2024.

Table 2 Characteristic by Age

Age	Frequency	Percentage (%)
16	11	21,6
17	37	72,5
18	3	5,9
Total	51	100

From table 2, the characteristics of the sample based on age shown that there are 11 individuals aged 16 years, with percentage for 21.6%. Then, there are 37 individuals aged 17 years, making up 72.5%, and 3 students aged 18 years, representing 5.9%

Characteristic of Red Blood Cell Indices

Table 3. Parameters Red Blood Cell Indices

No	Parameters	Levels
1	Red Blood Cells (RBC) Level	5,0998 ±0,496
2	Hematocrite (HCT) level	41,9548 ±4,965
3.	Mean Corpuscular Volume (MCV) Level	83,3 (54,6-91,3)
4.	Mean Corpuscular Haemoglobin (MCH) level	28,7 (15,8-31,6)

5	Mean Corpuscular Haemoglobin Consentration (MCHC) level	34,00 (26,3-37,2)

From the table 3 there are parameters of red blood cell indices, RBC level at 5,0998 ±0,496, HCt level at 41,9548 ±4,965. MCV level at 83,3 (min 54,6 and max 91,3), MCH level at 28,7 (min 15,8 and max 31,6) and MCHC level at 34,00 (min 26,3 and max 37,2). Both RBC and HCT level with normal distribution data, MCV, MCH, MCHC level with median ranges.

Charateristic Hemoglobin and Correlation test between *Hemoglobin* and Red Blood Cell Indices

Characteristic *Hemoglobin* based in data analysis is at normal distribution with level 14,24 ±2.07, then a correlation test was conducted on the Red Blood Cell Indices and *Hemoglobin* parameters, resulting in the following findings:

Table 4 Correlation test Red Blood Cell Indices and *Hemoglobin* levels.

Red Blood Cell Indices	*Hemoglobin* Level	P Value*
RBC	0,715	0,000
HCT	0,977	0,000
MCV	0,456	0,001
MCH	0,756	0,000
MCHC	0,810	0,000

P Value < 0,005 = there is correlation

P Value > 0,005 = no correlation

From this table, test between red blood cell indices and *Hemoglobin* shows a strong correlation, where p value < 0.005, indicating that there is a strong relationship or correlation between red blood cell indices and *Hemoglobin*.

CONCLUSION

Erythrocyte indices provide valuable estimates of the average size of erythrocytes and the average concentration and quantity of Hemoglobin within them. These indices, measured directly or electronically using modern hematology analyzers, are instrumental in further classifying anemia based on Hemoglobin quantity or erythrocyte size, as well as identifying the pathological processes causing anemia. Key indices include the MC, MCHC, and MCH, with the MC measuring the average size of circulating erythrocytes. Hemoglobin, a conjugated protein in red blood cells, plays a critical role in oxygen and carbon dioxide transport. Assessing Hemoglobin levels aids in diagnosing anemia, monitoring responses to anemia therapy, and evaluating related diseases, including polycythemia. Adolescents, as the nation's future generation, face significant nutritional challenges that can impact their health, with the quality and quantity of nutritional intake being critical factors. This study investigated the correlation between red blood cell indices and Hemoglobin levels among 51 male and female SMK-TI high school students in Badung, Bali. The findings revealed a strong correlation between red blood cell indices and Hemoglobin levels, with a statistically significant p-value of 0.000 ($p < 0.005$).

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