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THE EFFECT OF ZUMBA EXERCISE ON C-REACTIVE PROTEIN CONCENTRATION AND PERIPHERAL BLOOD PARAMETERS

Agus Irfan Effendi[1,2]; Indranila Kustarini Samsuria[1]; Purwanto Adhipireno[1]; Yuli Sulistyo[3]
[1]*Master of Biomedical Sciences, Faculty of Medicine, Diponegoro University*
[2]*Jaraga Sasameh Regional General Hospital, Central Kalimantan, Indonesia.*
[3]*Civil Service and Human Resources Development Agency of the South Barito Regency Government, Central Kalimantan, Indonesia.*

Corresponding author: Agus Irfan Effendi
Email: azqiza.btk@gmail.com

ABSTRACT

Maximum loads due to physical exercise cause a decrease in antibody production and a decrease in leukocyte function in general. Many studies have been conducted on the effects of physical exercise, including Zumba, on CRP levels and peripheral blood parameters, but the research results have yielded different conclusions. This study aimed to find out the effect of regular and irregular Zumba exercises on CRP concentration and peripheral blood examination parameters. This experimental study used a pre-test and post-test design. There were 30 females aged 18-40 years who were divided into 2 training groups. Group I Zumba training 5x/week and group II Zumba training 1x/week. Both groups had to practice 60 minutes/session for 6 weeks. After 6 weeks of intervention, there was no significant correlation of CRP concentration (p=0,100). There were significant differences in Hb concentration (p=0.035), leukocyte count (p=0.001), erythrocyte count (p=0.001), and platelet count (p=0.018) in both groups. There was no significant effect of RZ and IZ exercise on CRP concentration and leukocyte differential count. But there were significant differences in changes in Hb concentration, leukocyte count, erythrocyte count, and platelet count, after regular and irregular Zumba exercise.

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Keywords: Zumba exercise, CRP, peripheral blood parameters.

Introduction

Zumba exercise is one of the most popular physical exercises and is the largest and most successful dance fitness program in the world[1,2]. Zumba exercise movements refer to the principle of "enjoy the music" that is, individuals are asked to enjoy the music so that it raises spirits and provides a pleasant atmosphere and avoids boredom. This is what distinguishes Zumba exercise from other aerobic exercises[3–5]. Like other fitness exercises, Zumba will produce the desired results if done correctly. The measure of the effectiveness of Zumba exercises uses the concept of frequency, intensity, time, and type of exercise or abbreviated as FITT (Frequency, Intensity, Time, and Type)[6–8]. Regular, moderate physical exercise enhances the immune system's response by modulating peripheral leukocyte concentration according to exercise duration and intensity, thereby accelerating the circulation of immune cells throughout the body. While the

immune system returns to normal within hours after exercise, regular training makes these changes more lasting. This improved immunity suppresses systemic inflammation, creating an anti-inflammatory environment within the body[6,8–10]. Physical exercise can also induce temporary side effects such as stress response and fatigue, from which the body quickly recovers. Maximal exertion during physical exercise leads to decreased antibody production and a general decline in leukocyte function. Strenuous and irregular exercise can result in incomplete post-exercise recovery and adaptation, leading to excessive production of pro-inflammatory cytokines. This causes an imbalance between the production of pro-inflammatory and anti-inflammatory cytokines[9,10]. When the body experiences fatigue, it produces the stress hormones cortisol and adrenaline, which suppress the immune system. The tolerance limit of the body to hemostatic changes due to strenuous exercise is narrow, so fatigue from physical exertion can lead to inflammation. This can be observed through elevated levels of CRP (C-reactive protein), changes in hemoglobin levels, immune system disturbances indicated by alterations in the number and percentage of leukocyte types in peripheral blood smears, and changes in the number of erythrocytes and thrombocytes[10–12]. Increased CRP is linked to IL-6 synthesis from muscle damage. Muscle contraction during exercise produces ROS and impairs glucose availability, leading to elevated IL-6 and an inflammatory response[13]. Several studies that have been conducted have found that regular physical exercise will reduce CRP levels and increase Hb levels, the number of erythrocytes, the number of leukocytes, the number of platelets, and increase anti-inflammatory cytokines[13–16]. Meanwhile, heavy and irregular physical exercise will increase CRP levels and decrease Hb levels, erythrocyte count, platelet count, and increase pro-inflammatory cytokines[17–20].

Many studies have investigated the effects of physical exercise, including Zumba, on CRP levels and peripheral blood parameters, but the findings have yielded varied conclusions. This discrepancy may be attributed to differences in subjects, exercise type, exercise load, intensity, and duration. This research differs from previous studies as there has been no prior investigation into the combined effects of regular and irregular Zumba exercise on CRP levels and peripheral blood parameters. This study aims to scientifically determine whether regular and irregular Zumba exercise can influence CRP levels and peripheral blood parameters, namely Hb levels, leukocyte count, leukocyte differential percentage, erythrocyte count, and thrombocyte count.

Methods

This experimental study, employing a pre-test and post-test design, investigated participants at the X Gymnastics Studio in South Barito Regency between June and August 2017, with laboratory analyses conducted at Jaraga Sasameh Regional Hospital. The purposive sample comprised 30 healthy women aged 18-40 from the studio, ensuring normal vital signs and excluding those with blood abnormalities, hepatitis, or low hemoglobin (<12 g/dL). The participants were divided into two groups of 15 each. Regular Zumba (RZ) exercise is done five times a week, for 60 minutes/session. Irregular Zumba (IZ) exercise is done once a week, for 60 minutes/session. For both groups, Zumba exercise level 1 was used.

Serum CRP levels were measured using the agglutination method, and then titration tests (semi-quantitative tests) were performed to determine the titer value in the sample. Peripheral blood parameters include examination of Hb levels, leukocyte count, erythrocyte count, and platelet count. Hb levels in venous blood are calculated in gr/dl. The number of leukocytes, erythrocytes, and platelets in venous blood is calculated in mm^3.

Before conducting the research, a request for research permission was made from the Research Ethics Commission of the Faculty of Medicine, Diponegoro University No. 267/EC/FK-RSDK/V/2017. The recruitment of volunteer candidates for research subjects was carried out after obtaining permission from the owner of the gymnastics studio. During the research, all research subjects were asked for approval by signing an informed consent.

Results and Discussion

Based on the characteristics of the research subjects in Table 1, the results of statistical tests on the variables of age, weight, height, BMI, blood pressure, and body temperature measured before exercise did not show any significant differences between the two treatment groups.

Table 1. Characteristic of the respondents

Characteristic	Group		p-value
	RZ	IZ	
Age (year)	29 (18 – 43)	23 (18 – 45)	0,123*
Weight (Kg)	57 (50 – 73)	52 (42 – 80)	0,086*
Height (Cm)	158 (146-165)	155 (145-162)	0,106*
BMI (Kg/m$^{2)}$	23,03 (18,8-27,1)	22,44(19,9-30,50)	0,164*
Systolic (mmHg)	120 (110 – 130)	110 (110 – 120)	0,218*
Diastolic (mmHg)	80 (70 – 90)	80 (70 – 90)	0,171*
Body Temperature (^{o}C)	36,7 (36,5 – 37,5)	36,8 (36,4 – 37,5)	0,628*

*Mann-Whitney test

The existence of physical activities other than Zumba gymnastics by respondents such as jogging, basketball practice, volleyball practice, cycling, rope jumping, martial arts, and swimming which are feared to affect fitness and body adaptation, so the researcher tried to analyze the relationship between the frequency of other sports activities between the two treatment groups.

Table 2. Data on the frequency of other sports activities by treatment group

Frequency (x per week)	Group				p-value
	RZ		IZ		
	n	%	n	%	
0	8	53,33	2	13,33	0,125*
≤ 1	4	26,7	5	33,33	
1-2	3	20	5	33,33	
3-4	0	0	2	13,33	
5-7	0	0	1	6,67	
Total	15	100	15	100	

*Chi-square test

From the table 2, a significance value was obtained (0,125>α(0,05), meaning there was no significant relationship between the two treatment groups regarding the frequency of other sports activities.

Although statistically these variables do not affect the difference in results, there are limitations in this study. The researcher cannot control the daily activities and food intake of the research subjects. The data on the daily activity patterns of the research subjects tend to be subjective because they are not measured quantitatively (only seen from the questionnaire). Researchers ignore other physical activities carried out by the research subjects that would affect the results of this study.

Table 3. Relationship between CRP and Zumba exercise based on treatment group.

CRP	Group				p-value
	RZ		IZ		
	n	%	n	%	
Increase	0	0	4	26,7	0,100*
Not Increase	15	100	11	73,3	
Total	15	100	15	100	

*Chi-square test

The results of statistical tests showed no relationship between the RZ exercise group and the IZ exercise group with CRP levels as a marker of inflammation. This is different from several studies that state that regular physical exercise programs can increase the immune system's response to prevent systemic inflammation[21,22].

In this study, there was an increase in CRP levels of 26.6% in the IZ exercise group, while there was no increase in the RZ exercise group. Some mechanisms that link increased CRP levels include increased IL-6 synthesis due to muscle damage. Muscle contraction involves the formation of reactive oxygen species (ROS) and impaired glucose availability. Increased IL-6 levels during exercise indicate an inflammatory response[13]. TNF-α and IL-6 induce lipolysis but only IL-6 appears to induce fat oxidation. The classic proinflammatory cytokines, TNF-α and IL-1β, are generally not increased by exercise[23].

Table 4. Differences in Hb levels pre, post and differences based on treatment groups.

Hb level	Group		p-value
	RZ	IZ	
Pre	12,43 ± 0,34	12,99 ± 0,90	0,030§
Post	12,77 ± 0,42	12,35 ± 0,67	0,053§
p-value	<0,001¶	0,002¶	
Δ	0,34 ± 0,29	-0,64 ± 0,66	<0,001‡

§ T-test; ¶ Paired t-test; ‡ Mann-witney test

Hb levels in the RZ exercise group after the last exercise showed a significant increase in levels compared to before the Zumba exercise. The results of measuring Hb levels in the IZ exercise group showed a significant decrease in levels. The difference in Hb levels between the two treatment groups showed a significant difference. A significant increase in Hb levels in the RZ exercise group was caused by the exercise dose that met the target heart rate (THR), which was able to stimulate the erythrocyte-forming components to work optimally. This is likely due to regular exercise making the body able to adapt, which is compensated by increased erythropoietin activity in forming erythrocytes[14,24].

Table 5. Differences in the number of leukocytes pre, post and differences based on treatment groups.

Leukocytes	Group		p-value
	RZ	IZ	
Pre	7593 ± 1569	7420 ± 2356	0,350‡
Post	8240 ± 1773	7340 ± 2732	0,294‡
p	0,013¶*	0,572†	
Δ	646,67 ± 885,49	-80,00 ± 945,82	0,038§*

§ T-test; ¶ Paired t-test; ‡ Mann-whitney test; † Wilcoxon test

The number of leukocytes in the regular zumba exercise group after the last exercise showed a significant increase compared to before the zumba exercise. The results of measuring the number of leukocytes in the irregular zumba exercise group showed a decrease but not significant. The difference in the number of leukocytes between the two groups showed a significant difference. Zumba exercise plays a role in modulating peripheral leukocyte concentration and induces sufficient physiological changes in the immune system. Acute exercise activity can change the number and function of leukocytes, but the degree of recruitment depends on the intensity, duration of exercise, and individual fitness level[25,26].

Table 6. Differences in erythrocytes pre, post and differences based on treatment groups.

Erythrocyte	Group		p-value
	RZ	IZ	
Pre	4,39 ± 0,30	4,82 ± 0,38	0,002§*
Post	4,58 ± 0,32	4,65 ± 0,43	0,578§
p-value	0,008¶*	0,015¶*	
Δ	0,19 ± 0,24	-0,16 ± 0,23	0,001‡*

§T-test; ¶Paired t-test; ‡ Mann-whitney test; † Wilcoxon test

The number of erythrocytes in the RZ exercise group after the last exercise showed a significant increase in number compared to before the zumba exercise. The results of measuring the number of erythrocytes in the IZ exercise group after the last exercise showed a significant decrease in number compared to before the zumba exercise. Comparison between the two groups showed a significant difference. There was a significant increase in the number of erythrocytes in the RZ exercise group due to the dose of exercise given being able to stimulate the components that form erythrocytes to work optimally. This is likely due to regular exercise making the body able to adapt, which is compensated by an increase in erythropoietin activity in forming erythrocytes. But the increase in the number of erythrocytes can also be caused by the hemoconcentration mechanism, namely, plasma loss caused by exercise[14,24]. In irregular physical exercise, erythrocytes experience oxidative stress, which results in erythrolysis due to changes in the fragility of the erythrocyte membrane. This often occurs when the intensity of exercise increases and there is a lack of rest phases[12,14,19].

Table 7. Differences in platelets pre, post and differences based on treatment groups.

Platelets	Group		p-value
	RZ	IZ	
Pre	273600 ± 55114	266467 ± 59926	0,678‡
Post	293533 ± 58774	259467 ± 69883	0,160§
p-value	0,022¶*	0,198†	
Δ	19933 ± 29996	-7000 ± 28681	0,018§*

§ T-test; ¶ Paired t-test; ‡ Mann-whitney test; † Wilcoxon test

The number of platelets in the RZ exercise group after the last exercise showed a significant increase in number compared to before the zumba exercise. The results of measuring the number of platelets in the IZ exercise group after the last exercise showed a decrease in number compared to before the zumba exercise but no significant difference was found. Comparison between the two groups showed a significant difference.

The magnitude of the increase in the number of platelets is influenced by the severity of the exercise performed and is related to the release of platelets from the bone marrow[11,17]. There is no significant effect of IZ training on changes in the number of platelets. This may be due to the intensity of the irregular physical training and the duration of the training being too short, so that the average change in the number of platelets is relatively small after Zumba training[5,17].

Conclusion

While CRP levels showed no notable correlation with either regular or irregular Zumba exercise, significant differences were observed in several hematological parameters. Hemoglobin levels, leukocyte count, erythrocyte count, and platelet count all exhibited significant variations depending on the regularity of Zumba participation. This suggests that while Zumba may not impact systemic inflammation as indicated by CRP, it does appear to influence various components of blood composition.

References

1. Suri M, Sharma R, Saini N. Physiological Responses of Zumba: An Overview Understanding The Popular Fitness Trend. Indian Journal of Physical Education, Sports and Applied Sciences. 2017 Oct;7(4):23–30.
2. Inouye J, Nichols A, Maskarinec G, Tseng CW. A survey of musculoskeletal injuries associated with Zumba. Hawaii J Med Public Health. 2013 Dec;72(12):433–6.
3. Rembang AA, Rampengan JJ V., Supit S. Pengaruh Senam Zumba terhadap kadar trigliserida darah pada Mahasiswa Fakultas Kedokteran Universitas Sam Ratulangi. eBiomedik. 2015;3(1):406–11.
4. Sanders ME, Prouty J. Zumba® Fitness is Gold for All Ages. ACSMs Health Fit J. 2012 Mar;16(2):25–8.
5. Tjandra Y, Rampengan J, Supit S. Pengaruh senam zumba terhadap jumlah trombosit pada mahasiswa Fakultas Kedokteran Universitas Sam Ratulangi. eBiomedik [Internet]. 2015 [cited 2025 Apr 14];3(1):359–62. Available from: https://ejournal.unsrat.ac.id/index.php/ebiomedik/article/view/7490
6. Garber CE, Blissmer B, Deschenes MR, Franklin BA, Lamonte MJ, Lee IM, et al. Quantity and Quality of Exercise for Developing and Maintaining Cardiorespiratory, Musculoskeletal, and Neuromotor Fitness in Apparently Healthy Adults. Med Sci Sports Exerc. 2011 Jul;43(7):1334–59.
7. Yanuita RE, Kushartanti BMW. Pengembangan model latihan relaksasi Yochico bagi penderita diabetes mellitus tipe 2. Jurnal Keolahragaan. 2015 Apr 1;3(1):91–105.
8. Purwanto P. Dampak Senam Aerobik terhadap Daya Tahan Tubuh dan Penyakit. Jurnal Media Ilmu Keolahragaan Indonesia. 2011 Jul;1(1):1–9.
9. Ratulangi MRJ, Polii H, Wungouw HIS. Profil TNF-alfa sesaat setelah melakukan senam zumba. eBiomedik. 2016;4(1):76–80.
10. ARIKAWA AY, THOMAS W, SCHMITZ KH, KURZER MS. Sixteen Weeks of Exercise Reduces C-Reactive Protein Levels in Young Women. Med Sci Sports Exerc. 2011 Jun;43(6):1002–9.
11. Atan T, Alacam H. The Effects of Acute Aerobic and Anaerobic Exercise on Blood Parameters. The Anthropologist. 2015 Jan 17;19(1):87–93.
12. Hu M, Lin W. Effects of Exercise Training on Red Blood Cell Production: Implications for Anemia. Acta Haematol. 2012;127(3):156–64.
13. Chaar V, Romana M, Tripette J, Broquere C, Huisse MG, Hue O, et al. Effect of strenuous physical exercise on circulating cell-derived microparticles. Clin Hemorheol Microcirc. 2011 Jan 1;47(1):15–25.

14. Mukarromah SB. Pengaruh senam aerobik intensitas sedang terhadap kadar eritrosit dan hematokrit darah. In: Prosiding Seminar Nasional & Internasional UNIMUS. Semarang: UNIMUS; 2010. p. 238–44.
15. Zaki EAEM. The relation of overtraining Syndrome to immunity of long distance athletes . New York Science Journal. 2016;9(3):70–3.
16. Bessa AL, Oliveira VN, G. Agostini G, Oliveira RJS, Oliveira ACS, White GE, et al. Exercise Intensity and Recovery. J Strength Cond Res. 2016 Feb;30(2):311–9.
17. Suparno S. Pengaruh Latihan Aerobik Terhadap Jumlah Trombosit Pada Mahasiswa Program Studi Keperawatan Baturaja Tahun 2012. Jurnal Kesehatan. 2014 Jul 30;1(13).
18. Halim EV, Ticoalu SHR, Wongkar D. Pengaruh latihan Zumba terhadap kadar hemoglobin. eBiomedik. 2014;2(1).
19. Arifin Z, Kirwanto A, Triambarwanto S. Mempertahankan antal eritrosit pasca senam aerobik high impact menggunakan racikan wedang tomat dan multivitamin 500 mg. Interest: Jurnal Ilmu Kesehatan. 2013;2(2):54–9.
20. Albert MA, Glynn RJ, Ridker PM. Effect of physical activity on serum C-reactive protein. Am J Cardiol. 2004 Jan;93(2):221–5.
21. Donges CE, Duffield R, Drinkwater EJ. Effects of Resistance or Aerobic Exercise Training on Interleukin-6, C-Reactive Protein, and Body Composition. Med Sci Sports Exerc. 2010 Feb;42(2):304–13.
22. Martins RA, Neves AP, Coelho-Silva MJ, Veríssimo MT, Teixeira AM. The effect of aerobic versus strength-based training on high-sensitivity C-reactive protein in older adults. Eur J Appl Physiol. 2010 Sep 1;110(1):161–9.
23. Mathur N, Pedersen BK. Exercise as a Mean to Control Low-Grade Systemic Inflammation. Mediators Inflamm. 2008 Jan 11;2008(1).
24. Muangsrinoon S, Boonbrahm P. Burn in Zone: Real time Heart Rate monitoring for physical activity. In: 2017 14th International Joint Conference on Computer Science and Software Engineering (JCSSE). IEEE; 2017. p. 1–6.
25. Weiss DJ, Wardrop KJ, Schalm OW. Schalm's veterinary hematology. 6th ed. Ames, Iowa: Wiley-Blackwell; 2010. 263–305 p.
26. Kong WN, Gao G, Chang YZ. Hepcidin and sports anemia. Cell Biosci. 2014 Dec 14;4(1):19.