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Effects of Vitamin B Complex Supplementation on VO2max, Blood Lactate Concentration, and Heart Rate of Amateur Futsal Athletes

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ABSTRACT

COVID-19 is a viral disease that attacks the lungs, resulting in a decreased number of respiratory variables, especially VO2max. The decrease in VO2max causes a chain reaction affecting individual fitness variables, such as blood lactate concentration and heart rate, either directly or indirectly. Research regarding the effect of vitamin B complex on VO2max and blood lactate concentrations already exists, although not specifically described. This study aimed to compare the levels of VO2max, blood lactate concentration, and heart rate before and after the supplementation for futsal athletes. This study is expected to examine the restoration value when supplemented with vitamin B complex. The study involved 10 amateur futsal athletes having COVID-19 recovery record, ranging from the last 3 months until 12 months. The samples were divided into two treatment groups, namely the supplement group and the placebo group. The VO2max value was measured by using 2.4 km Cooper Test, while the the blood lactate concentration and heart rate were measured by using Accutrend® Plus and Polar® Heart Rate Sensor H10 and Polar® Heart Rate Monitor M400 during the 2.4 km Cooper test. The VO2max and blood concentration levels showed significant differences between before and after the supplementation ($p<0.05$), while the heart rate level did not show a significant difference ($p<0.05$). This study concludes that vitamin B complex supplementation has an effect on both VO2max and blood lactate concentration.

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INTRODUCTION

One of the key performance parameters of an athlete is maximal oxygen uptake (VO2max). VO2max (also referred to as maximal oxygen consumption, maximal oxygen uptake, or maximal aerobic capacity) is defined as the highest rate of oxygen consumption that can be achieved during physical activity (Dlugosz et al., 2013).

Individuals with optimal physical fitness exhibit higher VO2max values and are able to perform more intense physical activities compared to those with lower fitness levels (Mackenzie, 2005). In addition to VO2max, another important physiological parameter is blood lactate concentration. During high-intensity activities such as sprinting, when energy demand is elevated, glucose is broken down and oxidized into pyruvate, and lactate is subsequently produced from pyruvate at a rate faster than the body can metabolize it, leading to an increase in lactate concentration (Ferguson et al., 2018). The accumulation of lactic acid causes chronic fatigue, reduces physical performance, and induces pain and performance disturbances that may ultimately result in injury (Prihantoro & Ambardini, 2018). Another essential parameter is heart rate. Heart rate is defined as the speed of cardiac contractions, measured as the number of heartbeats per minute (Mallick & Patro, 2016). An athlete's heart rate may range from below 40 beats per minute (bpm) at rest to over 200 bpm in young athletes during maximal exercise (Baggish & Wood, 2011). A study conducted by Fagard (2003) reported that athletes tend to have lower heart rates compared to non-athletes. These three physiological parameters can be optimized through supplementation with B-complex vitamins. Research conducted by Joubert & Manore (2008) demonstrated that B-complex vitamin supplementation can increase VO2max values compared to individuals who do not consume the supplement. Furthermore, a study by Abdi (2019) provided evidence that B-complex vitamins contribute to the reduction of blood lactate levels. Moreover, research by Sucharita et al. (2012) specifically indicated that vitamin B12 supplementation can improve heart rate variability.

B-group vitamins represent essential micronutrients involved in various metabolic and regulatory processes necessary for human health, functioning as cofactors utilized by numerous enzymes that perform critical roles such as energy metabolism, DNA synthesis, protein synthesis, and other physiological functions. These vitamins consist of B1 (thiamine), B2 (riboflavin), B3 (niacin), B5 (pantothenic acid), B6 (pyridoxine), B7 (biotin), B9 (folic acid), and B12 (cobalamin). These eight sub-vitamins, collectively known as B-complex vitamins, are widely found in meat, fish, eggs, brown rice, legumes, potatoes, bananas, and green leafy vegetables (Kennedy, 2016). Furthermore, Shakoor et al. (2021) stated that B-complex vitamins constitute one of the essential nutrients in combating COVID-19. In addition to enhancing the immune system, B-complex vitamins are also capable of reducing symptoms associated with COVID-19. Additionally, B-complex vitamin supplementation has been reported to alleviate breathing difficulties.

As of August 24, 2021, the COVID-19 pandemic had affected approximately 212,357,898 individuals worldwide and resulted in 4,439,843 deaths. Beyond acute infection, COVID-19 has also been shown to cause physiological alterations in the body of recovered patients. Previous studies have reported the occurrence of persistent lung damage following COVID-19 infection (Wu et al., 2021). This condition leads to a reduction in the diffusion capacity of the lungs for carbon monoxide (DLCO), which affects gas exchange in the alveoli and may ultimately result in pulmonary fibrosis. Fontini et al. (2021) reported that approximately 72% of the individuals tested continued to experience post-COVID-19 symptoms, with fatigue being the most frequently reported symptom (42.4%). Pulmonary damage following COVID-

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19 infection has also been associated with a decrease in average VO_2max values (Crameri et al., 2020).

Numerous studies on COVID-19 were conducted during 2020–2021; however, these investigations predominantly focused on clinical aspects. Consequently, research examining the effects of dietary supplements—particularly B-complex vitamins—on the performance of athletes who have previously been infected with COVID-19 remains limited. Therefore, the purpose of this study was to compare VO_2max values, blood lactate concentrations, and heart rate parameters between post-COVID-19 athletes who consumed B-complex vitamin supplements and those who did not.

METHODS

Research Design

This study employed a non-randomized control group pretest–posttest design (Thomas et al., 2022). The research participants were divided into two categories based on the treatment administered, namely the supplementation group and the placebo group. Both groups followed the same research protocol, consisting of a pretest phase (pre-supplementation assessment), followed by the consumption of either vitamin B complex supplements or placebo pills for seven consecutive days, and subsequently a posttest phase (post-supplementation assessment).

Research Participants

The selection of research subjects was conducted using purposive sampling, in which sample selection was determined based on predefined criteria (Fraenkel et al., 1993). The purpose of this method was to obtain samples that could logically be considered representative of the population. The inclusion and exclusion criteria established in this study were as follows:

Table 1. Inclusion and Exclusion Criteria of Research Samples

Inclusion Criteria	Exclusion Criteria
• Male	• Having chronic diseases
• Amateur futsal athletes affiliated with clubs in the Bandung Raya area	• Smoking
• Aged between 17 and 22 years	• Consuming alcohol
• Physically and mentally healthy	• Having no history of COVID-19 infection
• Having a history of mild COVID-19 infection within the past 3–12 months	• Having a history of mild or severe COVID-19 infection more than 12 months prior
• Willing to participate in the study	• Unwilling to participate in the study

Based on the established inclusion and exclusion criteria, a total of 10 subjects were recruited, all of whom were athletes from the Mayasari Futsal Bandung team.

Research Instruments

The instruments used in this study included a Seca® 786 weighing scale with height measurement, Accutrend® Plus, Polar® Heart Rate Sensor H10, Polar® Heart Rate Monitor M400, and a Seiko® Digital Stopwatch SVAJ001. The materials used in this study consisted of non-fortified wheat flour for the placebo treatment and NaturesPlus® B Complex with Rice Bran for the supplementation treatment, with the following dosage specifications:

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Table 2. Dosage of Vitamin B Complex per Tablet

Sub-vitamin B	Dosage per tablet
Thiamine (Vitamin B1)	10 mg
Riboflavin (Vitamin B2)	10 mg
Niacin (Vitamin B3)	18 mg
Pantothenic Acid (Vitamin B5)	15 mg
Pyridoxine (Vitamin B6)	18 mg
Folic Acid	100 µg
Biotin	20 µg
Cyanocobalamin (Vitamin B12)	3 µg

Research Procedures

The study involved 10 subjects who had a history of mild COVID-19 infection within the past three to twelve months. Subjects were instructed to refrain from engaging in strenuous physical exercise for two days prior to the commencement of the study. On the testing day, anthropometric data were collected using the Seca® 786 weighing scale with height measurement. Subsequently, blood samples were taken to measure baseline blood lactate concentration using Accutrend® Plus. The Polar® Heart Rate Sensor H10 was attached to the subject's chest, while the Polar® Heart Rate Monitor M400 was worn on the wrist to measure heart rate. VO2max was assessed using the 2.4 km Cooper Test. Subjects were instructed to prepare at the starting line and begin running upon the sound of the whistle. They were required to complete the 2.4 km distance as quickly as possible and stop upon reaching the finish line. The completion time was recorded. Following the completion of the test, blood samples were collected again to determine post-exercise blood lactate concentration. These procedures constituted the pretest data collection. After the pretest phase, subjects were divided into two groups. Each subject received either a placebo capsule or a vitamin B complex supplement tablet according to their assigned treatment group. Subjects were instructed to consume one capsule per day after breakfast for seven consecutive days. Subjects were again instructed to avoid strenuous physical activity for two days prior to the posttest phase. The posttest procedures were conducted using the same methods applied during the pretest phase.

Data Analysis

The collected data were tested for normality using the Anderson–Darling test with a confidence level of 5%. Subsequently, comparisons between pre-supplementation and post-supplementation data were performed using a Paired T-Test. All statistical analyses were conducted using Minitab version 21.

RESULTS

The results were obtained from the time required by the research subjects to complete a 2.4 km run. The recorded running time was then converted into VO2max values (ml/kg·min^{-1}) using a predetermined formula. The VO2max values were subsequently averaged and compared within each group before and after vitamin B complex supplementation. Based on the results, the supplement group showed a statistically significant difference in VO2max values between the pre-supplementation and post-supplementation measurements ($p < 0.05$). In contrast, no significant difference was observed in the placebo group.

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Table 3. Mean VO_{2max} of research subjects and paired t-test results

Group	Pre-supplementation	Post-supplementation	P-Value
Supplement	43,76 ± 3,78	45,2 ± 3,89	0,039*
Placebo	44,82 ± 2,7	44,86 ± 3,37	0,939

Table 4. Mean heart rate of research subjects and paired t-test results

Group	Pre-supplementation	Post-supplementation	P-Value
Supplement	188,4 ± 3,78	187,6 ± 5,03	0,749
Placebo	189,2 ± 7,33	187,8 ± 3,77	0,743

Heart rate data were collected using the Polar® M400 and Polar® Heart Rate Sensor H10, which were attached to the subjects during the 2.4 km Cooper Test. The recorded heart rate data were averaged and compared within each group before and after vitamin B complex supplementation. The comparison of heart rate values indicated that there were no statistically significant differences between pre-supplementation and post-supplementation measurements in either the supplement group or the placebo group.

Table 5. Mean blood lactate concentration of research subjects

Group	Pre-Supplementation		Post-Supplementation	
	Initial	Final	Initial	Final
Supplement	1,26 ± 0,31	11,96 ± 1,86	3 ± 1,07	7,84 ± 0,84
Placebo	1,56 ± 0,39	12,58 ± 1,91	1,84 ± 0,59	10,82 ± 0,55

Notes:
Initial: Blood lactate concentration measured before the Cooper test
Final: Blood lactate concentration measured after the Cooper test

Table 6. Mean differences in blood lactate concentration and paired t-test results

Group	Pre-Supplementation Difference	Post-Supplementation Difference	P-Value
Supplement	10,7 ± 1,59	4,84 ± 0,76	0,002*
Placebo	11,02 ± 2,01	8,98 ± 0,57	0,075

The blood lactate concentration values obtained before and after the Cooper Test were averaged, and the difference between initial and final lactate concentrations was calculated for each group. These differences were then compared within each group between the pre-supplementation and post-supplementation periods. Based on the results presented in Tables 5 and 6, the supplement group exhibited a statistically significant reduction in the difference between pre-test and post-test blood lactate concentrations following vitamin B complex supplementation ($p < 0.05$). In contrast, the placebo group did not show a statistically significant difference between the pre-supplementation and post-supplementation periods.

DISCUSSION

In this study, the supplementation treatment demonstrated a significant effect on both VO2max values and blood lactate concentration. VO2max showed a substantial increase between the pre- and post-supplementation measurements following vitamin B complex intake. Conversely, blood lactate concentration exhibited a significant reduction after

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supplementation. These findings support the results reported by Joubert et al. (2008) and Abdi (2019), who stated that vitamin B complex supplementation can increase VO2max and reduce blood lactate concentration.

Based on previous literature, vitamin B complex serves two primary functions, namely its role in energy metabolism and red blood cell formation. Thiamine, riboflavin, niacin, pantothenic acid, pyridoxine, and biotin are involved in energy production from carbohydrates, fats, and proteins (Schellack et al., 2019). These six B sub-vitamins catalyze energy formation to provide additional energy during physical activity, particularly during high-intensity exercise, thereby delaying the onset of fatigue kelelahan (Kerksick et al., 2018; Rokitzki et al., 1994; Stryer, 1999; Tasevska et al., 2008).

Meanwhile, folic acid, pyridoxine, and cyanocobalamin play essential roles in red blood cell formation, which functions to transport oxygen throughout the body (Schellack et al., 2019). An increase in red blood cell production allows a greater volume of oxygen to be delivered to tissues, including skeletal muscles, thereby reducing the risk of muscle hypoxia (Williams, 1989). As a result, aerobic energy metabolism can be maintained, and blood lactate concentration in muscles tends to remain lower. Thiamine also contributes to reducing lactate accumulation in fatigued muscles by forming the coenzyme thiamine pyrophosphate (TPP) through the binding of phosphate groups from ATP (Kerksick et al., 2018; Rokitzki et al., 1994; Tasevska et al., 2008).

This study also examined differences in heart rate before and after supplementation. The results indicated that both the supplement and placebo groups showed no significant differences in heart rate between pre- and post-supplementation conditions. This outcome is likely due to individual variability in heart rate responses. Therefore, heart rate data were used only as a supporting variable for VO2max to confirm that the research subjects performed the Cooper test at maximal intensity. To date, no studies have directly linked vitamin B complex supplementation with heart rate values. Research conducted by Sucharita et al. (2012) only established a relationship between vitamin B complex—particularly vitamin B12—and heart rate variability.

CONCLUSION

Based on the findings of this study, it can be concluded that vitamin B complex supplementation increased VO2max and reduced blood lactate concentration in athletes who were former COVID-19 patients. However, this study involved only participants with a history of COVID-19 infection, which limits the ability to clearly determine the extent of fitness restoration achieved through supplementation. Future studies are expected to compare VO2max and blood lactate concentration between athletes who are former COVID-19 patients and athletes with no history of COVID-19 infection. Furthermore, due to the limited availability of former COVID-19 patients, the age range established in this study was relatively broad, which may have influenced individual VO2max values. It is recommended that future studies apply a narrower age range among former COVID-19 patients to minimize potential bias. The limited number of participants with a history of COVID-19 infection also resulted in a small sample size. Therefore, future research is expected to involve a larger number of participants so that each group is adequately represented and more accurate data can be obtained.

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AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

REFERENCES

Abdi, M. (2019). Pengaruh pemberian vitamin B1, B6, dan B12 terhadap kelelahan otot pada atlet bolabasket PERBASI Kabupaten Sinjai. Universitas Negeri Makassar.

Baggish, A. L., & Wood, M. J. (2011). Athlete's heart and cardiovascular care of the athlete: Scientific and clinical update. Circulation, 123(23), 2723–2735.

Crameri, G. A. G., Bielecki, M., Züst, R., Buehrer, T. W., Stanga, Z., & Deuel, J. W. (2020). Reduced maximal aerobic capacity after COVID-19 in young adult recruits, Switzerland, May 2020. Eurosurveillance, 25(36), 2001542.

Dlugosz, E. M., Chappell, M. A., Meek, T. H., Szafrańska, P. A., Zub, K., Konarzewski, M., Jones, J. H., Bicudo, J. E. P. W., Nespolo, R. F., & Careau, V. (2013). Phylogenetic analysis of mammalian maximal oxygen consumption during exercise. Journal of Experimental Biology, 216(24), 4712–4721.

Fagard, R. (2003). Athlete's heart. Heart, 89(12), 1455–1461.

Ferguson, B. S., Rogatzki, M. J., Goodwin, M. L., Kane, D. A., Rightmire, Z., & Gladden, L. B. (2018). Lactate metabolism: Historical context, prior misinterpretations, and current understanding. European Journal of Applied Physiology, 118, 691–728.

Fraenkel, J., Wallen, N., & Hyun, H. (1993). How to design and evaluate research in education (10th ed.). McGraw-Hill Education.

Joubert, L. M., & Manore, M. M. (2008). The role of physical activity level and B-vitamin status on blood homocysteine levels. Medicine and Science in Sports and Exercise, 40(11), 1923–1931.

Kerksick, C. M., Wilborn, C. D., Roberts, M. D., Smith-Ryan, A., Kleiner, S. M., Jäger, R., Collins, R., Cooke, M., Davis, J. N., Galvan, E., Greenwood, M., Lowery, L. M., Wildman, R., Antonio, J., & Kreider, R. B. (2018). ISSN exercise and sports nutrition review update: Research and recommendations. Journal of the International Society of Sports Nutrition, 15(1).

Mackenzie, B. (2005). 101 performance evaluation tests (1st ed.). Jonathan Pye.

Mallick, B., & Patro, A. K. (2016). Heart rate monitoring system using fingertip through Arduino and Processing software. International Journal of Science, Engineering and Technology Research, 5(1), 84–89.

Prihantoro, Y., & Ambardini, R. L. (2018). Prevalensi, karakteristik, dan penanganan delayed onset muscle soreness (DOMS). Medikora: Jurnal Ilmiah Kesehatan Olahraga, 17(2), 126–135.

Rokitzki, L., Sagredos, A. N., Reuss, F., Cufi, D., & Keul, J. (1994). Assessment of vitamin B6 status of strength and speed-power athletes. Journal of the American College of Nutrition, 13(1), 87–94.

Schellack, G., Harirari, P., & Schellack, N. (2019). Vitamin B-complex deficiency, supplementation and management. SA Pharmaceutical Journal, 86(3), 23–29.

Shakoor, H., Feehan, J., Mikkelsen, K., Al Dhaheri, A. S., Ali, H. I., Platat, C., Ismail, L. C., Stojanovska, L., & Apostolopoulos, V. (2021). Be well: A potential role for vitamin B in COVID-19. Maturitas, 144, 108–111.

Stryer, L. (1999). Biochemistry. Freeman.

Sucharita, S., Thomas, T., Antony, B., & Vaz, M. (2012). Vitamin B12 supplementation improves heart rate variability in healthy elderly Indian subjects. Autonomic Neuroscience, 168(1–2), 66–71.

Tasevska, N., Runswick, S. A., McTaggart, A., & Bingham, S. A. (2008). Twenty-four-hour urinary thiamine as a biomarker for the assessment of thiamine intake. European Journal of Clinical Nutrition, 62(9), 1139–1147.

Thomas, J. R., Martin, P., Etnier, J. L., & Silverman, S. J. (2022). Research methods in physical activity. Human Kinetics.

Williams, M. H. (1989). Vitamin supplementation and athletic performance. International Journal for Vitamin and Nutrition Research, 30, 163–191.

Wu, X., Liu, X., Zhou, Y., Yu, H., Li, R., Zhan, Q., Ni, F., Fang, S., Lu, Y., & Ding, X. (2021). 3-month, 6-month, 9-month, and 12-month respiratory outcomes in patients following COVID-19-related hospitalisation: A prospective study. The Lancet Respiratory Medicine, 9(7), 747–754.

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