



The Effect of Giving Hybrid Young Coconut Water to VO₂max Teenage Taekwondo Athletes

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Abstrak

Penelitian ini mengkaji pengaruh pemberian air kelapa muda hibrida terhadap peningkatan kapasitas aerobik yang diukur melalui VO₂max pada atlet remaja. Latar belakang penelitian didasari oleh kebutuhan peningkatan performa atlet dan potensi hidrasi alami yang kaya elektrolit serta antioksidan sebagai alternatif minuman olahraga, khususnya pada atlet remaja yang membutuhkan asupan nutrisi optimal untuk perkembangan dan performa. Tujuan penelitian adalah untuk mengetahui apakah konsumsi air kelapa muda hibrida secara signifikan meningkatkan VO₂max atlet remaja. Metode penelitian kuantitatif dengan desain pre-eksperimental satu grup pretest-posttest dilakukan pada 10 atlet remaja Taekwondo Sayoku Club Universitas Bengkulu yang dipilih secara purposive berdasarkan kriteria kebugaran dan pengalaman latihan. Data dikumpulkan melalui pengukuran VO₂max menggunakan beep test sebelum dan sesudah intervensi. Air kelapa muda hibrida diberikan secara rutin selama 2 minggu dengan frekuensi 250 ml, dua kali sehari setelah latihan. Data dianalisis dengan uji-t berpasangan (paired t-test). Hasil menunjukkan bahwa nilai rata-rata VO₂max meningkat dari 41,0 ml/kg/menit pada pretest menjadi 43,6 ml/kg/menit pada posttest, dengan peningkatan rata-rata sebesar +2,6 ml/kg/menit ($p < 0,05$). Temuan ini mengindikasikan bahwa pemberian air kelapa muda hibrida efektif dalam meningkatkan kapasitas aerobik melalui mekanisme hidrasi optimal dan perbaikan keseimbangan elektrolit. Simpulan penelitian ini menggarisbawahi potensi air kelapa muda hibrida sebagai minuman penunjang performa yang efektif yang dapat menjadi rekomendasi praktis untuk program nutrisi bagi atlet remaja dalam rangka meningkatkan ketahanan fisik mereka.

Kata Kunci: VO₂max, atlet remaja, air kelapa muda hibrida, hidrasi alami, kapasitas aerobik

Abstract

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This study investigates the impact of young coconut water on increasing aerobic capacity, as measured by VO₂max, in adolescent athletes. The background of the study was based on the need to improve athlete performance and the potential of natural hydration rich in electrolytes and antioxidants as an alternative to sports drinks, especially for adolescent athletes who require optimal nutritional intake for development and performance. The purpose of this study was to determine whether consuming young coconut water has a significant effect on VO₂max in adolescent athletes. A quantitative research method with a one-group pretest-posttest pre-experimental design was employed on 10 teenage athletes from the Taekwondo Sayoku Club at Bengkulu University, who were purposively selected based on fitness criteria and training experience. Data were collected through VO₂max measurements using the beep test before and after the intervention. Hybrid young coconut water was administered regularly for 2 weeks, with a dosage of 250 ml twice a day after training. Data were analysed using a paired t-test. Results showed that the mean VO₂max increased from 41.0 ml/kg/minute at pretest to 43.6 ml/kg/minute at posttest, with a mean increase of 2.6 ml/kg/minute ($p < 0.05$). This finding indicates that the administration of young coconut water effectively increases aerobic capacity through optimal hydration mechanisms and improved electrolyte balance. The conclusions of this study highlight the potential of young coconut water as an effective performance-enhancing beverage, making it a practical recommendation.

Keywords: VO₂max, adolescent athletes, hybrid young coconut water, natural hydration, aerobic capacity.

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INTRODUCTION

Aerobic ability in the world of sports is essential because it is one of the performance indicators that determines an athlete's performance. The parameter often used to measure aerobic capacity is VO₂max, which indicates the maximum amount of oxygen the body can use during intense physical activity. Youth athletes, particularly in taekwondo, need physical endurance and resilience to compete effectively. The quality of recovery after training and fighting also significantly affects an athlete's performance, and proper nutrition is key in improving these physical conditions. Young coconut water, which is known to have an electrolyte composition similar to human body fluids, offers the potential to enhance athletes' hydration and recovery ([Rahadiani, 2023](#); [Wulandari et al., 2018](#)).

The main issue in this study is the lack of understanding of how hybrid young coconut water can contribute to increased VO₂max in adolescent athletes in taekwondo, despite a wealth of research on nutrition and hydration in athletes. Previous research suggests that good hydration can improve athlete performance, including cardiovascular aspects that directly affect aerobic capacity, as measured through VO₂max ([Halim et al., 2018](#); [Prasetyo et al., 2021](#)). Young coconut water has a balanced electrolyte composition, making it a good choice as an isotonic drink, which can support stamina recovery ([Arimbi et al., 2023](#)). Specific focus on young coconut water and its effects on cardiovascular parameters, such as VO₂max, is still limited ([Roza et al., 2020](#)). Based on the problem, the researcher wants to identify whether young hybrid coconut water administration can significantly affect VO₂max in this group.

This study aimed to identify and analyse the effect of young hybrid coconut water consumption on increasing VO₂max in taekwondo youth athletes. This study is expected to provide results that show a significant relationship between nutrient intake from coconut water and the aerobic capacity of athletes. Relevant research shows the relationship between training and nutrition and its effect on athlete performance. According to [Gumantan and Fahrizqi \(2020\)](#) emphasises the importance of recreational exercise and nutrition in improving sports performance.

This study consists of two main variables that will be measured, namely hybrid young coconut water consumption and VO₂max. This study will use the experimental method by dividing athletes into groups that receive hybrid young coconut water with no control. The underlying concept of this study is that proper hydration and nutrient composition in coconut water can support increased aerobic capacity, accelerate recovery, and improve athletes' physical endurance. The electrolyte balance in young coconut water is expected to help the cardiovascular system significantly during the intensive activities faced by taekwondo youth athletes ([Palar et al., 2015](#)).

Research on young coconut water has also shown positive results in post-exercise recovery, according to existing studies, particularly concerning hydration ([Rahadiani, 2023](#)). This research seeks to provide a link by discussing how hybrid young coconut water specifically relates to increasing VO₂max.

Young coconut water is a miracle liquid that contains nutrients such as carbohydrates and minerals needed by the body to prevent dehydration during strenuous activity. Previous research has shown a significant relationship between the type of rehydration fluid, including young coconut water, and an increase in VO₂max in athletes, according to research (Hatta et al., 2016). The study showed that the administration of young coconut water, compared to isotonic drinks, significantly increased VO₂max in adolescent athletes. In the study, athletes who consumed young coconut water before and after exercise showed a faster decrease in recovery pulse rate compared to the group that did not drink it. This study reinforces the understanding that coconut water is a source of hydration and contributes to cardiorespiratory aspects important for improving athletic performance in aerobically demanding sports such as taekwondo.

This study also serves as an innovation in sports nutrition studies by investigating hybrid young coconut water, as an under-researched natural source of hydration in VO₂max enhancement, by quantitatively measuring the effects of hybrid young coconut water, this study contributes to the existing literature with an emphasis on variables that have received less attention in previous studies (Kasriman, 2017). The findings from this study are expected to pave the way for a deeper understanding of the efficacy of young coconut water in supporting athlete performance and serve as a practical guide for coaches and professionals in developing nutritional programmes for athletes. Although the potential of coconut water is widely recognised, most previous studies focus on regular coconut water (*Cocos nucifera*) or other types of sports drinks.

Research specifically examining hybrid young coconut water and its impact on VO₂max in the context of adolescent athletes, particularly in specific sports such as Taekwondo, is limited. Hybrid coconut water types may have slightly different nutrient and electrolyte profiles that need further exploration to discover their optimal potential as performance support. Adolescent athletes are a relevant group to study, with their unique nutritional and hydration needs, growth, and training intensity. This research is expected to provide a more transparent and more quantifiable understanding of how young coconut water can fill this void in the scientific literature, particularly in the context of athletes involved in martial arts sports such as taekwondo (Kurniawan & Halim, 2022; Relida et al., 2022).

This research is substantial from both a scientific and practical perspective in understanding how improving cardiorespiratory endurance through proper intake can significantly impact athletes' performance on the field. This area of research also includes practical implications for training and recovery programmes among athletes, particularly those with limited access to modern nutritional supplements. This study provides an easily accessible nature-based alternative, namely, hybrid young coconut water, which could solve the problem of recovery and performance enhancement.

METHODOLOGY

This research methodology was designed as a quantitative study with a pre-experimental design. It aimed to examine the beneficial effects of hybrid young coconut water administration on VO2max improvement in adolescent athletes. The study used a one-group pretest-posttest design, where measurements were taken before and after treatment, namely the administration of hybrid young coconut water.

Type of Research

This research falls into the quantitative category, where the resulting data can be measured numerically and analysed using statistics. A pre-experimental design with one pretest-posttest group was used to evaluate the impact of the treatment, with this design, researchers can compare the results of VO2max measurements taken before treatment (pretest) and after treatment (posttest). This allows for a clear understanding of the effects of the intervention applied.

Time and Place of Research

This research will be conducted for six weeks, from January to February 2024. The research venue will be the Sayoko Taekwondo Club Training Centre at Bengkulu University, which has adequate facilities for aerobic capacity measurement. This venue was chosen due to the accessibility and availability of adolescent athletes who fulfilled the research criteria.

Target of the Study

The study's target population was Sayoko Taekwondo Club adolescent athletes at Bengkulu University. Sampling was done by *purposive sampling* with the following inclusion criteria:

- a. Teenage Taekwondo athletes aged 13-17 years.
- b. Practising Taekwondo regularly at least 3 times a week for at least 1 year.
- c. Willing to participate in the study and sign *informed consent* (and *assent* for minors).
- d. Have no history of chronic illness or medical conditions that affect physical capacity.
- e. Not taking ergogenic supplements or other sports drinks outside the study protocol.
- f. No allergy to coconut. The total sample size in this study was 10 athletes.

Data Collection Techniques and Instrument Development

Data collection techniques were carried out through:

- a. VO2max measurement: The multistage fitness test (beep test) will be used to measure each participant's VO2max.
- b. Pre-Study Questionnaire: A questionnaire was designed to collect demographic information and medical history of the athletes.
- c. Treatment Administration: Athletes involved in this study will be administered a hybrid young coconut water throughout the intervention, with standardised doses to ensure consistency across participants.

Data Analysis Technique

The collected data were analysed descriptively to describe the sample characteristics and VO₂max values at *pretest* and *posttest*. To test the effect of giving young coconut water on VO₂max, inferential analysis used a *paired t-test*. This test was chosen because it compares two measurements from the same subject. Statistical analysis was carried out using the programme.

RESULTS AND DISCUSSION

RESULTS

Univariate analysis was conducted to describe the basic characteristics of the respondents. The observed variables included age, gender, height, and weight. Data were obtained from direct measurement and recording of respondents' identities. All data processing results are presented descriptively. Details of the characteristics are presented in Table 1.

Table 1. Distribution of Univariate Criteria

Characteristics	Category / Mean $\pm$ SD n / % (where relevant)	
Age (Years)	Average: 15,2 $\pm$ 1,5	
	Range: 13-17	
Gender	Male	6 (60,0%)
	Female	4 (40,0%)
Body Height (cm)	Average: 165,3 $\pm$ 6,2	
Body Weight (kg)	Average: 58,7 $\pm$ 5,8	

The age of the respondents was in the adolescent group. The mean value showed 15.2 years. The standard deviation value was 1.5 years. The youngest age was 13 years old. The oldest age was 17 years old. Most of the respondents were male. The proportion of men reached 60.0 per cent. The number of female respondents was 40.0 per cent. The height measurement results showed an average value of 165.3 centimetres. The distribution of height values is relatively homogeneous. The average body weight value was 58.7 kilograms. The range of body weight values is relatively narrow. This profile provides an overview of the demographic and anthropometric conditions of the respondents in the study.

Pretest Results of Youth Athletes

This study presents data from a pretest conducted on adolescent athletes, classified by their VO₂max category. VO₂max measures the maximal capacity of oxygen that the body can use during intense physical activity, an essential indicator in assessing athletes' cardiovascular fitness and endurance. VO₂max categories are divided into three groups, low, medium and high, with different value ranges according to the ml/kg/min standard. This data provides an overview of the distribution of the number of athletes in each category and their percentage of the total sample tested.

Table 2. Pretest percentage of Youth Athletes by VO2max Category

VO2max Category (ml/kg/min)	n	(%)
Low (35.0 - 39.9)	3	30.0
Medium (40.0 - 44.9)	5	50.0
High (45.0 - 49.9)	2	20.0
Total	10	100.0

Based on this table, it can be seen that most adolescent athletes are in the medium VO2max category (40.0 - 44.9 ml/kg/min), namely as many as five athletes or 50% of the total 10 athletes tested. Athletes with low VO2max (35.0 - 39.9 ml/kg/min) numbered three people (30%), while athletes with high VO2max (45.0 - 49.9 ml/kg/min) numbered two people (20%). This distribution suggests that most athletes have moderate aerobic capacity, with opportunities for performance improvement for those in the low category and optimal potential for those already in the high category. This information is essential for designing appropriate training programmes to improve athletes' fitness and performance.

Posttest Results of Youth Athletes

The following table presents data on the posttest results conducted on adolescent athletes, classified by their VO2max category. VO2max is a key indicator in assessing athletes' aerobic capacity and cardiovascular fitness. The VO2max category is divided into three groups: low, medium and high, with different value ranges according to the ml/kg/min standard. This data illustrates the distribution of the number of athletes in each category and their percentage of the total sample tested after undergoing a specific exercise programme or intervention.

Table 3. Table of pretest percentage of adolescent athletes by VO2max category

VO2max Category (ml/kg/min)	n	(%)
Low (35.0 - 39.9)	2	20.0
Medium (40.0 - 44.9)	6	60.0
High (45.0 - 49.9)	2	20.0
Total	10	100.0

The posttest table shows that most adolescent athletes are now in the medium VO2max category (40.0 - 44.9 ml/kg/min), namely as many as six athletes or 60% of the total 10 athletes tested. Athletes with low VO2max (35.0 - 39.9 ml/kg/min) reduced to 2 people (20%), while athletes with high VO2max (45.0 - 49.9 ml/kg/min) remained as many as two people (20%). This change shows an increase in the proportion of athletes in the moderate category, which was previously only 50%, and a decrease in the number of athletes in the low category from 30% to 20%. This indicates an overall improvement in aerobic capacity in the group of athletes after training or intervention, although the number of athletes with high VO2max remained stable. This information is beneficial for evaluating the effectiveness of training programmes and planning the future development of athletes' fitness.

Comparison of Average Results, VO2max Before and After

The following table presents data on the average VO2max values of adolescent athletes grouped by aerobic fitness category, namely low (35.0 - 39.9 ml/kg/min), medium (40.0 - 44.9 ml/kg/min), and high (45.0 - 49.9 ml/kg/min). This data includes the average value of VO2max before (pretest) and after (posttest) athletes were given treatment with hybrid young coconut water, as well as the number of athletes in each category at both measurement times. In addition, the table shows the percentage change in the number of athletes in each category as an indicator of the effectiveness of the treatment in increasing aerobic capacity.

Table 4. Average, Low, Medium, and High VO2max Results Before and After Water Treatment

Category VO2max (ml/kg/min)	Pretest Average	Posttest Average	(n) Pretest	(n) Posttest	Change (%)
Low (35.0 - 39.9)	38.0	39.0	3	2	-33.33
Medium (40.0 - 44.9)	42.0	43.8	5	6	+20.00
High (45.0 - 49.9)	46.0	47.0	2	2	+0.00
Total Average	41.0	43.6	10	10	+6.34

The table shows a positive change in the average VO2max value in each category after the hybrid young coconut water treatment. The average VO2max in the low category increased from 38.0 to 39.0 ml/kg/min, although the number of athletes in this category decreased by 33.33% (from 3 to 2 athletes). In the medium category, the average VO2max rose from 42.0 to 43.8 ml/kg/min with an increase in the number of athletes by 20% (from 5 to 6 athletes). While in the high category, the average VO2max also increased from 46.0 to 47.0 ml/kg/minute, although the number of athletes remained stable at two people. Overall, the average total VO2max of all athletes increased by 6.34%, from 41.0 to 43.6 ml/kg/minute. The following graph supports this.

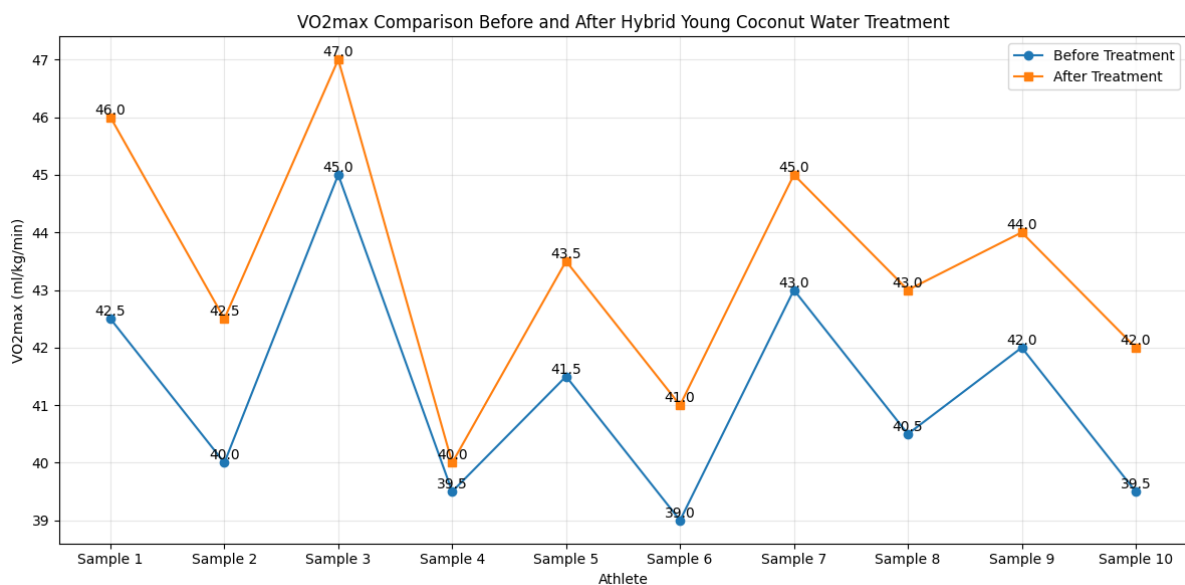


Image 1. Graphic Comparison of VO2max before and after hybrid coconut water treatment

These changes indicate that the hybrid young coconut water treatment contributed positively to improving adolescent athletes' aerobic capacity and cardiovascular fitness, especially with the shift of athletes from the low category to the better medium category. This data provides strong evidence that the nutritional intervention effectively supported the athletes' training programme.

Table 5. Normality Test

One-Sample Kolmogorov-Smirnov Test			Unstandardised Residual
N			15
Normal Parameters ^{a,b}	Mean		.0000000
	Std. Deviation		2.22
Most Extreme Differences	Absolute		.116
	Positive		.052
	Negative		.116
Test Statistic			.116
Asymp. Sig. (2-tailed)			.200
a. Test distribution is Normal.			
b. Calculated from data.			
c. Lilliefors Significance Correction.			

Based on the results of the One-Sample Kolmogorov-Smirnov test on Unstandardised Residual, the Asymp is known. Sig. (This value is greater than the significance level of 0.05, so it can be concluded that there is not enough evidence to reject the null hypothesis (H_0), which states that the residual data is usually distributed. Thus, the residuals of the regression model can be said to follow a normal distribution. This shows that one of the classical assumptions in regression analysis, namely the assumption of residual normality, has been met. Residual normality is essential to ensure the validity of statistical tests used in the regression model so that they can be used to test the effect of hybrid young coconut water on adolescent athletes.

Table 5. Homogeneity Test Results

Test of Homogeneity of Variance					
		Levene Statistic	df1	df2	Sig.
Fine Motor Skills	Based on Mean	1.256	1	18	.277
	Based on Median	1.200	1	18	.292
	Based on Median and with adjusted df	1.218	1	15	.291
	Based on trimmed mean	1.346	1	18	.252

Based on the results of the homogeneity of variance test shown in Table 3.10, the significance value (Sig.) of Levene's Test is 0.277 based on the mean, 0.292 based on the median, 0.291 based on the median with adjusted degrees of freedom, and 0.252 based on the trimmed mean. These significance values are greater than 0.05, meaning there is no significant difference in variance between groups. Thus, it can be concluded that the fine motor skills data have a homogeneous variance. This shows that the assumption of homogeneity of variance has been fulfilled.

Table 6. Hypothesis Test Results

		Paired Samples Test							
		Paired Differences							
		Mean	Std. Deviation	Std. Error	95% Confidence Interval of the Difference		t	df	Sig. (2-tailed)
					Lower	Upper			
Pair 1	PRE-TEST - POST-TEST	2.35	0.5297	0.1675	1.97	2.73	14.030	9	<0.001

The paired samples t-test results showed that the treatment significantly improved the athletes' aerobic capacity (VO₂ max). With an average increase of 2.35 ml/kg/min, good consistency, and statistical significance, this intervention should be considered part of an athlete's training programme to improve aerobic performance.

DISCUSSION

This study aimed to examine the effect of hybrid young coconut water on aerobic capacity, as measured by VO₂max, in adolescent Taekwondo athletes. The main findings showed a statistically significant increase in VO₂max after the intervention, indicating the potential of hybrid young coconut water as a physical performance support.

This study reveals that the administration of hybrid young coconut water causes a significant increase in VO₂max of adolescent athletes. The results of a paired samples t-test analysis conducted on aerobic capacity data (VO₂ max) of 10 athletes before and after treatment show statistically significant results. The average increase in VO₂ max of 2.35 ml/kg/min with a t value of 14.030 at degrees of freedom (df) 9 and a significance value of $p < 0.001$ confirms that the treatment given has a real positive effect on the aerobic capacity of athletes.

This increase suggests that hydration intervention using young coconut water can increase aerobic capacity by improving hydration status and electrolyte balance in the body. Electrolytes such as potassium and sodium present in young coconut water help maintain fluid balance and support muscle contraction function. In contrast, antioxidants present contribute to reducing oxidative stress during intensive physical activity (Dieny & Putriana, 2016). The observed increase in VO₂max reflects improvements in metabolic efficiency and the body's ability to optimise oxygen, especially in athletes with lower baseline VO₂max.

The increase in VO₂max observed in this study can be explained through several mechanisms related to the content of hybrid young coconut water. Coconut water is rich in essential electrolytes such as potassium, sodium, magnesium and calcium. These electrolytes are crucial in maintaining the body's fluid and electrolyte balance, which is often lost through sweat during intense exercise. Optimal hydration ensures adequate blood plasma volume, thus allowing efficient oxygen transport to the

working muscles. Even mild dehydration can lead to decreased blood volume, increased blood viscosity and stress on the cardiovascular system, all of which negatively impact VO₂max. Therefore, the ability of hybrid young coconut water to restore electrolyte balance and maintain good hydration status is likely to contribute to improved aerobic capacity.

Young coconut water contains natural sugars (glucose, fructose, sucrose) that can provide a quick energy source for the muscles and brain during exercise. A steady energy supply prevents premature fatigue and allows athletes to maintain exercise intensity for longer, indirectly stimulating the cardiorespiratory system's adaptation. The antioxidant content of coconut water also plays a role in reducing oxidative stress and inflammation that occur during strenuous physical exercise, speeding up the recovery process and allowing athletes to better adapt to the demands of training.

The variation in effects between individuals indicates that athletes with lower baseline fitness levels significantly improved more than athletes with relatively higher baseline values. This supports the view that hydration interventions should be tailored to the athlete's baseline for optimal performance improvement. These findings are in line with research ([Gumantan & Fahrizqi, 2020](#)) which showed that different training methods (such as fartlek and cross country) resulted in varying VO₂max improvements. This indicates that physiological responses to interventions, whether exercise or hydration, differ significantly.

This study supports the findings from [Tih et al \(2017\)](#) which indicated that coconut water has the potential to be a rehydration drink and may improve exercise endurance. Although these studies may not have specifically measured VO₂max or used hybrid coconut water in adolescent athletes, the hydration principles and electrolyte benefit they highlighted align with the findings. Other studies have examined the effect of natural hydration on improving VO₂max [Violeta & Ratnayani \(2023\)](#) found that administering young coconut water to basketball athletes resulted in a significant improvement in hydration status, which contributed to an increase in aerobic capacity. Although the research context between that study and this study was different (basketball athletes vs. adolescent athletes in general), both studies noted an increase in VO₂max, which supports the critical role of hydration in improving sports performance. Such findings strengthen the argument that young coconut water interventions, with their electrolyte and antioxidant content, can be relied upon as an alternative hydration drink to boost aerobic performance.

Research by [Sulastio et al \(2022\)](#), which examined the relationship of hydration status to VO₂max in karate athletes, showed that an increase in hydration status was directly proportional to the rise in VO₂max. This is relevant to the results of the current study, which showed a rise in VO₂max after the hybrid young coconut water intervention. The differences between the studies, such as variations in dosage, duration of intervention, and sample characteristics, illustrate that despite diverse methodological approaches, the basic principle of optimal hydration remains key in improving aerobic

performance. The consistency of these findings strengthens the argument that natural sources of hydration, such as hybrid young coconut water, can be an effective and natural alternative to synthetic sports drinks. The focus on adolescent taekwondo athletes in this study also provides a new perspective, given the unique physiological needs of this age group and the specific demands of taekwondo.

The practical implications of these findings are significant in developing training programmes for adolescent athletes. The recorded increase in VO₂max indicates that coaches can integrate young coconut water into their pre-hydration and post-hydration to support muscle recovery. In practice, coaches can adjust the dose and timing of hybrid young coconut water consumption to suit each athlete's training intensity and physical condition, so that the benefits of increased aerobic capacity can be optimised. This finding is in line with a study by [Dieny and Putriana \(2016\)](#) which showed that using natural drinks rich in electrolytes and antioxidants helped improve athletes' performance and hydration status in the short term and reduce the likelihood of dehydration during intensive activities.

Hydration interventions with hybrid young coconut water offer advantages in terms of economy and sustainability compared to commercial sports drinks. With the abundant availability of young coconut water in Indonesia, this natural source supports improved physical performance and reduces reliance on synthetic products that may have long-term side effects. Research by [Reza Ramdhan \(2016\)](#) suggests that adapting individual condition-based hydration interventions can significantly increase their effectiveness, thus providing a basis for implementing personalised and holistic interventions. Therefore, applying young coconut water as a hydration strategy in youth athlete training programmes can improve overall performance while benefiting athletes' long-term health.

This study has several aspects to note in terms of research limitations. One of the main limitations was the relatively small sample size, which may reduce statistical power and limit the generalisability of the findings to a broader population of adolescent athletes ([Tih et al., 2017](#)). The short duration of the intervention may not have been sufficient to capture the long-term effects of young coconut water administration on VO₂max. In addition, this study has not collected data on other biochemical variables related to aerobic capacity. Therefore, further research is highly recommended to examine this intervention's long-term effects and integrate measurements of different biochemical and physiological parameters to explain the cause-and-effect relationship more comprehensively.

Development of practical applications, the findings of this study suggest that young coconut water has significant potential as a natural hydration strategy for adolescent athletes. The electrolyte content in young coconut water, such as potassium and sodium, may help support muscle recovery after intense exercise. However, additional research is needed to directly compare the hydration effects between young coconut water and other hydration sources. Therefore, coaches and nutritionists may consider integrating the consumption of young coconut water into daily hydration programmes. Further research should also examine the applicability of young coconut water in other sporting contexts so that

more standardised and applicable usage protocols can be developed to support athletes' performance and overall health.

CONCLUSIONS

Based on the results of the study, it can be concluded that the administration of hybrid young coconut water significantly increased the aerobic capacity of adolescent athletes, as indicated by an increase in mean VO₂max from 41.0 ml/kg/minute at pretest to 43.6 ml/kg/minute at posttest, with an average increase of +2.6 ml/kg/minute. These findings indicate that hydration interventions using young coconut water effectively improve hydration status, balance electrolyte levels, and support muscle contraction, increasing the body's ability to optimise oxygen during intensive physical activity.

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