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Influence of Recovery Strategy And Rehidration upon Recovery Perception and Performance Following Fatiguing Exercise In College Students

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Abstract— Regular physical exercise significantly reduces morbidity and mortality (death) by lowering risks for chronic diseases like heart disease, type 2 diabetes, and some cancers, improving mental health, and increasing overall longevity. But exercise can sometimes cause fatigue that interferes the daily activities, and the right recovery strategy can help a person recover more quickly. The purpose of this study was to analyze the effects of various recovery methods and rehydration on physical performance and recovery perception. The 36 college students (age 24,3±5,1 years, 67,6±16 kg, 166,5±5,2 cm, and VO2max 40,6±2,25 ml/kg/min) divided into six treatment groups: K1 (passive recovery, n=6), K2 (active recovery, n=6), K3 (electrolite water, n=6), K4 (green coconut water, n=6), K5 (active recovery + electrolite water, n=6), and K6 (active recovery + green coconut water, n=6). All subject underwent a fatigue protocol using the Yoyo intermittent recovery test level 1 (YYIRT1) and handgrip strength dan sprint 20m and rating perceived exertion (RPE) were measured before and after the recovery intervention to assess the effects of various types of treatment. A difference test analysis will be conducted to observe the effect of each treatment group. The results of this study indicate that there was a significant difference in the reduction of RPE (p<0,05) and the electrolyte water group showed the most

significant decrease. There was no significant difference in handgrip strength and 20 m sprint parameters (p>0,05). Electrolite water significant decreasing short term perceptual recovery after high intensity training, electrolite water should be implemented after high intensity training.

Keywords—*recovery methods; electrolite water; coconut water*

I. INTRODUCTION

People who participate in competitive sports are often faced with intensive training sessions. Inadequate recovery after intense, high-intensity exercise can result in significant physiological changes in the nervous system, immune system, and muscle fatigue[1][2]. This has a negative impact on sport person, the body does not fully recover from fatigue resulting in physiological and psychological stress that can interfere with sports performance, increase the risk of injury and interfere with daily activities[3][4]. Therefore, a proper recovery strategy is considered an important component of a post-exercise program as it can relieve fatigue and improve physical performance [5][6].

Several post-exercise recovery methods have been widely recommended, and they generally fall into two categories: active and passive recovery. Active recovery can include low-intensity aerobic exercise and stretching, while passive

recovery involves physical rest during which the body does not engage in any exercise activity[7]. Previous research suggests that both active and passive recovery can enhance the perception of recovery and reduce muscle damage. Active recovery methods involving low-intensity exercise can increase blood flow to muscles after exercise[8][9]

In addition, high-intensity sports activities over long durations often cause increased sweat production [10][11]. A body that loses a lot of sweat and is not balanced with adequate fluid intake can trigger dehydration after exercise [12][13]. Therefore, proper rehydration is highly recommended to replace fluids lost during exercise. Various types of rehydration fluids are widely used by sport person, including electrolyte solutions and green coconut water [14][15].

To date, to the author's knowledge, no studies have simultaneously compared various recovery methods, such as coconut water and electrolyte solutions, with active and passive recovery, on physical performance after exercise. This study aimed to assess the effects of various recovery methods and rehydration solutions on perceptions of fatigue, strength, and speed. It is hoped that this research will yield conclusions about rapid recovery programs to address post-exercise fatigue.

II. METHOD

This study is an experimental study with a pretest and posttest group design. The sample in this study consisted of male athletes from various sports who met the inclusion and exclusion criteria. The inclusion criteria were: (a) aged ≥ 18 years, (b) actively involved in a sports team, (c) no injuries or muscle pain, (d) no cardiovascular or lung diseases, and (e) willing to be a research subject. The exclusion criteria in this study were subjects who used ergogenic aids and had active lower extremity injuries or muscle pain. The sample consisted of 24 subjects who were randomly divided into 6 groups (1 group consisted of 4 people). The sample calculation used Federer's formula as follows:

$$\begin{aligned} (n-1)(t-1) &\geq 15 \\ (n-1)(6-1) &\geq 15 \\ (n-1)(5) &\geq 15 \\ 5n &\geq 15 + 5 \\ n &\geq 4 \end{aligned}$$

The minimum total sample size plus 10% to account for dropouts, so $n = 5$.

Collection of Subjects characteristic data

The characteristic data collected included age, height, weight, body mass index, and VO₂max. Weight was measured using Body Impedance Analysis (BIA) digital scales (Omron, Japan) and height was measured using a microtoise. Body mass index (BMI) is analyzed using Indonesia Ministry of Health criteria. VO₂max is measured using the Yoyo intermittent recovery test level 1 (YYIRT1), handgrip strength was measured by electronic handgrip dynamometer (Camry EH101, Hongkong), sprint 20m measured using stopwatch (Casio HS-3V-1R,

Japan) and the level of perceived exertion is measured using the modified Borg Scale 1-10.

Intervention implementation

Prior to data collection, samples were instructed not to engage in strenuous physical activity for 24 hours before testing and not to consume caffeine or alcohol for 12 hours before testing. The samples were divided into six treatment groups, namely K1 (passive recovery group) as the control group, K2 (active recovery group), K3 (isotonic fluid group), K4 (green coconut water group), K5 (active recovery + isotonic fluid group), and K6 (active recovery + green coconut water group). K1 is recovery by sitting still. K2 is recovery by jogging for 12 minutes and dynamic stretching for 8 minutes. K3 is recovery by drinking 300 ml of commercial isotonic fluid. K4 is recovery by drinking 300 ml of coconut water. K5 is jogging and drinking isotonic fluid. K6 is recovery by jogging and drinking 300 ml of coconut water.

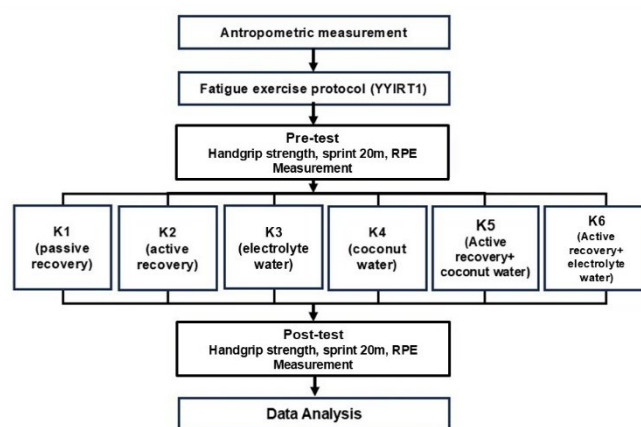


Figure 1. Schematic figure representing the experimental protocol. YYIRT1= yoyo intermittent recovery test level 1; RPE= rating of perceived exertion.

III. RESULTS AND DISCUSSION

Subjects Characteristics

Table 1 presents the findings of subjects characteristics. The findings indicate that the variables of height, weight, BMI, and VO₂max did not differ significantly ($p > 0.05$). Since the initial conditions of the respondents were the same for all groups, this result suggests that the initial conditions of the respondents will not have an impact on how treatment is administered.

TABLE I. SUBJECTS CHARATERISTIC

Group	Height (cm)	Weight (kg)	BMI (kg/m ²)	Body Fat (%)	VO ₂ max
K1	164.8±3.6	66.7±9.2	24.5±2.7	19.6±1.3	40.2±1.2
K2	164.8±6.4	63.1±12.3	23.1±2.6	16.6±6.3	41.9±4.5
K3	169.0±6.7	59.5±9.6	21.1±2.5	15.3±5.7	41.9±1.0
K4	167.8±3.3	71.3±14.7	25.3±4.3	20.4±6.0	41.9±2.1
K5	167.0±2.7	62.9±7.2	22.6±2.4	17.9±4.6	39.4±1.6
K6	163.5±6.2	58.9±14.1	21.8±3.7	14.1±9.5	40.3±0.8
P-value	0.527	0.656	0.411	0.403	0.277

Fatigue Perception

The results of the Rating of Perceived Exertion (RPE) test showed that all groups receiving the recovery method and rehydration fluid experienced a decrease in scores, indicating a decrease in perceived fatigue after receiving the recovery method and fluids (Table 2). However, there was significant difference in RPE scores between the treatments in pre test, post test dan difference. This result indicates that all recovery methods and rehydration fluid administration had nearly the same effect and significantly differ among the groups. Moreover, these results also show that the rehydration fluid group (K3) experienced a relatively greatest decrease in scores compared to the other groups

TABLE II. EFFECT OF RECOVERY METHOD AND REHYDRATION FLUID ON RPE

Group	Pre-test mean±SD	Post-test mean±SD	Difference mean±SD
K1	7,33±0,82	4,5±1,76	-2,83±1,33
K2	6,67±1,21	5,33±2,66	-1,33±1,63
K3	6,17±1,17	1,50±1,22	-4,67±1,75
K4	7,33±1,37	3,67±2,16	-3,67±1,50
K5	7,17±1,47	3,33±2,50	-3,83±2,14
K6	7,14±1,07	4,57±1,40	-2,57±1,40
P-value	0,496*	0,040*	0,024*

*significant difference (p<0,05), ANOVA test

Handgrip strength

The results of handrip strength test showed that all groups receiving the recovery method and rehydration fluid experienced varies results between group after receiving the recovery method and fluids and no difference in statistic (Table 3). Active recovery group showed decrease strength buat coconut water group (K4) is the most increased by the same to *electrolite water* (K3) are 3,43 kg and 2,82 kg. This result shows that passive rest with coconut water and electrolyte water drinks can relatively increase handgrip strength.

TABLE III. EFFECT OF RECOVERY METHOD AND REHYDRATION FLUID ON HANDGRIP STRENGTH

Group	Pre-test mean±SD	Post-test mean±SD	Difference mean±SD
K1	35,35±8,63	36,12±12,24	0,77±6,08
K2	35,15±4,05	34,00±3,58	-1,15±4,68
K3	31,43±5,48	34,25±4,80	2,82±1,94
K4	41,32±14,98	44,75±12,53	3,43±4,21
K5	37,92±9,2	38,67±13,02	0,75±7,70
K6	41,89±8,66	42,32±8,33	0,44±5,78
P-value	0,308	0,209	0,710

Sprint 20m

The result of sprint 20m test showed there was no significant difference in the 20m sprint between treatments (p=0.093). These results indicate that all recovery methods and rehydration fluids have almost the same effect and are no better than passive recovery (K1) in speed parameter.

TABLE IV. EFFECT OF RECOVERY METHOD AND REHYDRATION FLUID ON SPRINT 20M

Group	Pre-test mean±SD	Post-test mean±SD	Difference mean±SD
K1	4,22±0,83	3,35±0,37	-0,87±1,04
K2	4,19±0,45	3,77±0,72	-0,42±0,53
K3	4,30±0,60	3,76±0,48	-0,54±0,32
K4	4,09±0,67	3,90±0,37	-0,19±0,39
K5	3,79±0,49	3,64±0,38	-0,15±0,26
K6	3,72±0,46	3,69±0,43	-0,03±0,31
P-value	0,321	0,285	0,093

This study showed that there was significant difference in RPE scores between the treatments in difference. Moreover, these results also show that the electrolite water fluid group (K3) experienced the greatest decrease in scores compared to the other groups.

The results of handrip strength test showed that all groups have increased in handgrip strength except active recovery group and have no difference in statistic. However, coconut water and electrolyte drinks may increase handgrip strength after strenuous exercise. In sprint test, there was no significant difference in the 20m sprint between treatments. These results indicate that all recovery methods and rehydration fluids have almost the same effect and are no better than passive recovery.

Previous studies comparing the effects of electrolyte drinks with coconut water showed no significant differences in performance or physiological measures between commercial electrolyte drinks and coconut water during long-duration cycling exercise where differences in heart rate, lactate, and sweat loss were very small, and differences in glucose concentration were also small during 90 minutes of high-intensity cycling[16]. However, drinking coconut water and electrolyte drinks can prevent fluid loss in the body [16].

During intense exercise, the body loses fluids through sweat, respiration, the kidneys, and the digestive tract. This can also lead to the loss of important electrolytes such as sodium (Na) and potassium (K) [17]. These ions serve to provide electrical impulses that allow the complex cell systems in our body to communicate with each other through our nervous system [18]. Electrolyte dan coconut water have these ions that importance for sport performance. However in this study tidak menunjukkan perbedaan bermakna pada performa handgrip strength and sprint 20m

However, sodium consumption during exercise is generally not necessary to maintain performance in endurance events lasting less than 2 hours. Sodium consumption appears to be important only for those who produce a high sweat (>40 mmol/L) in endurance events lasting several hours) [19].

IV. CONCLUSIONS

Consuming electrolyte water or coconut water after strenuous exercise has the potential to reduce perceived fatigue but has no effect on handgrip strength and 20m sprint performance.

This study has limitations, namely relatively small sample size between groups, no control over sleep patterns and food and beverage intake before training.

For further research, a larger sample size between groups is needed and other recovery parameters such as creatine kinase or blood lactate can be tested. There needs to be stricter control of the subjects regarding their sleep and eating patterns before the research is conducted.

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