2024, Retos, 56, 864-869

Fatigue Index, Haemoglobin Level and Physical Fitness: A Correlation Analysis Study
Índice de fatiga, nivel de hemoglobina y condición física: un estudio de análisis de correlación

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Abstract. Physical fitness is one of the most important indicators in daily life, supported by various factors including fatigue index and haemoglobin levels. The purpose of this study was to determine: 1) the contribution of fatigue index to physical fitness, 2) the contribution of haemoglobin level to physical fitness, and 3) the contribution of fatigue index and haemoglobin level simultaneously to physical fitness. The research studied belongs to the type of quantitative research with a correlational approach and continued by calculating the amount of contribution of the independent variable (predictor) to the dependent variable (criterion) through the determination index, namely r2 x 100%. Sampling was carried out using purposive sampling technique and the sample amounted to 48 people. The characteristics of this research sample are active sports students aged 18.68 ± 0.86 years, height 165.38 ± 6.71 centimetres, and body weight 56.75 ± 9.70 kilograms. Fatigue Index was measured by Running Based Anaerobic Sprint Test (RAST Test), Haemoglobin Level was measured by Sahli method, and Physical fitness was measured by the Bleep Test. The data analysis techniques used were simple and multiple correlation analysis techniques. Hypotheses 1 and 2 were analysed by simple correlation and regression, while hypothesis 3 was analysed by correlation and multiple regression. Simple correlation and multiple regression analysis, this analysis is used to determine the contribution of fatigue index variables and haemoglobin levels to physical fitness. The results in this study are: 1) Fatigue index contributes to the level of physical fitness by 6.09%. 2) Haemoglobin levels contribute to the level of physical fitness by 9.14%, and 3) Fatigue index and haemoglobin levels together contribute to the level of physical fitness by 16.83%.
Keywords: Fatigue Index, Haemoglobin Level, and Physical Fitness.

Abstracto. La aptitud física es uno de los indicadores más importantes en la vida diaria, respaldado por varios factores, incluido el índice de fatiga y los niveles de hemoglobina. El propósito de este estudio fue determinar: 1) la contribución del índice de fatiga a la aptitud física, 2) la contribución del nivel de hemoglobina a la aptitud física y 3) la contribución del índice de fatiga y el nivel de hemoglobina simultáneamente a la aptitud física. La investigación estudiada pertenece al tipo de investigación cuantitativa con enfoque correlacional y se continuó calculando el monto de contribución de la variable independiente (predictora) a la variable dependiente (criterio) a través del índice de determinación, es decir r2 x 100%. El muestreo se realizó mediante la técnica de muestreo intencional y la muestra ascendió a 48 personas. Las características de esta muestra de investigación son estudiantes de deportes activos con edad de 18,68 ± 0,86 años, altura 165,38 ± 6,71 centímetros y peso corporal 56,75 ± 9,70 kilogramos. El índice de fatiga se midió mediante la prueba de sprint anaeróbico basada en la carrera (prueba RAST), el nivel de hemoglobina se midió mediante el método Sahli y la aptitud física se midió mediante la prueba Bleep. Las técnicas de análisis de datos utilizadas fueron técnicas de análisis de correlación simple y múltiple. Las hipótesis 1 y 2 se analizaron mediante correlación simple y regresión, mientras que la hipótesis 3 se analizó mediante correlación y regresión múltiple. Análisis de correlación simple y regresión múltiple, este análisis se utiliza para determinar la contribución de las variables del índice de fatiga y los niveles de hemoglobina a la aptitud física. Los resultados de este estudio son: 1) El índice de fatiga contribuye al nivel de aptitud física en un 6,09%. 2) Los niveles de hemoglobina contribuyen al nivel de aptitud física en un 9,14%, y 3) El índice de fatiga y los niveles de hemoglobina juntos contribuyen al nivel de aptitud física en un 16,83%.
Palabras clave: índice de fatiga, nivel de hemoglobina y condición física.

Fecha recepción: 08-11-23. Fecha de aceptación: 30-04-24
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Introduction

One of the goals in doing physical activity and sports is to improve physical fitness. Physical fitness has a close relationship with physical activity and health (Perdana Ilsya et al., 2023);(Marheni et al., 2022). Efforts to improve physical fitness are health efforts that utilize physical activity to improve health status (Carballo-Fazanes et al., 2022; Giakoni et al., 2021; Sepriadi et al., 2022). This means that efforts to improve physical fitness will indirectly also improve health status in other words, physical fitness is related to health.

High physical activity will affect the level of physical fatigue. A person with high physical activity will indirectly be easier to level of fatigue, especially physical fatigue (Philipp et al., 2023). Fatigue in sports reduces or weakens a person's ability to perform physical activity. In sports training, the fatigue index is during exercise (Hernández-Cruz et al., 2022; Naharudin, M. N., & Yusof, 2013). Exercises that can increase fatigue levels are anaerobic exercises such as running that rely on glycogen rather than oxygen for fuel (Ferrara & D'Angelo, 2023; Sehle et al., 2014). The fatigue index can be measured by a series of sprint times. So, to overcome fatigue, everyone should have good endurance.

One of the factors that is the main benchmark in determining a person's physical fitness is the aerobic endurance factor. Endurance is the body's ability to cope with loads for a long time without experiencing significant fatigue (Bafirman et al., 2023; Medrano Ureña, 2023; Sepriadi et al., 2023;). Many factors affect physical fitness including motivation, physical activity, motor skills, nutritional status, and genetics (Khairuddin; et al., 2022); (Khairuddin et al., 2023);(Bafirman et al., 2023);(Welis et al., 2023).

Physical fitness is also closely related to aerobic

endurance, so we can also know that the state of health can also affect a person's aerobic endurance. The degree of health is one indicator that affects haemoglobin levels (Sepriadi et al., 2020). Haemoglobin is found in red blood cells and is the main component in red blood cells (Carballo-Fazanes et al., 2022; Fucharoen & Weatherall, 2012). Red blood cells are the most blood cells in the human body. As the main component of red blood cells, haemoglobin (Hb) functions as a carrier of oxygen (O2) and carbon dioxide (CO2).

A body condition with lower than normal haemoglobin levels is referred to as anaemia. Anaemia is characterised by a low haemoglobin (Hb) concentration or hematocrit threshold value caused by low red blood cell (erythrocyte) production, increased erythrocyte destruction (hemolysis), or excessive blood loss.

Method

The research studied belongs to the type of quantitative research with a correlational approach that aims to investigate how far the relationship between the variables obtained is related to other variables based on the magnitude of the correlation coefficient. This research seeks to reveal the relationship between variables by the actual situation. The analysis is continued by calculating the contribution of the independent variable (predictor) to the dependent variable (criterion) through the determination index, namely r^2x100%.

The population in this study were students of the Faculty of Sports Science Universitas Negeri Padang who took the Physical Fitness Development course. Sampling was done with a purposive sampling technique so that the sample obtained 48 people. The characteristics of the study sample are as shown in the Table 1 below.

Table 1.
Sample Descriptive Analysis Results

Criteria	Average	Standard Deviation (SD)
Age (Years)	18.68	0.86
Height (cm)	165.38	6.71
Weight (Kg)	56.75	9.70

From this table, of the 48 samples that took tests and measurements, the results obtained: the mean age of participants was 18.68 years (± 0.86). Other clinical characteristics of the participants include a mean height of 165.38 cm (± 6.761) and a mean weight of 56.75 kg (± 9.70).

Fatigue Index is the ability of a person to be able to perform physical activity by maintaining fatigue for as long as possible. Fatigue index as measured by the Running Based Anaerobic Sprint Test (RAST Test) (Abbasian S et al., 2012; Naharudin, M. N., & Yusof, 2013). The Running-based Anaerobic Sprint Test (RAST) was developed at the University of Wolverhampton (United Kingdom) to test an athlete's anaerobic performance. The RAST is similar to the Wingate Anaerobic 30-cycle Test (WANT) in that it provides measurements of power and fatigue index. The Wingate test is more specific for cyclists whereas the RAST provides a test that can be used with athletes where running forms the basis of their sport/event. The sample completes six 35-metre runs at maximum pace; (10 seconds allowed between each sprint for turnaround). Records the time taken for each 35-metre sprint to the nearest hundredth of a second.

Power output for each sprint is found using the following equations:

- Velocity = Distance ÷ Time
- Acceleration = Velocity ÷ Time
- Force = Weight × Acceleration
- Power = Force × Velocity OR Power = Weight × Distance² ÷ Time³

From the six times calculate the power for each run and then determine:

- Maximum power - the highest value
- Minimum power - the lowest value
- Average power - sum of all six values ÷ 6
- Fatigue Index - (Maximum power - Minimum power) ÷ Total time for the 6 sprints

Indicates the rate at which power declines for the athlete. A low value (<10) indicates the ability of the athlete to maintain anaerobic performance. A high fatigue index value (>10) indicates the athlete may need to focus on improving their lactate tolerance (Anonymous, 2006).

Haemoglobin level is the ability of blood in the body to bind oxygen. Haemoglobin levels as measured by the sahli method (Sepriadi, S., & Eldawaty, 2019). Haemoglobin estimation will be done by Sahli's method by a person in the pathology laboratory (obg-gyn opd) of the hospital sample collected by finger prick (Lokhande et al., 2015). Physical fitness is a person's ability to perform physical activities without experiencing significant fatigue. Physical fitness is measured by the Bleep Test (Kavcic et al., 2012; Paradisis, G. P., Zacharogiannis, E., Mandila, D., Smirtiotou, A., Argeitaki, P., & Cooke, 2014).

The data analysis techniques used are simple and multiple correlation analysis techniques. To test the research hypothesis with correlation and regression analysis. The correlation and regression analysis used is simple and multiple analysis.

Results

This study aims to see: 1) the contribution of fatigue index to physical fitness, 2) the contribution of haemoglobin level to physical fitness, and 3) the contribution of fatigue index and haemoglobin level simultaneously to physical fitness.

From the sample, the mean age of participants was 18.68 years (± 0.86). Other clinical characteristics of the participants include a mean height of 165.38 cm (± 6.761) and a mean weight of 56.75 kg (± 9.70). Based on the measurement results, the fatigue index results were obtained with an average of 7.72 (±5.11). Haemoglobin levels in the blood with an average measurement of 14.31

(±2.31) and Maximum Oxygen Volume results with an average of 39.03 (±7.98). This can be seen in Table 2.

Table 2.
Descriptive Analysis of Research Variables

Variable	Max	Min	Median	Variance	Mean ± SD
Fatigue Index	1.28	24.75	6.06	26.13	7.72 ± 5.11
Haemoglobin levels	19.80	10.00	14.30	4.56	14.31 ± 2.31
Maximum Oxygen Volume	51.90	23.90	39.70	63.61	39.03 ± 7.98

Contribution of Fatigue Index to Physical Fitness

The results of the analysis show that the fatigue index contributes significantly to the level of physical fitness. The value of the regression equation can be described as follows $\hat{Y}$ = 33.20 + 0.75X with F_{obs} 14.05 > F_{table} 4.05. Furthermore, based on the regression linearity analysis, the value of F_{obs} 1.21 < F_{table} 3.05 was obtained. This states that the data is in a linear state. Thus, the proposed hypothesis can be accepted. More details can be seen in Table 3.

Table 3.
ANOVA List of Linear Regression $\hat{Y}$ = 33.20 + 0.75X

Source of Variation	dk	JK	KT	F_{obs}	F_{tabel} α=0,05	Summary
Total	48	76099,11	-	-		
Coefficient (a)	1	73109,44	-			
Regression (b/a)	1	699,32	699,32	14,05	4,05	Significant Regression
Remain	46	2290,36	49,79			
Suitable Tuna	38	1950,99	51,34	1,21	3,05	Linear Regression
Error	8	339,37	42,42			

Furthermore, in Table 4, the correlation analysis of the research data obtained the correlation coefficient of the fatigue index on the level of physical fitness. Where the value obtained rx1 y = 0.247 with t_{obs} 1.889> t_{table} 1.678 states that there is a significant relationship. And when viewed from the coefficient of determination, it can be seen that the fatigue index contributes to the level of physical fitness by 6.09%.

Table 4.
Results of Correlation Analysis between Fatigue Index and Physical

Correlation	Coefficient of Correlation (r)	t_{obs}	t_{tabel} α=0,05	Coefficient of Determination
Fatigue Index and Physical Fitness	0.247	1.889	1.678	6,09%

Contribution of Haemoglobin Level to Physical Fitness

The analysis shows that haemoglobin level contributes significantly to the level of physical fitness. The value of the regression equation can be described as follows $\hat{Y}$ = 8.18 + 2.16X with F_{obs} 22.98 > F_{table} 4.05. Furthermore, based on the regression linearity analysis, the value of F_{obs} 0.66 < F_{table} 2.42 is obtained. This states that the data is in a linear state. Thus, the proposed hypothesis can be accepted. More details can be seen in Table 5.

Furthermore, in Table 6, the correlation analysis of the research data obtained the correlation coefficient of the fatigue index on the level of physical fitness. Where the value obtained rx2 y = 0.302 with t_{obs} 2.352> t_{table} 1.678 states that there is a significant relationship. And when viewed from the coefficient of determination it can be seen that haemoglobin levels contribute to the level of physical fitness by 9.14%.

Table 5.
ANOVA List of Linear Regression $\hat{Y}$ = 8.18 + 2.16X

Source of Variation	dk	JK	KT	F_{obs}	F_{table} α=0,05	Summary
Total	48	76099,11	-	-		
Coefficient (a)	1	73109,44	-			
Regression (b/a)	1	996,00	996,00	22,98	4,05	Significant Regression
Remain	46	1993,68	43,34			
Suitable Tuna	36	1323,49	36,76	0,66	2,42	Linear Regression
Error	12	670,19	55,85			

Table 6.
Results of Correlation Analysis between Haemoglobin Level and Physical

Correlation	Coefficient of Correlation (r)	t_{obs}	t_{table} α=0,05	Coefficient of Determination
Haemoglobin Level and Physical Fitness	0.302	2.352	1.678	9,14%

Contribution of Fatigue Index and Haemoglobin Level to Physical Fitness

The results of the analysis show that fatigue index and haemoglobin levels contribute significantly together to the level of physical fitness. The value of the regression equation Y on X1 and X2 can be described as follows $\hat{Y}$ = 19.60 +0.28X1 +0.33X2. Furthermore, based on the analysis of the multiple regression significance test, the value of F_{obs} 4.55> F_{table} 3.20 was obtained. This states that the fatigue index and haemoglobin levels contribute significantly together to the level of physical fitness. More details can be seen in Table 7.

Table 7.
ANOVA Testing Significance of Multiple Regression Analysis $\hat{Y}$ = 19.60+0.28X1+0.33X2

Source of Variation	dk	JK	RJK	F_{obs}	F_{table} α=0,05
Regression	2	774,37	387,18	4,55	3,20
Remain	45	3825,63	85,01		
Reduced	48				

Furthermore, in table 8, the correlation analysis of the research data obtained the correlation coefficient of the fatigue index and haemoglobin levels to the level of physical fitness. Where the obtained value of Rx1 x2 y = 0.410 with F_{obs} 5.465>F_{table} 3.20 states that there is a significant relationship between fatigue index and haemoglobin levels together with physical fitness. And when viewed from the coefficient of determination, it can be seen that the fatigue index and haemoglobin levels together contribute to the level of physical fitness by 16.83%.

Table 8.
Results of Correlation Analysis between the Relationship between Fatigue Index and Haemoglobin Level to Physical Fitness level

Correlation	Coefficient of Correlation (R)	F_{obs}	F_{tabel} α=0,05	Coefficient of Determination
Fatigue Index and Haemoglobin Level to Physical Fitness	0.410	5.465	3,20	16.83%

Discussion

The results showed that fatigue index and Hb levels have a significant relationship to physical fitness. This means that if the fatigue index and Hb are in the good category then physical fitness is also expected to be in the good category.

Physical fitness is a very important factor in supporting health and also one's work in everyday life. Physical fitness in the health sector is closely related to the work of the body's organs, namely the heart blood circulation and lungs (Martins; et al., 2023);(Ayubi et al., 2024). And to support work in everyday life is closely related to physical condition. Excellent physical fitness will have a positive impact on improving the ability of blood circulation and heart work, increasing strength, flexibility, endurance, coordination, balance, speed, and agility of the body, it will have an impact on increasing the ability to move efficiently and increasing the ability to recover organs after exercise and increasing the body's response power (Bryantara, 2017).

Fatigue index is one of the factors that affect a person's physical fitness. This is because the lower the ability of a person's body to overcome fatigue, the lower the level of physical fitness. The body's inability to maintain work for as long as possible and also causes a decrease in bodywork is influenced by the level of fatigue (Bar-Or O, Dotan R, 1977; Marquardt JA, Bacharach DA, 1993; Naharudin, M. N., & Yusof, 2013). So, it is clear that physical fitness is strongly influenced by the fatigue index because physical fitness is the ability to perform daily tasks without experiencing fatigue and still have the energy to enjoy leisure activities and do other activities (Carson Conrad, 1981; Caspersen, C. J., Powell, K. E., & Christenson, 1985). Based on the results of this study, it was found that the fatigue index contributed 6.09% to physical fitness.

Haemoglobin level is also one of the factors that affect a person's physical fitness. This is closely related to health because haemoglobin is closely related to physical fitness (Ekblom B, 1991; Otto, J. M., Montgomery, H. E., & Richards, 2013). Haemoglobin has an important role in the human body that carries oxygen to all body tissues along with red blood cells. The ability of the heart, lungs and blood to perform physical activity is greatly influenced by physical fitness so increasing the ability of blood to bind oxygen levels in the blood can also increase a person's physical fitness (Sepriadi et al., 2020). Based on the results of this study, it was found that the fatigue index contributed 9.14% to physical fitness.

Fatigue index and haemoglobin levels are two factors that are very supportive in physical fitness. This is because the higher the Fatigue index, the better the body will be able to withstand fatigue caused by the activities carried out. Likewise, with haemoglobin levels, where with the better haemoglobin levels in the blood, the better physical fitness will be because it can bind better oxygen in the blood. Based on the results of research that has been done that the fatigue index and haemoglobin levels contribute 16.83%. This means that the other 83.17% is influenced by other factors such as exercise, nutrition, lifestyle, physical activity and many other factors.

Conclusions

Based on the results of the researchers' research and data analysis, it can be concluded that fatigue index and haemoglobin levels have an influence on physical fitness levels. This is proven by the value obtained which states that there is a significant relationship between the fatigue index and haemoglobin levels, it has an influence on the level of physical fitness, where F_{obs} 5,465 > F_{table} 3.20 is obtained and a contribution value of 16.83% is also obtained. This proves that fatigue index and haemoglobin levels have a significant influence on physical fitness levels. Thus, it can be concluded that improving the fatigue index and haemoglobin levels will also have a good influence on physical fitness. The following Suggestions can be made in response to the findings of this research are: 1) to be able to do exercises that can increase fatigue index and also physical fitness, 2) to be able to maintain and regulate food consumption and lifestyle to increase haemoglobin levels in the blood,

References

Abbasian S, Golzar S, Onvani V, & Sargazi L. (2012). The predict of RAST Test from WANT test in Elite Athletes. *Research Journal of Recent Sciences*, *1*(3), 72–75. www.isca.in

Anonymous. (2006). Running-based Anaerobic Sprint Test (RAST). *Sports Performance Bulletin 21/12/06Sports Performance Bulletin*, 93.

Ayubi, N., Firman Halip, M., Komaini, A., Sazeli Rifki, M., Ridwan, M., Nashrudin Bin Naharudin, M., Ardy Kusuma, D., & Tri Mario, D. (2024). Citrus Limon Has the Potential to Reduce Oxidative Stress and Inflammation After Physical Activ-ity/Exercise: Systematic Review Citrus Limon tiene el potencial de reducir el estrés oxidativo y la inflamación después de la actividad física/ejercicio: revis. *Retos*, *51*, 1168–1173. https://recyt.fecyt.es/index.php/retos/index

Bafirman, Zarya, F., Wahyuri, A. S., Ihsan, N., & Batubara, R. (2023). Improving the martial art skills and physical fitness quality of students grade VII through e-module development. *Journal of Physical Education and Sport*, *23*(12), 3271–3281. https://doi.org/10.7752/jpes.2023.12374

Bar-Or O, Dotan R, I. O. (1977). A 30s all-out ergometric test: its reliability and validity for anaerobic capacity. *Sr J Med Sci*, *13*(1).

Bryantara, O. F. (2017). Factors That are Associated to Physical Fitness (VO2 Max) of Football Athletes. *Jurnal Berkala Epidemiologi*, *4*(2), 237–249. https://doi.org/http://dx.doi.org/10.20473/jbe.V4I22016.237-249

Carballo-Fazanes, A., Rodríguez-Fernández, J. E., Mohedano-Vázquez, N., Rodríguez-Núñez, A., & Abelairas-Gómez, C. (2022). Competencia motriz y condición física relacionada con la salud en escolares de Educación Primaria (Motor competence and health-related physical fitness in schoolchildren). *Retos*, *46*, 218–226. https://doi.org/10.47197/retos.v46.93906

Carson Conrad, C. (1981). The president's council on physical fitness and sports. *The American Journal of Sports Medicine*, *9*(4), 199–202.

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Reports*, *100*(2).

Ekblom B, B. B. (1991). Effect of erythropoietin administration on maximal aerobic power. *Scand J Med Sci Sports*, *1*, 88–93.

Ferrara, L., & D'Angelo, S. (2023). Post-exercise fatigue, lactate, and natural nutritional strategy. *Journal of Physical Education and Sport*, *23*(9), 2274–2283. https://doi.org/10.7752/jpes.2023.09261

Fucharoen, S., & Weatherall, D. J. (2012). The hemoglobin E thalassemias. *Cold Spring Harbor Perspectives in Medicine*, *2*(8), a011734.

Giakoni, F., Bettancourt, P. P., & Duclos-Bastías, D. (2021). Physical education in Chile: Duration and its influence on physical condition, body composition, and level of physical activity in schoolchildren. *Retos*, *2041*(39), 24–29. https://doi.org/10.47197/retos.v0i39.77781

Hernández-Cruz, G., Estrada-meneses, E. F., Ramos-Jiménez, A., Rangel- Colmenero, B. R., Miranda-mendoza, J., Reynoso-Sánchez, L. F., & Quezada-Chacón, J. T. (2022). Relación entre el tipo de ejercicio físico y la fatiga cuantificada mediante VFC, CK y el lactato en sangre , **Edson Francisco Estrada-Meneses, **Arnulfo Ramos-Jiménez, *Blanca Rocío Rangel-Colmenero, ***Luis Felipe Reynoso-Sánchez, *Janeth Miranda-Mend. *Retos*, *44*, 176–182.

Kavcic, I., Milic, R., Jourkesh, M., Ostojic, S. M., & Ozkol, M. Z. (2012). Comparative Study of Measured and Predicted VO2max During a Multi-Stage. *Kinesiology*, *44*(1), 18–23.

Khairuddin;, Alnderal;, Komaini;, A., Syahrastani;, & Masrun. (2022). Effect of learning approach and motor skills on physical fitness. *Journal of Physical Education and Sport*, *22*(9), 2273–2280. https://doi.org/DOI:10.7752/jpes.2022.09289

Khairuddin, Masrun, Baktiar, S., & Syahruddin. (2023). Analysis of the impact of game-based physical education learning on physical fitness of junior high school students. *Cakrawala Pendidikan*, *42*(1), 241–253. https://doi.org/10.21831/cp.v42i1.54605

Lokhande, R., Gedam, B., Shah, Y., Tandon, M., & Bansod, P. Y. (2015). Validation of different tests for haemoglobin estimation. *International Journal of Biomedical and Advance Research IJBAR International Journal of Biomedical and Advance Research Journal*, *6*(605), 427–430. https://doi.org/10.7439/ijbar

Marheni, E., Donie, Ridwan, M., Laksana, G. S., Apriani, L., Ardiansyah, Purnomo, E., Jermaina, N., & Cahyani, F. I. (2022). Exploration of Structural Life Skill Program on Physical Activity. *International Journal of Human Movement and Sports Sciences*, *10*(6), 1197–1203. https://doi.org/10.13189/saj.2022.100610

Marquardt JA, Bacharach DA, K. J. (1993). Comparison of power outputs generated during 20 and 30 s Wingate tests. *Res Q Exercise Sport*, *64*(1).

Martins;, J., Honório, S., & Cardoso, J. (2023). Physical fitness levels in students with and without training capacities – A comparative study in physical education classes. *Retos*, *45*, 43–50.

Medrano Ureña, M. del R. (2023). El Papel de la Autoeficacia y la Condición Física en la Sostenibilidad de la Actividad Física en Mujeres Adultas de Mediana Edad (The Role of Self-Efficacy and Physical Fitness in Sustaining Physical Activity in Middle Aged Women). *Retos*, *49*, 701–712. https://doi.org/10.47197/retos.v49.98105

Naharudin, M. N., & Yusof, A. (2013). Fatigue index and fatigue rate during an anaerobic performance under hypohydrations. *PloS One*, *8*(10). https://doi.org/https://doi.org/10.1371/journal.pone.0077290

Otto, J. M., Montgomery, H. E., & Richards, T. (2013). Haemoglobin concentration and mass as determinants of exercise performance and of surgical outcome. *Journal of Extreme Physiology & Medicine*, *2*(1). https://doi.org/10.1186/2046-7648-2-33.

Paradisis, G. P., Zacharogiannis, E., Mandila, D., Smirtiotou, A., Argeitaki, P., & Cooke, C. B. (2014). Multi-stage 20-m shuttle run fitness test, maximal oxygen uptake and velocity at maximal oxygen uptake. *Journal of Human Kinetics*, *41*(1), 81–87.

Perdana Ilsya, S. A. C., Ma'mun, A., Kusmaedi, N., Nuryadi, Purnomo, E., Ilsya, M. N. F., & Hasan, M. F. (2023). The Relevance of Physical Activity to Public Health Levels in West Java, Indonesia. *International Journal of Human Movement and Sports Sciences*, *11*(4), 832–837. https://doi.org/10.13189/saj.2023.110417

Philipp, N. M., Cabarkapa, D., Eserhaut, D. A., Yu, D., & Fry, A. C. (2023). Repeat sprint fatigue and altered neuromuscular performance in recreationally trained basketball players. *PLOS ONE*, *18*(7), e0288736. https://doi.org/10.1371/journal.pone.0288736

Sehle, A., Vieten, M., Sailer, S., Mündermann, A., & Dettmers, C. (2014). Objective assessment of motor fatigue in multiple sclerosis: the Fatigue index Kliniken Schmieder (FKS). *Journal of Neurology*, *261*(9), 1752–1762. https://doi.org/10.1007/s00415-014-7415-7

Sepriadi, S., & Eldawaty, E. (2019). Journal of Physical Education , Sport , Health and Recreations. *The Contribution of Hemoglobin Levels to Students' Physical*

Fitness, *8*(2), 82–90. https://doi.org/https://doi.org/10.15294/active.v8i2.30237

Sepriadi, Jannah, K., & Eldawaty. (2020). The effect of jogging exercise to improve hemoglobin levels. *Journal of Physics: Conference Series*, *1481*, 12028. https://doi.org/10.1088/1742-6596/1481/1/012028

Sepriadi, S., Apri, A., Suwirman, S., Syafruddin, S., Nurul, I., HAR;, P. F., & PRATIWI, M. D. (2022). Game-based exercise model for elementary school student's physical fitness. *Gazzetta Medica Italiana - Archivio per Le Scienze Mediche*, *181*(10), 744–750. https://doi.org/10.23736/S0393-3660.21.04741-0

Sepriadi, Syafruddin, Khairuddin, Ihsan, N., Eldawaty, Zulbahri, Juniar, S. R., & Pratiwi, M. D. (2023). The Relationship Between Physical Fitness and Mental Health on Physical Education Learning Outcomes. *Educational Administration: Theory and Practice*, *29*(1), 137–146. https://doi.org/10.17762/kuey.v29i1.514

Welis, W., Yendrizal, Darni, & Mario, D. T. (2023). Physical fitness of students in Indonesian during the COVID-19 period: Physical activity, body mass index, and socioeconomic status. *Physical Activity Review*, *11*(1), 77–87. https://doi.org/10.16926/par.2023.11.10

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