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Analysis of determinants of hydration status of medical students at the Universitas Sumatera Utara

Analisis faktor penentu status hidrasi mahasiswa kedokteran Universitas Sumatera Utara

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Abstract

Dehydration can impair the operation of the body's organs and cause mortality because the human body is 60% water. The purpose of this study was to analyze factors related to hydration status. This study using a cross-sectional research design in a descriptive-analytical study. The study was conducted in the Nutrition Department of the Faculty of Medicine, Universitas Sumatera Utara. The study was conducted from September to October 2020. 99 students were chosen at random to participate in the study. Respondent characteristics, physical activity, nutritional status, body composition, fluid intake, and hydration status were among the information gathered. Subject follow-up was carried out for 7 consecutive days. Positive relationships and significance between dietary status (p= 0,014), total body water (p= 0,018), muscle mass (p= 0,012), level of exercise (p= 0,003), and total fluid intake (p= 0,044) were found in the results of the multiple regression test. Additionally, a negative association and significance between visceral fat (p= 0,03) and body fat (p= 0,016) is discovered. Based on the test's findings, a determination coefficient with a value of 85,5% was calculated, meaning that 85,5% of factors influencing hydration status include dietary habits, body composition, visceral fat, total body water, muscle mass, level of exercise, and total fluid intake. Conclusion, nutritional status, total body water, muscle mass, physical activity, and overall fluid intake all have a positive correlation with hydration status. However, there was shown to be a negative correlation between body fat and visceral fat and hydration status.

Keywords: Anthropometric, body composition, fluid consumption

Abstrak

Tubuh manusia tersusun dari 60% cairan sehingga dehidrasi dapat mengganggu fungsi organ tubuh dan berakibat kematian. Tujuan dari penelitian ini adalah untuk menganalisis faktor-faktor yang berkaitan terhadap status hidrasi. Jenis penelitian adalah deskriptif analitis dengan desain penelitian potong lintang. Studi ini dilaksanakan di ruangan Departemen Gizi Fakultas Kedokteran Universitas Sumatera Utara. Penelitian ini dilaksanakan dari bulan September sampai Oktober 2020. Peneliti melibatkan 99 mahasiswa Fakultas Kedokteran Universitas Sumatera Utara yang dipilih secara acak sederhana. Data yang dikumpulkan meliputi karakteristik responden, aktivitas fisik, status gizi, komposisi tubuh, asupan cairan dan status hidrasi. Subjek penelitian dilakukan *follow up* selama 7 hari berturut-turut. Dari hasil uji regresi didapatkan hasil signifikan dan korelasi yang positif dari status nutrisi (p= 0,014), total cairan tubuh (p= 0,018), massa otot (p= 0,012), tingkat aktivitas (p = 0,003) dan total konsumsi cairan (p= 0,044). Selain itu, hasil signifikan dan korelasi negatif didapatkan pada lemak tubuh (p= 0,016) dan lemak viseral (p= 0,030). Berdasarkan hasil uji koefisien determinasi didapatkan nilai 85,5% yang menandakan bahwa 85,5% status hidrasi dipengaruhi oleh status nutrisi, lemak tubuh, lemak

viseral, total body water, massa otot, tingkat aktivitas dan total konsumsi cairan. Kesimpulan yang diperoleh terdapat hubungan yang positif antara status hidrasi dengan status gizi, cairan tubuh total, massa otot, aktivitas dan asupan cairan total. Namun, hubungan negatif diperoleh antara status hidrasi dengan lemak tubuh dan lemak visceral.
Kata Kunci: Komposisi tubuh**,** penilaian antropometrik, asupan cairan

Introduction

The majority of the human body, between 50 and 75%, is composed of water. The older a person is, the lower the water content in the body system. Fluid in the body system is divided into two types: intracellular (± 67%) and extracellular space (± 33%). Additionally, the fluid in the extracellular space is divided into two types: interstitial space (75%) and intravascular space (25%) (Brinkman et al., 2023; Chen et al., 2022; Tobias et al., 2022). The compositions of the electrolytes in these spaces showed different concentrations. The compositions of the interstitial and intravascular spaces are generally similar, with sodium and chloride being the main contributors to osmolarity. In the intracellular space, osmolarity is mainly regulated by potassium ions, the rest is regulated by other substances such as phosphate, magnesium, and phosphocreatine (Brinkman et al., 2023; Chen et al., 2022)

Water plays a role in thermoregulation, maintaining intravascular volume, as a transport medium for nutrients and as a solvent for waste products (Liska et al. 2019). Subsequently, fluid loss can affect various bodily functions. For example, mild dehydration, defined by–1-2% fluid loss, causes symptoms such as impaired concentration, memory, and cognition (Kostelnik et al., 2021). The long-term effects of this dehydration were also associated with an increased risk of kidney stones, chronic kidney disease, urinary tract infections, cardiovascular diseases, and metabolic diseases (Nakamura et al., 2020) The fluid intake needed differs among individuals depending on age, gender, and other condition such as pregnancy and lactation. A fluid intake of 2500 ml and 2350 ml is generally recommended for men and women between the ages of 19 and 64 years (Moeloek, 2019).

The hydration status is used to determine whether a person is dehydrated. This status describes the balance between the amount of fluid leaving and entering the body, which is then determined by measuring the concentration of urine. The concentration of urine can be measured using common markers such as urine osmolality, specific gravity, and urine color (Kostelnik et al., 2021). Less common methods include measuring body composition using a Bioelectrical Impedance Analysis (BIA) tool, changes in body weight, and hematological parameters (Kusuma, 2020).

Various studies have shown that body water content is related to body composition and overall health. A balanced amount of body fluid is associated with a low ratio of waist circumference to body fat mass (Carretero-Krug et al., 2021; García et al., 2019). Individuals who are not adequately hydrated has 1,59 times risk of becoming obese (Chang et al., 2016). However, this is not consistent with the study conducted by Kurniawati et al. (2021), where no relationship was found between nutritional and hydration status in male workers (Kurniawati et al., 2021). The amount of fluid intake and physical activity also affect hydration status (Pustisari et al., 2020); however, the study carried out by Merita et al. (2018) also did not find a significant relationship between the nutritional and hydration status of adolescents in Jambi City (Merita et al., 2018).

According to earlier research, students' levels of hypohydration ranged from 26,9% to 41,3% (Abdulsalam et al., 2022; Nur'aini et al., 2021). Students who are dehydrated may have poorer psychomotor, cognitive, physical, and motivational abilities (Ekpenyong & Akpan, 2017). Since our university has not yet conducted any research on the hydration status of medical students, further research is essential to determine the rate of dehydration among these students and the variables influencing their hydration condition.

Depending on a variety of variables, such as age, physical size, gender, sport, type of work, and place occupied, each person has a varied level of water adequacy. It is important to monitor hydration levels to prevent dehydration, which can harm health and fitness. The study aims to analyze factors related to the hydration status of students. This study aims to analyze factors related to hydration status in college students.

Methods

This study used a cross-sectional observational design to obtain data on the relationship between various factors and hydration status. Furthermore, it was carried out at the residence of each subject by the Department of Nutrition at the Faculty of Medicine, Universitas Sumatera Utara USU, from September to October 2020. This study was authorized by the Universitas Sumatera Utara USU Ethics Committee for Research on June 15, 2020, with reference number 69/KEP/USU/ 2020.

Sample Size

In this study, the target population included all USU Faculty of Medicine students which were comprised of students of 2017 (254 people), 2018 (249 people), and 2019 (245 people). The respondents were students who were selected using simple random sampling. The sample size was determined using the Taro Yamane formula (Yamane., 1973), where a total population of 748 people with a precision level of 10%, a sample size of 89 respondents was obtained.

$$n = \frac{N}{1 + N\,(e)^2}$$

$$n = \frac{748}{1 + 748\,(0.1)^2} = 88{,}2 \approx 89\ respondents$$

n : sample size l
N : population
e : allowable (10%)

To anticipate the occurrence of dropouts, additional respondents were added based on the following formula (Kang, 2021):

$$n' = \frac{n}{1 - d}$$

$$n' = \frac{89}{1 - 0{,}1} = 98{,}88 \approx 99\ respondents$$

n' : final sample size
n : sample size
d : drop out proportion

Instruments

Primary data collected were respondents' characteristics, physical activity, nutritional status, body composition, total fluid intake and hydration status were obtained. These data were obtained by questionnaires, which consists of fluid intake, hydration status, as well as measuring body composition and nutritional status.

Body composition measurements, such as categorizing BMI levels, can be used to determine nutritional status. (IMT). The Bio Impedance Analysis tool is used to determine the amount of total body water, body fat, visceral fat, and muscle mass, while a statumeter is used to determine the body height (TB) in meters.

The nutritional status of the respondents was obtained from the calculation of the body mass index (BMI) by comparing body weight in kilograms and height in meters. The results obtained are compared using BMI tables for the Asia Pacific population, namely underweight (< 18,5 kg/m2), normal (18,5-22,9 kg/m^2), overweight (23-24,9 kg/m^2), and obesity (≥ 25 kg/m^2) (Weir & Jan, 2022). The respondents were also asked about physical activity, which was categorized into light, moderate and heavy. It is classified to be light activity 75% of the time used is sitting, moderate if 40% of the time is spent sitting, and heavy if 25% of the time is spent sitting (Almatsier, 2010).

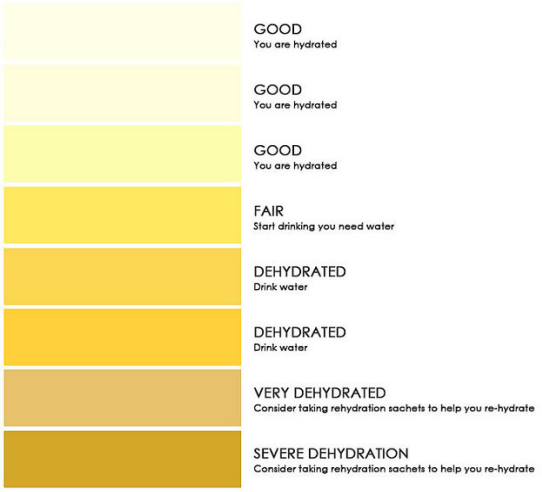

Figure 1. Urine self-examination card (Gunawan et al., 2018).

The collection of fluid intake data was carried out for seven consecutive days at three different times, namely at 10 am, 5 pm and 10 pm using a consumption recall form. Respondents reported independently through the google form application that had been designed by the researcher. The recommended

daily fluid intake for people is around eight glasses of 230 ml each, or a total of 2000 ml. As a result, the researchers divided daily fluid intake into two categories: sufficient consumption (2000 mL or more) and insufficient consumption (less than 2000 mL).

Hydration status was measured by comparing the color of one's urine using a urine self-examination card (PURI card). The status is classified as hydrated when the color of the urine paired with the PURI card shows good and it is categorized as dehydrated when it does not fulfil the criteria.

Statistical Analysis

Data processing and analysis were carried out descriptively to determine the frequency distribution of the primary data. The normality test and the colinearity test are used to validate the regression analysis results before the hypothesis is tested. The link between free variables and bound variables is evaluated using the Pearson correlation test.

Furthermore, analytical tests were carried out to determine the factors affecting hydration status using a multiple linear regression method with the equation below:

$$Y = b0 + b1X1 + b2X2 + b3X3 + b4X4 + b5X5 + b6X6 + b7X7 + e$$

Description

Y : Hydration status
X1 : Nutritional status
X2 : Body fat
X3 : Total body wate
X4 : Muscle mass
X5 : Physical activity
X6 : Visceral fat
X7 : Total fluid consumption
e : Error term
bo : Constant
b1-7 : Regression coefficient

The examiner's tested the uniformity of the data with a normality test to avoid bias for each variable. Furthermore, a multicollinearity test was performed to avoid correlations between independent variables by paying attention to the Variance Inflation Factor (VIF) value, which did not exceed 10 and tolerance value was greater than 0,1. The sustainability of proving the hypothesis was carried out by using a t-test with a limit of coefficient of determination from 0 to 1. Approaching 1 means that the independent variable provides almost all the information needed to predict the dependent variable, and vice versa.

Result and Discussion

Respondents' Characteristics, Body Composition, and Hydration Status

A total of 99 respondents consisted of 48 male (48,5%) and 51 female (51,5%) with an average age of 20,08 ± 1,08 years. Most of the respondents did relatively light daily physical activity (79,8%) (Table 1).

In this study, the majority of the respondents were female who engaged in light daily physical activity, were overweight, and well hydrated. In previous studies, which conducted on university students, it was reported that the majority of the respondents were female and had good hydration status (Arista & Wahyudin, 2021; Ekpenyong & Akpan, 2017; Nur'aini et al., 2021). The results of previous studies regarding physical activity showed different results. The study carried out on students showed that their activity is classified as moderate (Amaliya, 2018; Merita et al., 2018), and low (Ekpenyong & Akpan, 2017; Nur'aini et al., 2021). The results of the study performed on the nutritional status of students showed that it was classified as normal (Amaliya, 2018; Ekpenyong & Akpan, 2017; Merita et al., 2018; Nur'aini et al., 2021). The difference in the results was due to the difference in the time of sampling. In this study, sampling was carried out during the COVID-19 pandemic, and the learning process was carried out online. This causes a decrease in most of the student's physical activity, which results in an increase in BMI. In addition, the density of learning activities for medical students as respondents causes limited time to do physical activities.

Table 1 also shows that the majority of respondents are overweight (48,45%) and obese (7,1%) with a body fat percentage of 27,73 ± 8,65 and a ratio of visceral fat of 6,02 ± 3,95. Based on the self-examination of urine conducted by respondents, most of them belonged to the category of hydrated (51,5%) and an average daily fluid intake of 2070,07 ± 654,93mL.

Table 1. Respondents characteristics, body composition, and hydration status

Respondents	Mean (SD) or Total n (%)	
Age in years	20,08 ± 1,08 >0,05	
Gender	Male	48 (48,5)
	Female	51 (51,5)
Daily physical activity	Light	79 (79,8)
	Moderate	19 (19,2)
	Heavy	1 (1,0)
Body weight in kilograms	64,89 ± 15,39	
Body height in meters	1,63 ± 0,08	
Nutritional status	Normal	44 (44,4)
	Overweight	48 (48,5)
	Obesity	7 (7,1)
Percentage of total body water	48,64 ± 5,71	
Percentage of body fat	27,73 ± 8,65	
Visceral fat ratio	6,02 ± 3,95	
Muscle mass in kilogram	43,74 ± 10,69	
Hydration status	Hydrated	51 (51,5)
	Dehydrated	48 (48,5)
Average of total fluid consumption in milliliters	2070,07 ± 654,93	

According to the examination results of body composition (Table 1), the average percentage of respondents' total body water was around 48,64%. In previous studies, it was found that the average total body water in medical students was around 54,4% (Mastria & Adyaksa, 2014). The average percentage of body fat obtained in this study ranged from 27,73%, this result is no different from previous studies which obtained an average percentage of body fat in medical students ranging from 26,7% (Haq et al., 2020) to 28,34% (Widiastuti et al., 2018). Based on the average visceral fat ratio, 6,02 was recorded, while the study done with medical students in China, 4,1 was recorded (Haq et al., 2020). Finally, muscle mass was 43,74 Kg and the study carried out in China obtained an average muscle mass of 41,3 Kg (Haq et al., 2020).

Analysis of Factors Affecting Hydration Status

Table 2 shows the analysis results of the factors affecting hydration status. The results of the multiple regression test shows that there was a positive and negative relationship between the respondent's dehydration status, which can be seen in the B value. Nutritional status, total body water, muscle mass, physical rating, and total fluid consumption have a positive relationship with hydration status. It can be seem when the variable increases by 1 unit, then the hydration status will increase by B value from the statistical test. On the other hand, the test results show a negative relationship against body fat and visceral fat.

Table 2. Colinearity test for respondents' body composition

Model	T	p value	B
Constant 3,682 0,010			
Nutritional status	-4,216	0,014	1,282
Body fat	-3,585	0,016	-1318
Total body water	-3,271	0,018	2,301
Muscle mass	-4,206	0,012	1,226
Physical rating	3,044	0,003	1,418
Visceral fat	3,024	0,030	-1,200
Total water consumption	4,043	0,044	2,500

Based on the results of the coefficient of determination, a correlation value of 0,892 was obtained (Table 3). This means that the general nutritional status, body fat, total body water,

muscle mass, physical rating, visceral fat and total water consumption can improve hydration status.

Table 3. Coefficient of determination test

R	R Square	Adjusted R Square	Std. Error
0,892	0,855	0,802	4,849

From the same test, it is also known that the coefficient of determination (R2) is 0,855 (85,5%). Therefore, it can be reported that the 85,5% variation of hydration status in the model can be explained by variables such as nutritional status, body fat, total body water, muscle mass, physical rating, visceral fat and total water consumption. The remaining 14,5% can be influenced by other variables outside the model.

In this study, there was a significant and positive correlation with hydration status for the variables of nutritional status, total body water, muscle mass, physical rating, and total fluid intake. This result is not consistent with the study by (Kurniawati et al., 2021) on male workers and (Nur'aini et al., 2021) on medical students in Palembang (Nur'aini et al., 2021) as well as with the physical activity variable (Merita et al., 2018; Nur'aini et al., 2021). The results of other studies obtained a significant relationship with nutritional status (Merita et al., 2017), physical activity (Pustisari et al., 2020), and total fluid intake (Nur'aini et al., 2021; Pustisari et al., 2020; Suprabaningrum & Dieny, 2017), on hydration status.

This study shows that visceral and body fat has a significant relationship and are negatively correlated with hydration status. In the study done by (Carretero-Krug et al., 2021), it was found that body fat had a relationship with hydration status (Carretero-Krug et al., 2021), in contrast to Pustisari et al., (2020) on project workers, which showed the opposite relationship (Pustisari et al., 2020). The results of the various analyzes in these studies may have been caused by differences in respondents (age, and occupation), geography, data analysis techniques, and time of data collection. A person with obese nutritional status is more likely to be dehydrated than a person with normal nutritional status. An overweight person generally loses more water from their body, increasing the risk of dehydration (Arista & Wahyudin, 2021).

Respondents with low physical activity were more dehydrated than those with moderate-high activity. This condition is triggered because an increase in physical activity stimulates the hormone vasopressin to stimulate thirst to maintain a balance of body fluids (Carretero-Krug et al., 2021; Ekpenyong & Akpan, 2017). People with a high BMI have body fat, visceral fat, and total body water that is greater than the muscle mass. This will lead to dehydration. The low total body water causes the water content in fat cells to be lower than the water content in muscle cells (García et al., 2019).

The results of Ekpenyong & Akpan (2017) and Kurniawati et al., (2021) regarding total fluid consumption are in line with the results of this study. Inadequate fluid consumption has a significant relationship with the incidence of dehydration in respondents, which can be assessed by specific gravity and urine color. Adequate water consumption is indicated by clearer urine color and a lower urine-specific gravity value (Ekpenyong & Akpan, 2017; Kurniawati et al., 2021).

From the results of the coefficient of determination, it was reported that 85,5% hydration status was influenced by nutritional status, total body water, muscle mass, physical rating, total fluid consumption,body fat, and visceral fat. The remaining 14,5% of hydration status is influenced by other factors outside this study model. These other factors in several studies are knowledge variables (Kurniawati et al., 2021), gender (Amaliya, 2018), age (Bruno et al., 2021) and type of diet that implemented (San Mauro Martín et al., 2019).

The weakness in this study is the number of respondents. Other variables that may affect hydration status such as body temperature, climate (temperature, moist) and type of fluid consumed were not included. Therefore, in a future study, it is hoped that there would be an increase in the number of samples and more variables that affect hydration status can be analyzed.

Conclusion

From this study it was found that the variables of nutritional status, total body water, muscle mass, activity level, total fluid consumption, body fat and visceral fat contributed 85,5% to

students' hydration status. This research can be used as a reference for making policies on campus to overcome dehydration in students, for example by providing education on the importance of fluid consumption, increasing physical activity such as routine sports.

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References

Abdulsalam, R., Alsadah, A., Alkhuboli, M., Muala, D., Hussein, A., & Elmoselhi, A. B. (2022). Hydration status assessment and impinging factors among university students in the UAE. *European review for medical and pharmacological sciences*, 26(18), 6451–6458. https://doi.org/10.26355/eurrev_202209_29744

Almatsier, S. (2010). Prinsip dasar ilmu gizi. Jakarta: Gramedia Pustaka Utama

Amaliya, R. M. (2018). Gambaran Status Hidrasi dan Hubungannya dengan Jenis Kelamin, Indeks Massa Tubuh, Aktivitas Fisik, dan Jumlah Air yang Dikonsumsi pada Mahasiswa Preklinik Fakultas Kedokteran Universitas Islam Negeri Syarif Hidayatullah jakarta Tahun 2018. UIN Syarif Hidayatullah Jakarta.

Arista, L., & Wahyudin, A. A. (2021). Faktor-Faktor Yang Berhubungan Dengan Status Hidrasi Mahasiswa Program Profesi Ners Fakultas Ilmu Keperawatan Universitas Indonesia. *Jurnal Ilmu Keperawatan Medikal Bedah*, *4*(2), 36–47. https://doi.org/10.32584/jikmb.v4i2.669

Brinkman, J. E., Dorius, B., & Sharma, S. (2023). *Physiology, Body Fluids*. StatPearls; StatPearls Publishing. https://www.ncbi.nlm.nih.gov/books/NBK482447/

Bruno, C., Collier, A., Holyday, M., & Lambert, K. (2021). Interventions to improve hydration in older adults: A systematic review and meta-analysis. *Nutrients*, *13*(10), 1–20. https://doi.org/10.3390/nu13103640

Carretero-Krug, A., Úbeda, N., Velasco, C., Medina-Font, J., Laguna, T. T., Varela-Moreiras, G., & Montero, A. (2021). Hydration status, body composition, and anxiety status in aeronautical military personnel from Spain: a cross-sectional study. *Military Medical Research*, *8*(1), 1–9. https://doi.org/10.1186/s40779-021-00327-2

Chang, T., Ravi, N., Plegue, M. A., Sonneville, K. R., & Davis, M. M. (2016). Inadequate hydration, BMI, and obesity among US adults: NHANES 2009-2012. *Annals of Family Medicine*, *14*(4), 320–324. https://doi.org/10.1370/afm.1951

Chen, J., Sabir, S., & Khalili, Y. (2022). *Physiology, Osmoregulation and Excretion*. StatPearls Publication. https://www.ncbi.nlm.nih.gov/books/NBK541108/

Ekpenyong, C. E., & Akpan, I.-A. M. (2017). High prevalence and associated risk factors of dehydration among college students: implications for health and academic performance. *International Journal Of Community Medicine And Public Health*, *4*(4), 1043. https://doi.org/10.18203/2394-6040.ijcmph20171322

García, A. I. L., Moráis-Moreno, C., Samaniego-Vaesken, M. de L., Puga, A. M., Varela-Moreiras, G., & Partearroyo, T. (2019). Association between hydration status and body composition in healthy adolescents from Spain. *Nutrients*, *11*(11). https://doi.org/10.3390/nu11112692

Haq, I. U., Mariyam, Z., Zeb, F., Jiang, P., Wu, X., Shah, J., Xu, C., Zhou, M., Feng, Q., & Li, M. (2020). Identification of Body Composition, Dietary Patterns and Its Associated Factors in Medical University Students in China. *Ecology of Food and*

Nutrition, *59*(1), 65–78. https://doi.org/10.1080/03670244.2019.1663350

Kang, H. (2021). Sample size determination and power analysis using the G*Power software. *Journal of Educational Evaluation for Health Professions*, *18*(17), 1–12. https://doi.org/10.3352/JEEHP.2021.18.17

Kostelnik, S. B., Davy, K. P., Hedrick, V. E., Thomas, D. T., & Davy, B. M. (2021). The Validity of Urine Color as a Hydration Biomarker within the General Adult Population and Athletes: A Systematic Review. *Journal of the American College of Nutrition*, *40*(2), 172–179. https://doi.org/10.1080/07315724.2020.1750073

Kurniawati, F., Sitoayu, L., Melani, V., Nuzrina, R., & Wahyuni, Y. (2021). Hubungan Pengetahuan, Konsumsi Cairan dan Status Gizi dengan Status Hidrasi pada Kurir Ekspedisi Relationship between Knowledge, Fluid Intake and Nutritional Status with Hydration Status of Expedition Couriers. *Jurnal Riset Gizi*, *9*(1), 46–52.

Kusuma, A. D. (2020). Penilaian Status Hidrasi. *Jurnal Ilmiah Kesehatan Sandi Husada*, *9*(1), 13–17. https://doi.org/10.35816/jiskh.v10i2.196

Liska, D., Mah, E., Brisbois, T., Barrios, P. L., Baker, L. B., & Spriet, L. L. (2019). Narrative review of hydration and selected health outcomes in the general population. *Nutrients*, *11*(1), 1–29. https://doi.org/10.3390/nu11010070

Mastria, A., & Adyaksa, G. (2014). Hubungan Persentase Lemak Tubuh Dengan Total Body Water Mahasiswa Fakultas Kedokteran Universitas Diponegoro Semarang. *Jurnal Kedokteran Diponegoro*, *3*(1), 105714.

Merita, M., Aisah, A., & Aulia, S. (2018). Status Gizi Dan Aktivitas Fisik Dengan Status Hidrasi Pada Remaja Di Sma Negeri 5 Kota Jambi. *Jurnal Ilmu Kesehatan Masyarakat*, *9*(3), 207–215. https://doi.org/10.26553/jikm.v9i3.313

Moeloek, N. F. (2019). Angka Kecukupan Gizi yang dianjurkan untuk masyarakat Indonesia. In *Menteri Kesehatan Republik Indonesia*.

Nakamura, Y., Watanabe, H., Tanaka, A., Yasui, M., Nishihira, J., & Murayama, N. (2020). Effect of Increased Daily Water Intake and Hydration on Health in Japanese Adults. *Nutrients*, *12*(4), 1–17.

Nur'aini, D. L., Kurniati, A. M., Damayanti, M., Husin, S., & Marwoto, J. (2021). Fluid consumption, hydration status, and its associated factors: a cross sectional study among medical students in Palembang, Indonesia. *World Nutrition Journal*, *5*(1), 88. https://doi.org/10.25220/wnj.v05.i1.0012

Pustisari, F., Sitoayu, L., Nuzrina, R., Angkasa, D., & Gifari, N. (2020). Hubungan Aktivitas Fisik, Konsumsi Cairan, Status Gizi Dan Status Hidrasi Pada Pekerja Proyek. *Jurnal Gizi*, *9*(2), 215. https://doi.org/10.26714/jg.9.2.2020.215-223

San Mauro Martín, I., Garicano Vilar, E., Romo Orozco, D. A., Mendive Dubourdieu, P., Paredes Barato, V., Rincón Barrado, M., Valente, A., Bentancor, F., Morales Hurtado, A. D., & Garagarza, C. (2019). Hydration Status: Influence of Exercise and Diet Quality. *American Journal of Lifestyle Medicine*, *13*(4), 414–423. https://doi.org/10.1177/1559827617711906

Suprabaningrum, A. R., & Dieny, F. F. (2017). Hubungan konsumsi cairan dengan status hidrasi pekerja di suhu lingkungan dingin. *Journal of Nutrition College*, *6*(1), 76. https://doi.org/10.14710/jnc.v6i1.16896

Tobias, A., Ballard, B. D., & Mohiuddin, S. S. (2022). *Physiology, Water Balance*. StatPearls. https://www.ncbi.nlm.nih.gov/books/NBK541059/

Weir, C. B., & Jan, A. (2022). *BMI Classification Percentile And Cut Off Points*. StatPearls Publishing. https://pubmed.ncbi.nlm.nih.gov/31082114/

Widiastuti, I. A. E., Priyambodo, S., & Buanayuda, G. W. (2018). Korelasi Pengukuran Antropometrik dengan Kebugaran Kardiorespirasi pada Mahasiswa Fakultas Kedokteran Universitas Mataram. *Unram Medical Journal*, *7*(4), 19. https://doi.org/10.29303/jku.v7i4.311

Yamane, T. (1973). Statistics: An introductory analysis. pp. 1088