

# HEALTH STATUS OF ADOLESCENCE GIRLS BASED ON NUTRITIONAL STATUS ASSESSMENT AND CARDIORESPIRATORY ENDURANCE ( $VO_2$ MAX)

Dini Junita<sup>1\*</sup>, Agus Hendra Al Rahmad<sup>1</sup>, Farah Fajarna<sup>3</sup>

<sup>1</sup>Prodi Sarjana Terapan Gizi dan Detetika, Jurusan Gizi, Poltekkes Kemenkes Aceh, Kampus Terpadu Jl. Soekarno-Hatta, Lampeuneurut, Aceh Besar, Aceh, Indonesia

<sup>2</sup>Jurusan Teknologi Laboratorium Medik, Poltekkes Kemenkes Aceh, Kampus Terpadu Jl. Soekarno-Hatta, Lampeuneurut, Aceh Besar, Aceh, Indonesia

E-mail corresponding author: [dinijunitapoltekkesaceh@gmail.com](mailto:dinijunitapoltekkesaceh@gmail.com) \*

## ABSTRACT

*Adolescent health sometimes still receives less attention, even though this age group has a high level of vulnerability to various nutritional and health problems. This study aims to determine the health status of adolescent girls including hemoglobin status, hydration status, and cardiorespiratory endurance ( $VO_2$ Max). Samples were taken using a total sampling technique with the criteria of not having a history of heart and lung disease, living in the girls' dormitory at Integrated Islamic High School Al-Fityan School Aceh in good health and being willing to be respondents, and 60 female students were obtained. Hemoglobin status was observed from the hemoglobin level in the blood sample, hydration status was defined based on the composition of body fluids as measured by Bioelectrical Impedance Analysis (BIA),  $VO_2$ Max value was calculated from pulse per minute in resting conditions. Data obtained from each variable was presented descriptively and tested for correlation using the Pearson 95% test. Based on the research results, in general, the majority of respondents can be concluded to have good nutritional status and cardiorespiratory endurance. However, 28.3% of respondents were still found with abnormal nutritional status, abnormal hemoglobin status of 28.3%, dehydration of 43.3% and 33.3% had low cardiorespiratory endurance. This research cannot prove the relationship between hemoglobin status and hydration status on cardiorespiratory endurance ( $p$ -value > 0.05). Periodic health status checks are required through the school health unit involving the Community Health Center or health workers to overcome existing problems in these four health status parameters.*

**Keywords:** Adolescence girl, Hemoglobin Status, Hydration status, Nutritional Status,  $VO_2$ Max

## INTRODUCTION

Adolescence is a period of significant development that begins with the onset of puberty and ends in the mid-20s. Consider how different a person at the age of 12 from the person he or she at age 24. The trajectory between those two ages involves a profound amount of change in all domains of development including biological, cognitive, psychosocial, and emotional. Adolescent health sometimes still receives less attention, even though this age group has quite high vulnerability to various nutritional and health problems. One of the fastest stages of human development is adolescence. Meanwhile many of the changes seem to occur in the same order every time, people differ in terms of when and how quick they change. These alterations are influenced by both internal (such as sex) and environmental (such as poor

nutrition and an abusive environment) factors (WHO, 2020). Besides, micronutrient factors and fluid intake are also important to pay attention to support high activity and changes in body function. However, it is common among teenagers to ignore the role of micronutrients and fluid intake. The high level of activity they had causes the quality of teenagers' eating and drinking to be neglected. The impact that can arise during adolescence is micronutrient deficiency, one of it is anemia which characterized by low blood hemoglobin levels and also dehydration.

Hemoglobin plays a role in oxygen transport, 30 to 100 times the amount of oxygen dissolved in fluid or blood plasma is transported by hemoglobin. The high and low levels of hemoglobin, known as blood hemoglobin status, will determine the oxygen level in the blood. If the hemoglobin status

in the blood is lower than normal, the amount of oxygen in the blood will also be lower and vice versa, if the hemoglobin status is higher than normal, the oxygen status in the blood will increase (Anggraeni L and Wirjatmadi RB, 2019). Several studies state that hemoglobin status in the blood, which is a parameter for anemia conditions, has a correlation with work productivity, physical and cognitive performance (Ghalda et al, 2019; Muzayyaroh M and Suyati S, 2018). So these conditions play a role in the performance, fitness and achievements of teenagers in their daily activities.

Apart from hemoglobin, hydration status is an important benchmark for adolescent conditions. Hydration is defined as fluid balance in the body and is an important requirement to ensure the metabolic function of body cells, so that dehydration in adolescents can inhibit metabolic processes which ultimately results in stunted growth. Lack of fluid intake can reduce body water by 2% or more, physical performance can be impaired. If not anticipated or treated, this condition can worsen and increase the risk of muscle heat cramps, fainting, heat exhaustion, and heat stroke which can be life threatening (Saharun Iso AT, 2016). Therefore, as important as hemoglobin status, hydration status in adolescents will also be seen in their performance or physical fitness.

Physical fitness is the ability of a teenager's body to carry out work or daily activities without feeling excessive fatigue, namely optimal energy reserves to overcome the existing physical workload (Ghalda et al, 2019). Fitness can be seen from cardiorespiratory endurance through measuring  $VO_2$ Max (Anggraeni L, Wirjatmadi RB, 2019). The aim of this study was to determine the description of hemoglobin status, hydration status and fitness condition of adolescent girls as seen from cardiorespiratory endurance. This research is important to carry out as a theoretical basis for preventive and promotive health efforts in adolescents regarding the role of nutrition and fluid intake in maintaining health and body performance. The following is the state of the art of this research, cardiorespiratory endurance seen from the  $VO_2$ Max value describes how a person's health condition, especially fitness, there are

several factors that influence this condition, namely related to hemoglobin function in the form of heart, lung and blood vessel function, the process of delivering oxygen to tissues by erythrocytes. and the number of red blood cells and related blood volume which are related to a person's adequacy of body fluids (hydration status) (Siswanto, 2017; Anggraeni L and Wirjatmadi RB, 2019).

## METHODS

This research was carried out at SMAIT AL-Fityan Aceh Besar with a population of 246 students with the data collection time being July–August 2023. Samples were taken using a total sampling technique with the criteria of not having a history of heart and lung disease, living in the girls' dormitory at Integrated Islamic High School Al-Fityan School Aceh in good health and being willing to be respondents, and 60 female students were obtained. This type of research is observational research with a cross-sectional design. The variables in this study are respiratory endurance, hemoglobin status, hydration status. Hemoglobin levels were measured using a digital Hb/ Quick-Check Hemoglobin System Ministry of Health RI AKL No: 20205312473, which has an Hb measurement range of 4.5-25.6 g/dL. Hemoglobin status was categorized as normal if the Hb value is 12-16 g/dL, abnormal if it is out of that range. Hydration status was measured using a Bioelectrical Impedance Analysis (BIA) digital scale, Serenity Body Fat/Hydration Monitor Scale type SRF 934, cardiorespiratory endurance ( $VO_2$ max value) was measured during normal activities referring to Meredith Juncker's theory with the formula  $VO_2 \text{ max} = 15 \times (\text{heart rate}). \text{maximum: heart rate at rest}$ . Maximum heart rate is obtained from the formula  $HR_{\text{max}} = 205.8 - (0.685 \times \text{age})$ , while resting heart rate is calculated from the number of pulses during 1 minute in resting conditions. Furthermore, the  $VO_2$ Max results are categorized as normal if the value is greater or equal to 31 ml/kg/minute and low if it is less than 31 ml/kg/minute. The data obtained for each variable, namely hemoglobin status and hydration status as well as the dependent variable cardiorespiratory endurance, are then processed and presented tabularly and textually. The relationship

between hemoglobin status and hydration status on cardiorespiratory endurance was tested using the Pearson test. This research has gone through an ethical approval process by the Health Research Ethics Commission of the Aceh Health Polytechnic with number: LB.02.03/54/2023.

## RESULTS AND DISCUSSIONS

### Respondent Characteristics

The respondents in this study were all teenage girls who lived in the Al Fityan School Aceh dormitory. This is a consideration in determining research locations, aimed at reducing the possibility of bias due to other factors outside the research such as intake, rest patterns or physical activity. Apart from that, respondents have also gone through a screening process to meet the inclusion criteria, including being in good physical and mental health, having no history of chronic disease or heart disease, being willing to be a research respondent, having a blood sample taken by signing an informed consent. Based on these criteria, 60 female students met and were involved in this research. The ages of the female respondents who were respondents ranged from 14 years to 19 years, falling into the teenage and early adulthood age groups. Based on age data, the largest number of young women are in the middle adolescence age group (15-17 years old), namely 53 people (88.3%).

Assessment of nutritional status is carried out based on Body Mass Index parameters according to age (BMI-for-age) for ages less than 18 years, and Body Mass Index (BMI) parameters for ages 19 years. The data is then processed and categorized as normal if the BMI value according to age is in the z-score range -2 standard deviation to +1 standard deviation and BMI is in the range of 18.5-25 kg/m<sup>2</sup>, and categorized as abnormal if BMI according to age < -2 Standard Deviations or >+1 standard deviation and BMI is within, 18.5kg/m<sup>2</sup> or > 25 kg/m<sup>2</sup>. Based on anthropometric assessments of the nutritional status characteristics of the majority of respondents, 43 people (71.7%) had normal nutritional status, but there were still 17 respondents with abnormal nutritional status (both undernutrition and overnutrition) (28.3%).

**Table 1.** Characteristics of Respondents (n=60)

Variable	Category	Frequency	(%)
Age	Early adolescence (10-14 y.o)	1	1.7
	Middle adolescence (15-17 y.o)	53	88.3
	Late adolescence (18-19 y.o)	6	10
	Total	60	100
	Nutritional status	Normal	43
Abnormal		17	28.3
Total		60	100.0

Nutritional status is a health condition resulting from interactions between food, the human body and the human environment. Nutritional status is the result of a balance between nutrients entering the human body and their utilization. Nutritional status is influenced by food consumption and the use of nutrients by the body. If the body receives sufficient nutrients and uses them effectively, it will achieve optimal nutritional conditions that lead to high levels of physical growth, brain development, work capacity, and general health. Malnutrition occurs if the body lacks one or more important nutrients. Excess nutrition occurs when the body receives nutrients in excess of its needs (Almatsier S, 2010). Basically, a person's nutritional status is determined based on food consumption and the body's ability to use these food substances. Normal nutritional status shows the quality and quantity of food to meet the body's needs (Amsi, Muhajirin, 2011). Several factors influence the nutritional status of adolescent girls, namely eating patterns, physical activity, body image, and depression (Rahayu TB and Fitriana, 2020).

Respondents in this study live together in a school dormitory so they may have eating patterns and physical activity that are not much different, but other factors such as body image, level of depression, genetics, history of nutritional status and other factors can of course also influence nutritional status of teenage girls when the research was conducted. The finding of data on nutritional status outside normal limits for 17 teenage girls can certainly provide input for schools in handling female students' nutritional problems early, so that they can be addressed and prevent negative

impacts on the health status of teenagers in the future.

### Hemoglobin Status

Hemoglobin status is a parameter commonly used to detect anemia in adolescent girls which is indicated by a hemoglobin value <12 gr/dL, the normal hemoglobin value in adolescent girls is 12-16 gr/dL (Hermanto RA et al., 2020). Hemoglobin (Hb) status in this study was measured using the Nesco Multi / Quick-Check digital Hb check tool. Hemoglobin status data is categorized as normal if the hemoglobin value is in the range 12-16 g/dL, and categorized as abnormal if it is outside this range. Based on the data recap, the average hemoglobin value for female adolescents was 15.32 g/dL with a minimum value of 11.2 g/dL and a maximum value of 18.9g/dL. Based on the categorization of the results of measuring respondents' blood hemoglobin levels, it is known that the majority of respondents in this study had normal hemoglobin status, namely 43 people (71.7%) while the remaining 17 respondents had abnormal hemoglobin status (28.3%).

Based on the research results, it is known that on average young women have high hemoglobin levels or do not experience iron nutritional anemia, however, the cause of hemoglobin abnormalities above the normal range certainly needs to be studied. Hemoglobin is a protein found in red blood cells that contains iron. The function of Hb is to transport oxygen from the lungs throughout the body and carbon dioxide to the lungs to be exhaled. Due to certain conditions, hemoglobin levels in a person's body can be low or high. Low Hb levels cause anemia in young women, have a negative impact during the growing period, they are easily infected, resulting in reduced body fitness/freshness, decreased enthusiasm for learning/achievement, so that when young women become mothers-to-be they have a high risk of

experiencing problems ( Junita D and Wulansari A, 2021 ). Likewise, excessive Hb levels are a sign of the body's adaptation to exposure to health problems. Increased hemoglobin levels can be caused by several factors, including dehydration, exposure to cigarette smoke, being in a low-oxygen environment (altitude), lung disease and other pathologies (Fadila I, 2022). Regarding this risk, the high hemoglobin levels in young women in this study certainly need to be investigated further.

### Hydration Status

Hydration status is defined as the balance of fluids in the body and is an important requirement to ensure the metabolic function of body cells, so that dehydration in adolescents can inhibit metabolic processes which ultimately results in stunted growth. Hydration status can be determined in several ways, such as looking at urine color indicators, calculating urine specific gravity, or measuring total body fluids (Sudrajat A et al., 2019). Hydration status in this study was measured using a digital Bioelectrical Impedance Analysis (BIA) body composition scale, Serenity Body Fat/Hydration Monitor Scale type SRF 934.

Data on hydration status was categorized as dehydration if the results of the female adolescent's body fluid composition were less than 53%, and categorized as dehydration. not dehydrated if the body fluid composition result of a teenage girl is more equal than 53%. Based on the recapitulation of data obtained, the average body fluid composition value for young women is 52.39% with a minimum fluid composition value of 32.7% and a maximum value of 62.1%.

Based on the categorization of the results of measuring fluid composition, it is known that the majority of young women in this study were not dehydrated as many as 34 people (56.7%) while the remaining 26 people experienced dehydration (43.3%).

**Table 2.** Description of Respondents' Hemoglobin Status (n=60)

Hemoglobin Status	Frequency	(%)
Normal	43	71.7
Abnormal	17	28.3
<b>Total</b>	<b>60</b>	<b>100</b>

**Table 3.** Description of Respondents' Hydration Status (n=60)

Hydration Status	Frequency	(%)
Dehydrated	26	43.3
Not dehydrated	34	56.7
<b>Total</b>	<b>60</b>	<b>100</b>

The state of hydration is a picture of the balance of water penetration into the body. Water balance is influenced by age, physical environmental conditions, food intake, fluid consumption, nutritional status, ecology, body fluid output, gender, knowledge and physical activity. Dehydration is the loss of large amounts of dissolved substances and water. Hydration status affects a person's health status, dehydration can cause the body to tire quickly, lack enthusiasm and inhibit physical work activities (Kusuma AD, 2020). The results of research by Ghalda et al, (2019) show that mild dehydration occurs more often in adolescents (49.5%) than adults (42.5%). Not much different from the prevalence of female teenagers in the study who experienced dehydration was 43.3%. This certainly needs to be a concern for future researchers to explore the factors that cause dehydration in adolescent girls, so that it can be controlled and adolescent girls avoid the bad effects caused by dehydration. Dehydration conditions cause a decrease in blood volume so that the heart works harder. This increases heat attacks, to keep blood pressure stable when blood volume decreases, blood vessels will also constrict and cause symptoms of dizziness (Siswanto, 2017). A person's fluid needs vary depending on several factors, including: metabolic rate, body weight and body size, environmental conditions, level of physical fitness, intensity and duration of physical exercise, as well as genetic factors (Sudrajat A et al., 2019).

### Cardiorespiratory Endurance (VO<sub>2</sub>Max)

The cardiorespiratory endurance (VO<sub>2</sub>Max) of young women in this study was seen based on Meredith Juncker's theory, namely the result of comparing the maximum respiration value based on age with the respiration value at rest from pulse measurements. Cardiorespiratory endurance (VO<sub>2</sub>Max) is categorized as good if the value is greater or equal to 31 and categorized as poor endurance if the value is below 31. Based on the data recap obtained, the average value of cardiorespiratory endurance for young women is 34.07 with a minimum value of 26.81 and a maximum of 47.14. Based on the cardiorespiratory endurance categorization, there were 40 young women (66.7%) with good cardiorespiratory

**Table 4.** Description of Respondents' Cardiorespiratory Endurance (n=60)

Cardiorespiratory Endurance	Frequency	(%)
Good	40	66.7
Poor	20	33.3
Total	60	100

endurance and the remaining 20 people had poor cardiorespiratory endurance (33.3%).

Cardiorespiratory endurance is a description of the ability of the cardiovascular and respiratory systems to meet the oxygen needs of the muscles used during physical activity without experiencing excessive fatigue after completing the activity (Aditama MG, 2020). Cardiorespiratory endurance is a component of assessing physical fitness. Physical fitness is the ability of a teenager's body to carry out work or daily activities without feeling excessive fatigue, namely optimal energy reserves to overcome the existing physical workload (Ghalda et al, 2019). Cardiorespiratory endurance assessment to see a person's fitness can be measured through VO<sub>2</sub> max or aerobic capacity (Anggraeni L and Wirjatmadi RB, 2019). The lower the VO<sub>2</sub>max value, the faster fatigue will come. VO<sub>2</sub>max is the Maximal Oxygen Uptake Volume or maximum oxygen consumption, which is the highest amount of oxygen that a person can take in and utilize to produce aerobic energy (ATP) while breathing air during heavy or simple exercise. VO<sub>2</sub>max shows the maximum volume of oxygen consumed by the body. The respiratory system brings oxygen from the air, the cardiovascular system transports oxygen and cells use oxygen in energy production (ATP).

**Table 5.** Relationship between hemoglobin status and hydration status on cardiorespiratory endurance

Variable	Cardiorespiratory Endurance				<i>p value</i>
	Good		Poor		
	n	(%)	n	(%)	
<b>Hemoglobin Status</b>					
Normal	29	48.33	14	23.33	0.839
Abnormal	11	18.33	6	10.00	
<b>Hydration status</b>					
Dehydration Not dehydrated	16	26.67	10	16.67	0.461
	24	40.00	10	16.67	

Several factors that can greatly influence the VO<sub>2</sub>Max value include the function of the heart, lungs and blood vessels; the process of delivering oxygen to tissues by erythrocytes which involves the function of the heart to pump blood; blood volume; and the number of red blood cells in the diversion of blood from tissues which are then transported to working muscles. The VO<sub>2</sub>max value is a description of the activity of the lungs' ability to take in oxygen, the heart's ability to pump blood, the ability of hemoglobin to distribute oxygen, the ability of muscles to get oxygen supply and the ability of mitochondria and body enzymes to produce energy (Sudiana IK, 2015).

The research results show that there are still 20 young women with low VO<sub>2</sub>Max values, this can certainly affect the quality of health and also physical performance in daily life. Seeing the many factors that influence the value of cardiorespiratory endurance apart from cardiorespiratory function factors which have been eliminated from the inclusion criteria for this study, of course it is also necessary to investigate what is the main cause of this condition so that it can be overcome. The limitation of this research variable is that it is not able to prove the relationship between hemoglobin status and hydration status on the condition of low cardiorespiratory endurance in teenage girls (p-value > 0.05).

## CONCLUSION

Based on the research results, in general, the majority of respondents can be concluded to have good nutritional status and cardiorespiratory endurance. However, respondents were still found with abnormal nutritional status of 28.3%, abnormal hemoglobin status of 28.3%, dehydration of 43.3% and 33.3% have low cardiorespiratory endurance. This research cannot prove the relationship between hemoglobin status and hydration status on cardiorespiratory endurance. Periodic health status checks are required through the school health unit involving the Community Health Center or health workers to overcome existing problems in these four health status parameters.

The research sample has gone through a more specific screening stage, namely female students who lived in girls' dormitories to avoid bias from

lifestyle and eating patterns so that it was hoped that the research results could describe health conditions and nutritional status without any influence from other factors. However, the number of respondents from the screening results was 60 people, of course still not enough to describe the broader situation.

## ACKNOWLEDGEMENT

We would like to thank the Aceh Ministry of Health Polytechnic for its moral and material assistance. Thank you to the Al Fityan Education Foundation for permission and cooperation in carrying out research. This research was carried out using funds sourced from the Aceh Ministry of Health Health Polytechnic DIPA funds for 2023.

## REFERENCES

- Aditama MG. (2020). *Tingkat Daya Tahan Kardiorespirasi Atlet Renang Usia Remaja Di Club Satria Mataram Aquatic Kabupaten Sleman*. Fakultas Ilmu Keolahragaan Universitas Negeri Yogyakarta.
- Almatsier, Sunita. (2010). *Prinsip Dasar Ilmu Gizi*. Jakarta: Gramedia Pustaka Utama.
- Amsi, Muhajirin. (2011). *Gizi dan Makanan Sehat*. Jakarta: Salemba Medika.
- Anggraeni L, Wirjatmadi RB. (2019). Status Hemoglobin, Kebiasaan Merokok Dan Daya Tahan Kardiorespirasi (Vo<sub>2</sub> Max) Pada Atlet Unit Kegiatan Mahasiswa Bola Basket. *Media Gizi Indones*. 2019;14(1):27–34.
- Fadila I. (2022) . *Catat! Ini 8 Penyebab Kadar Hemoglobin Terlalu Tinggi*. *Harian digital Hellosehat*, diakses pada bulan September 2023. Link : 8 Penyebab Hemoglobin (Hb) Tinggi yang Perlu Diperhatikan (hellosehat.com)
- Ghalda A, Gifari N, Nadiyah N. (2019). Pengetahuan, Status Hidrasi, Porsen Lemak Tubuh, Kadar Hemoglobin, dan Kebugaran Atlet Senam. *Gorontalo J Public Heal*. 2019;2(2):170.
- Hermanto RA, Kandarina BI, Latifah L. (2020). Hubungan Antara Status Anemia, Tingkat Aktivitas Fisik, Kebiasaan Sarapan Dan Depresi Pada Remaja Putri Di Kota Yogyakarta. *Media Gizi Mikro Indones*. 2020;11(2):141–52.
- Junita D, Wulansari A. (2021). Pendidikan Kesehatan tentang Anemia pada Remaja Putri di SMA N 12 Kabupaten Merangin. *J Abdimas Kesehat*. 2021;3(1):41.

- Kusuma AD. (2020). Penilaian Status Hidrasi. *Jurnal Ilmiah Kesehatan Sandi Husada*. 9(1):13-17. p-ISSN: 2354-6093 dan e-ISSN: 2654-4563 DOI: 10.35816/jiskh.v10i2.196.
- Muzayyarah M, Suyati S. (2018). Hubungan Kadar Hb (Haemoglobin) Dengan Prestasi Belajar Pada Mahasiswi Prodi D-III Kebidanan FIK UNIPDU Jombang. *J Kesehat Kusuma Husada*. 2018;220–5.
- Rahayu TB dan Fitriana. (2020). Analisis Faktor-Faktor Yang Mempengaruhi Status Gizi Remaja Putri. *Jurnal Vokasi Kesehatan*. 6(1):46–51. [Http://Ejournal.Poltekkes-Pontianak.Ac.Id/Index.Php/Jvk](http://Ejournal.Poltekkes-Pontianak.Ac.Id/Index.Php/Jvk)
- Saharun Iso AT. (2016). PRINSIP UMUM PENATALAKSANAAN CEDERA OLAHRAGA HEAT STROKE Saharun. *J Olahraga Prestasi*. 2016;12(2):41–60.
- Siswanto. (2017). Darah dan Cairan Tubuh. *Diklat Fisiol Vet 1*. 2017;1–49.
- Sudiana IK. (2015). Konsumsi Oksigen Maksimal (Vo2 Maks) Dan Aktivitas Olahraga. *J PENJAKORA [Internet]*. 2015;2(2):76–87. Available from: <https://ejournal.undiksha.ac.id/index.php/PENJAKORA/article/view/11485>.
- Sudrajat A, Mexitalia M, Rosidi A. (2019). Status hidrasi, tingkat kebugaran jasmani dan daya konsentrasi anak sekolah dasar. *J Gizi Indones (The Indones J Nutr)*. 2019;7(2):109–13.
- WHO. (2020). Adolescent Health and Development. Available online : Adolescent health and development (who.int).