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Post-Exercise Supplementation: Impact on VO_2Max of Futsal Athletes

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Abstract:
Background: Futsal is a high-intensity sport that requires optimal lung capacity and aerobic endurance, efforts to improve VO_2max are often associated with nutritional interventions, including supplementation. Calcium D Redoxon (CDR), which contains vitamin C, vitamin D, and calcium, energy metabolism, and the immune system. This study aims to investigate the effect of Calcium D Redoxon supplementation after exercise on the improvement of VO_2max in futsal athlete.
Methods: The research method eksperimen used a design one-group pretest-posttest design with a total sampling technique involving 21 athletes. The instrument for measuring VO_2max endurance was a respirometer (FEV1), and data analysis included normality tests and a t-test.
Result: The normality test results showed that variable X had an Asymp. Sig. (2-tailed) value of 0.103 ($p > 0.05$) and variable Y had an Asymp. Sig. (2-tailed) value of 0.148 ($p > 0.05$), indicating that both datasets were normally distributed. Based on the t-test results, the pretest mean was 4492.952 ml with a t-value of 43.418 and a significance value of 0.000 ($p < 0.05$), indicating statistical significance. The posttest mean was 4088.857 ml with a t-value of 42.525 and a significance value of 0.000, also indicating high statistical significance. Although both results are statistically significant, there was an average decrease of 404.095 ml from pretest to posttest.
Conclusion: These findings indicate that the intervention did not positively impact lung capacity improvement; in fact, it tended to cause a decrease.

Keywords: CDR Supplement, Futsal, Respirometer, Vo2Max.

1. INTRODUCTION

Futsal is a modern sport that requires a combination of technical skills and high physical readiness (Lhaksana et al, 2018). It is not enough to just master basic techniques such as control, passing, and shooting, futsal players are also required to have prime physical condition to be able to compete in a fast and intense game tempo. Futsal itself was born as an alternative to large field football, especially in areas with limited open space, so this game developed on small fields and indoors (Lubis et al, 2021). Unlike other forms of indoor games that use boards or nets as boundaries, futsal uses clear boundary lines, making it more dynamic and demanding high developed since the time of the ancestors as a form of self-defense and adaptation to the environment. In concentration (Correa & Montero, 2013; Madjid, 2017). With its fast, narrow, and intense game character, futsal is a sport that not only hones technical skills, but also becomes an important indicator in the development of players' physical capacity (Naser et al., 2017). Characters are formed at athletes through extracurricular sports activities and their physical abilities are developed.

According to players must have high endurance, because the greater/higher the endurance capacity (aerobic capacity) faster players in a training/match (Ma et al., 2023; Suarez, 2015). The fitness component itself has a very vital meaning, namely the ability to exercise power. aerobicsthe largest component that a person has, which is the ability to receive oxygen in the heart, breathing and hemohydro-limpatiticor transportO2, CO2and nutrients every minute reach the body's metabolism (Ilyas et al., 2023; Suherman, 2019; Yudhi, 2020; Gumantan, 2020).

Endurance is the human strength to withstand and release energy for a very long time which is transported in the bloodstream combined with hemoglobin and used for the oxidation of energy substrates glucose and fatty acids in the

mitochondrial respiratory chain so that ATP resynthesis occurs (Gras & Gras, 2022; O'Donovan et al., 2017; Scott et al., 2019). According to (Nugroho, 2018) VO_2max describes the maximum ability of the cardiovascular system to supply oxygen during intense and repeated futsal games (Pache, 2020; Vasquez-bonilla et al., 2022). Doing sports regularly has benefits for the body including endurance (Yudhi, 2020).

Heart lung function, aerobic muscle metabolism, body fatness, exercise status, and heredity are factors that affect a person's endurance (Nursahid, 2017)**.** In addition to this stated that the high and low values of endurance influenced by several factors, namely differences in the duration of physical activity, nutritional status, and age. Athletes with high endurance have high endurance values and can perform stronger physical exercises than athletes with low endurance (Jonas Solissa, 2018). The results of this study can conclude a significant influence of interval training exercises on high school basketball players' endurance. The determinant value of endurance is 67% contribution. Thus, high-intensity interval training significantly increases the Vo2max endurance capacity (Adila et al, 2023).

Several studies have been conducted in an effort to increase the value of VO2Max in an athlete. Such as research conducted (Martinez-ferran et al., 2020) using a systematic review method involving 424 respondents (average age 30 years, 82% male). The results of VO2Max did not differ at baseline between the control and random groups. VO2Max increased in both groups but increased less after creatine supplementation than without (effect size -0.32, 95% CI -0.51 to -0.12). Comparison after supplementation confirmed VO2Max lower in the random group (-0.20, -0.39 to -0.001). This yielded similar results, as well as in the subgroup of young and healthy participants. Similar studies have been conducted between vitamin C supplements related to endurance is very optimal. Long-term results of giving this vitamin C supplement can repair muscle damage through normal nutrition. Scientific evidence from this study provides a 73% effect on athletes' active endurance in intense exercise adaptation. And 74% of the supplement effect contributes to endurance when using power. VO2Max is the capacity of each individual to produce the energy needed during endurance activities and VO2Max one of the most important factors in determining an individual's ability to practice longer than training for four or five minutes (Jalil, 2020).

Therefore, researchers chose (CDR) to help increase endurance (Saluy et al., 2022). Calcium d redoxon (CDR) has strength in its formula, namely a unique combination of vitamin C and zinc in a double-action formula that can provide comprehensive protection for the body and is safe for daily consumption (Higgins & Izadi, 2020; Martinez-ferran et al., 2020; Puspaningtyas et al., 2015). Vitamin C and zinc can help your immune system to work effectively. Calcium d redoxon (CDR) also maintains the immune system of someone who consumes it (Suwarni, 2020). Vitamin C helps accelerate the absorption of iron in the body and plays a role in moving iron into the blood, mobilizing iron stores, especially hemosiderin in the leen (Sajjad et al., 2023). The iron consumption rate was 54.67%, while the vitamin C consumption rate was 39.21% (<65% of the recommended RDA) in children indicating iron deficiency (Suwarni, 2020).

Table 1. CDR Content with Body Resistance

Types of Vitamins	Endurance Enhancement Mechanism	Recommended Dosage			Source of Theory
		Man	Women	Others	
Calcium Carbonate	Calcium in bones and teeth (99%) is distributed in the blood and soft tissues, maintaining cell structure. Nerve message transmitter and smooth muscle contraction.	Age 15-25 years 1.5%-2.2% of total body / day	Age 15-25 years 1.5%-2.2% of total body / day	Age 15-25 years 1.5%-2.2% of total body / day	(Dewi et al., 2017)
Vit C	An effective oxidant by inhibiting*reactive oxygen species* (ROS) and cytokine production (*Interleukin*-10)	14-18 years 75mg/day, 19-50 years 90 mg/day	14-18 years 65mg/day, 19-50 years 75 mg/day	Pregnant women 85 mg/day. Children 25 mg/day	(Ketut Tia Pran Anggar Yani, 2022)
Vit D	Enhances GTF response and stimulates cytokine production (Interleukin-10)	19-40 years per 600 IU mg/day	19-40 years per 600 IU mg/day	Pregnant women and	(Ketut Tia Pran Anggar Yani, 2022)

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				children per 600 IU mg/day	
Vit B6	Regulates inflammatory responses in cytokine production and CD4 Plasma cell activity.	19-50 years (thiamine B1) 2mg/day	19-50 years (thiamine B1) 1mg/day	19-50 years (B2) 1.4mg/day	(Ketut Tia Pran Anggar Yani, 2022)
Zinc	Increase the number of plasma CD4+ cells, T cells as antioxidants and inhibit ROS activity.	17-35 years 55 mg/day	17-35 years 55 mg/day	Children 17-35 years 30 mg/day	(Ketut Tia Pran Anggar Yani, 2022)

Based on the brief explanation above, researchers see that Calcium d redoxon (CDR) supplements can provide energy after completing training, which can increase athlete endurance and reduce fatigue during training. This makes researchers interested in conducting further studies on the effects of supplementation with calcium d redoxon (CDR) to increase endurance. Observations made by previous researchers have shown that to increase endurance has been done by using vitamin C as a supplement to increase endurance. Vitamin C is made by using orange juice. As a proposal to provide supplements to increase endurance with calcium d redoxon (CDR).

2. MATERIAL AND METHOD

The design of this study is to find out the results of the increase in the results of the treatment that has been given. The researcher here uses One Group Pretest - Posttest Design, which is only an experimental group, there is no control group, there is a pretest then given treatment after that posttest.

After that, a CDR supplement was given from the training that had been given by the trainer, then it was carried out. *posttest*. The research was conducted at the Gusty Pelalawan Riau futsal field from March to September 2024. The population in this study were Amorsos Pelalawan Riau futsal athletes using the total sampling method totaling 21 athletes. The instrument in this study was a *Spiro Ball Spirometer*.

The data analysis technique in this study used the normality test and t-test. The normality test is carried out to determine whether the sample data is data that comes from a normal distribution using the Kolmogorov-Smirnov test. If the significance value is less than 0.05 or the calculated D is greater than the D table, then the data is not normally distributed. If the significance value is more than 0.05 or the calculated F is smaller than the F table, then the data is normally distributed.

After the prerequisite test is carried out through the normality test and the homogeneity test, the t-test or dependent sample t-test is carried out. To find out the differences in the data from one group to another, it is analyzed using the dependent sample t-test analysis technique. If the significant value is more than 0.05 or the calculated T is smaller than the T table, it means there is no significant difference. If the significant value is less than 0.05 or the calculated T is greater than the T table, it means there is a significant difference.

3. RESULT AND DISCUSSION

3.1 Result

The description of this pretest data was obtained from respirometer instrument measurements taken from 21 respondents in futsal players which were calculated using the SPSS version 23.0 application by knowing the sum, mean, maximum, minimum, standard deviation and variance values which are useful for describing each data substantively.

Based on the pretest data obtained, the value data from 21 respondents futsal players obtained a sum value of 94352, mean 4492.95, standard deviation 474.21, variance 224879.14, maximum value 5420 and minimum value 3678 and range 1742.

Based on the general description of the pretest value data in table 4.3, a categorization is then made. This categorization aims to place individuals into separate groups in a hierarchical and continuum manner based on the aspects being measured. The determination of the categorization is based on the general value unit.

Tabel 2. Categorization of Respirometer Pretest Value Data

Pretes Respirometer			
Category	**Interval**	**Frequency**	**Percent %**
Very good	≥ 5500 ml	0	0%
Good	4500 ml - 5499 ml	12	57,14%
Enough	3500 ml - 4499 ml	9	42,86%
Not enough	2500 ml - 3499 ml	0	0%
Very less	< 2500 ml	0	0%
Total		21	100%

Based on data categorization using the Likert scale formula from (Sugiyono, 2018), then the pretest data in this study is divided into 5 parts, namely very good, good, sufficient, lacking, and very lacking. The data from the Respirometer Pretest consisting of 21 participants showed the distribution of lung capacity in several categories, with capacity intervals varying from "Very Good" to "Very Poor".

1. Very Good Category (≥ 5500 ml): No participants reached this category, with 0% of total participants.
2. Good Category (4500 ml - 5499 ml): Most of the participants, as many as 12 people (or 57.14%), were in this category, which indicates that their lung capacity is in the good range.
3. Sufficient Category (3500 ml - 4499 ml): A total of 9 participants (or 42.86%) were in this category, which indicates that their lung capacity was sufficient.
4. Less (2500 ml - 3499 ml) and Very Less (< 2500 ml) categories: There were no participants in this category, with 0% each.

From the data, we can conclude that the majority of participants have good or sufficient lung capacity, with none falling into the poor or very poor category. None of the participants reached the "Very Good" level. This description reflects the relatively good lung fitness condition of the participants, but none reached the optimal level.

The description of the post-test data was obtained from respirometer instrument measurements taken from 21 respondents in Amorsos Pelalawan futsal players which were calculated using the SPSS version 23.0 application by knowing the sum, mean, maximum, minimum, standard deviation and variance values which are useful for describing each data substantively.

Based on the post-test data obtained, the value data from 21 respondents of Amorsos Pelalawan futsal players obtained a sum value of 85866, mean 4088.86, standard deviation 440.60, variance 194151.92, maximum value 4867 and minimum value 3267 and range 1600.

Table 3. Categorization of Respirometer Postest Value Data

Postes Respirometer			
Category	**Interval**	**Frequency**	**Percent %**
Very good	≥ 5500 ml	0	0%
Good	4500 ml - 5499 ml	4	19,03%
Enough	3500 ml - 4499 ml	15	71,42%
Not enough	2500 ml - 3499 ml	2	9,53%
Very less	< 2500 ml	0	0%
Total		21	100%

Based on data categorization using the Likert scale formula from (Sugiyono, 2018), then the posttest data in this study is divided into 5 parts, namely very good, good, sufficient, lacking, and very lacking. The Respirometer Pretest results data classified participants' lung capacity into five categories: "Very Good," "Good," "Fair," "Poor," and "Very Poor." Here is a description of each category:

1. Very Good (≥ 5500 ml): No participants reached this category. The frequency value is 0 with a percentage of 0%.
2. Good (4500 ml - 5499 ml): There were 4 participants (19.03%) who fell into this category, indicating good but not optimal lung capacity.
3. Sufficient (3500 ml - 4499 ml): The majority of participants, namely 15 people (71.42%), were in this category, indicating sufficient lung capacity for daily activity needs.

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4. Less (2500 ml - 3499 ml): Only 2 participants (9.53%) had less lung capacity, indicating possible limitations in respiratory function.
5. Very Poor (< 2500 ml): No participants were in this category.

The total number of participants tested was 21 people, with the most dominant distribution in the Sufficient category, which covers more than 70% of the population. This shows that the majority of participants have sufficient lung capacity, but need improvement to reach a better category.

Normality tests were performed on each variable, namely variable X CDR before exercise and variable Y Vo2max.

Table 4. Kolmogorov-Smirnov Normality Test

One-Sample Kolmogorov-Smirnov Test			
N		Pretest	Positions
		21	21
Normal Parameters[a,b]	Mean	4492.95	4088.86
	Std. Deviation	474.214	440.627
Most Extreme Differences	Absolute	.097	.134
	Positive	.082	.120
	Negative	-.097	-.134
Test Statistic		.097	.134
Asymp. Sig. (2-tailed)		.103[c,d]	.148[c,d]

The results of the normality test above show that variable x has an asymp. Sig. 2 tailed value of 0.103 (ρ > 0.05) and variable y has an asymp. Sig. 2 tailed value of 0.148 (ρ > 0.05). This shows that both data from variables x and y are normally distributed.

The results of the t-test conducted for the pretest and posttest data showed that there were significant differences in both groups of data. The analysis was conducted using the average pretest and posttest values compared to the test value = 0.

Table 5. Hypothesis Test T Test.

One-Sample Statistics				
	N	Mean	Std. Deviation	Std. Error Mean
Pretest	21	4492.95	474.214	103.482
Positions	21	4088.86	440.627	96.153

For the pretest, the t value (t-statistic) was 43.418 with df (degrees of freedom) of 20, and the significance value (Sig. 2-tailed) of 0.000, which means that this result is very significant (p < 0.05). The average pretest value is 4492.952 ml, with a 95% confidence interval ranging from 4277.09 ml to 4708.81 ml. This shows that the pretest value is significantly higher than 0 and is in a fairly consistent range.

For the post-test, the t-statistic value is 42.525 with 20 degrees of freedom, and a significance value (Sig. 2-tailed) of 0.000, which also shows a very significant result. The average post-test value is 4088.857 ml, with a 95% confidence interval between 3888.29 ml to 4289.43 ml. This result also shows that the post-test value is significantly higher than 0.

Table 6. Two-Way ANOVA Calculation

One-Sample Test						
	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Pretest	43.418	20	.000	4492.952	4277.09	4708.81
Positions	42.525	20	.000	4088.857	3888.29	4289.43

In conclusion, both pretest and posttest results have statistically significant values. However, there is a difference in the mean between the pretest (4492.952 ml) and posttest (4088.857 ml), which may indicate a decrease in capacity or performance in students after the intervention, although the decrease is also still significant compared to 0. Further analysis, such as

two-way ANOVA, can help understand the factors that influence this difference.

From these data, it can be concluded that there is no significant effect of the intervention or conditions affecting the participants, but the effect is actually a decrease in capacity or performance (in this case FEV1) after the posttest compared to the pretest. To deepen the interpretation of this effect, further analysis is needed through a two-way ANOVA to see the interaction between variables, for example whether other variables contribute to the decrease

3.2 Discussion

Based on the results of the t-test, a significant difference was found between the pretest and posttest results. The average pretest value was 4492.952 ml, while the average posttest was 4088.857 ml, which indicated a decrease in the lung capacity of students after the intervention. This decrease was declared significant with a p-value of 0.000, meaning that the changes that occurred were not random, but had strong reasons based on the intervention given.

Based on the test results obtained, this study showed that of the 21 subjects who took the pretest and posttest, there was no significant increase in FEV1 capacity after treatment. Changes in FEV1 values were seen in varying ranges among subjects, with most showing a decrease in lung capacity. In detail, the results showed that subjects such as M. Aidil Rahman experienced a small decrease of -0.03% in FEV1 values, and were categorized as sufficient. Likewise with other subjects such as Farhan Hafiz and Asri Muzaky, who each experienced a decrease of -0.53% and -0.21%, both of which were categorized as sufficient but there was no increase after the intervention.

Another study also emphasized the importance of a structured exercise program to achieve increased respiratory endurance. In this study, systematic and intensive exercise provided significant results in increasing lung capacity. Conversely, if the exercise is carried out without considering the individual aspects of the participants, performance can decrease, as also seen in this study. The effectiveness of physical exercise is highly dependent on the adjustment of the exercise program to the individual's conditions and abilities.

This finding is also in line with a study by Saluy et al. (2022) which found that non-individualized interventions, or suboptimal training conditions, often lead to a lack of significant improvement, or even a decline in participants' physical capacity. Factors such as motivation, fatigue, and environmental conditions during training greatly affect test results.
Overall, this study shows that despite the intervention, the decline in performance after the posttest indicates that the program implemented has not been effective in increasing the participants' lung capacity. This indicates the need for further evaluation of the training method, taking into account individual factors of the learners, management of exercise intensity, and increasing motivation so that the expected results can be achieved.

VO_2max increase is influenced by various factors, and if the CDR used does not produce the expected results, there are probably several aspects that need to be considered. One of the main factors is the content of the training material in the CDR. If the training intensity is too low or does not comply with the principles of increasing VO_2max, then the results will not be optimal. High-intensity interval training (HIIT) has been shown to be more effective in increasing VO_2max than moderate or low-intensity training. In addition, the duration and frequency of training also play an important role. Training programs that are too short or infrequent may not be sufficient to produce the physiological adaptations needed to increase aerobic capacity.

Other factors to consider are individual characteristics, such as nutritional status and exercise habits. A study conducted by (Fajar Syahputra et al., 2024) revealed that individuals with a higher body mass index (BMI) tend to have lower VO_2max values than those with a BMI within the ideal range. In addition, lifestyle habits, such as an unbalanced diet or smoking habits, can also inhibit the increase in aerobic capacity (Cahyono et al., 2023). Other studies have shown that age and gender differences contribute to variations in VO_2max results, with younger individuals and males generally having higher aerobic capacities than other groups (Trioclarise et al., 2022).

4. CONCLUSION

Based on the statistical test results, both the pretest and posttest showed highly significant outcomes ($p < 0.05$). The average pretest score was 4492.952 ml, with a 95% confidence interval ranging from 4277.09 ml to 4708.81 ml, indicating that the values are statistically meaningful and consistent. Similarly, the average posttest score was 4088.857 ml, with a 95% confidence interval between 3888.29 ml and 4289.43 ml, also demonstrating high statistical significance.

This research can conclude that there is no effect of giving Calcium D Rexdoxon (CDR) drink on the Vo2Max of Futsal Players after training.

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6. AUTHOR CONTRIBUTION STATEMENT

The first author was responsible for designing the study and collecting field data. The second author contributed by providing research legalities and assisting in data editing. The third author played a key role in statistical data analysis and in drafting and organizing the manuscript.

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